
Jøtul North America Inc.

Project # 18-425

Model: F 500 V3

Type: Catalytic Wood Fired Heater

November 16, 2018

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

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Affidavit

PFS-TECO was contracted by Jøtul North America Inc. (Jøtul) to provide testing services for the F 500 V3 Catalytic Wood-Fired Room Heater per EPA Method 28R, *Certification and Auditing of Wood Heaters*. All testing and associated procedures were conducted at PFS-TECO's Portland Laboratory beginning on 10/1/2018 and ending on 10/16/2018. PFS-TECO's Portland Laboratory is located at 11785 SE Highway 212 – Suite 305, Clackamas, Oregon 97015. Testing procedures followed EPA Method 28R and ASTM E2780, *Standard Test Method for Determining Particulate Matter Emissions from Wood Heaters*. Particulate sampling was performed per ASTM E2515, *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel*.

PFS-TECO is accredited by the U.S. Environmental Protection Agency for the certification and auditing of wood heaters pursuant to subpart AAA of 40 CFR Part 60, New Source Performance Standards for Residential Wood Heaters and subpart QQQQ of 40 CFR Part 60, Standards of Performance for New Hydronic Heaters and Forced Air Furnaces, Methods 28R, 28WHH, 28 WHH-PTS, and all methods listed in Sections 60.534 and 60.5476. PFS-TECO holds EPA Accreditation Certificate Numbers 4 and 4M (mobile). PFS-TECO is accredited by IAS to ISO 17020:2012 "Criteria for Bodies Performing Inspections, By A2LA to ISO 17025:2005 "Requirements for Testing Laboratories", and by Standards Council of Canada to ISO 17065:2012 "Requirements for Bodies Operating Product Certification Systems".

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



Sebastian Button, Laboratory Supervisor

Introduction

Jøtul of Gorham, ME, contracted with PFS-TECO to perform EPA certification testing on the F 500 V3 Catalytic Wood-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory. Testing was performed by Mr. Sebastian Button.

Notes

- Prior to start of testing, 50 hours of conditioning was performed per ASTM E2780.
- Prior to start of testing, the dilution tunnel was cleaned with a steel brush.
- Front filters were changed on sample train A at one hour for all 6 test runs.
- A total of 6 test runs were performed in accordance with EPA Method 28R, 1 at the maximum burn rate category, 1 at the medium high burn rate category, 2 at the medium low burn rate category, one of which was meets the 1.00 kg/hr or less requirement for stoves operating at minimum air setting, 1 fan confirmation test, and another attempted medium low category test, during which the fire went out, and the test was not completed. All test runs, other than the one during which the fire went out, met validity requirements, and all of those but the fan confirmation test are included in the weighted average. See Run Narrative section for further detail on each run.

Wood Heater Identification and Testing

- Appliance Tested: **F 500 V3**
- Serial Number: **Un-serialized Prototype – PFS Tracking Number 0011**
- Manufacturer: **Jøtul North America, Inc.**
- Catalyst: **Yes**
- Heat exchange blower: **Optional**
- Type: **Wood Stove**
- Style: **Free Standing**
- Date Received: **Monday, September 24, 2018**
- Wood Heater Aging: **September 25, 2018 – September 28, 2018**
- Testing Period – Start: **Monday, October 01, 2018** Finish: **Tuesday, October 16, 2018**
- Test Location: **PFS-TECO Portland Laboratory, 11785 SE HWY 212 - Suite 305, Clackamas, OR 97015**
- Elevation: **≈131 Feet above sea level**
- Test Technician(s): **Sebastian Button**
- Observers: **[REDACTED] of Jøtul (Test Runs 1 through 5 only).**

Test Procedures and Equipment

All Sampling and analytical procedures were performed by Sebastian Button. All procedures used are directly from ASTM E2780 and ASTM E2515. See the list below for equipment used. See Appendix C submitted with this report for calibration data.

Equipment List:

Equipment ID#	Equipment Description
040	Delmhorst J-2000 Wood Moisture Meter
041	Rice Lake 3'x3' floor scale w/digital weight indicator
050	Digiweigh DWP12i Platform Scale
053	APEX XC-60 Digital Emissions Sampling Box A
054	APEX XC-60 Digital Emissions Sampling Box B
055	APEX Ambient sampling box
057	California Analytical ZRE CO2/CO/O2 IR ANALYZER
109A/B	Troemner 100mg/200mg Audit Weights
107	Sartorius Analytical Balance
051	10 lb audit weight
090	Dewalt Tape Measure
092	Digital Calipers
095	Anemometer
111	Microtector
CC144992	Gas Analyzer Calibration Span Gas
CC332147	Gas Analyzer Calibration Mid Gas

Results

A total of 6 test runs were performed on the F 500 V3. Run #3, the fire went out, and Run #6, a fan confirmation test, are not used in any weighted average results calculations. The weighted average emissions rate for the 4 run test series was measured to be **0.5 g/hr** with a Higher Heating Value efficiency of **78.4%**. The average CO emission rate for the 4 tests was **0.5 g/min**. The Jøtul F 500 V3 Catalytic Wood-Fired Room Heater meets the 2020 crib wood PM emission standard of ≤ 2.0 g/hr per CFR 40 part 60, §60.532 (b).

Detailed individual run data can be found in Appendix A submitted with this report.

Summary Table

	Cat. 2 ≤ 1.00 kg/hr.	Attempted Cat. 2 ≤ 1.00 kg/hr. ¹	Cat. 2 0.80 - 1.25 kg/hr.	Cat. 3 1.25 - 1.90 kg/hr.	Cat. 4 Max Burn Rate	Fan Confirmation (Cat. 2) ²
Date	10/4/2018	10/3/2018	10/2/2018	10/1/2018	10/5/2018	10/16/2018
Run Number	4	3	2	1	5	6
Emission Rate (g/hr).	0.28	N/A	0.40	0.52	0.93	0.45
Burn Rate (kg/hr)	0.91	N/A	1.17	1.46	2.96	1.21
Heat Output (Btu/hr)	14,001	N/A	17,565	20,500	38,804	17,437
Overall Efficiency (% HHV)	83.2	N/A	80.6	75.7	70.5	77.5
CO Emissions (g/MJ Output)	0.46	N/A	0.31	0.01	2.81	0.10
CO Emissions (g/kg Dry Fuel)	7.60	N/A	4.90	0.16	39.20	1.58
CO Emissions (g/min)	0.11	N/A	0.09	0.00	1.91	0.03
ASTM E2515 Emissions – First Hour (g/hr)	0.33	N/A	0.55	0.64	0.41	0.66
Weighted particulate emission average of 4 test runs: 0.5 grams per hour.						
Weighted average HHV efficiency of 4 test runs: 78.4%.						
Average CO emissions of 4 test runs: 0.5 g/min						

¹ Fire went out during test

² Fan Confirmation test not included in weighted average calculations.

Weighted Average Calculation Summary

28R Weighted Average.xlsm

EPA Method 28R Weighted Average Emissions

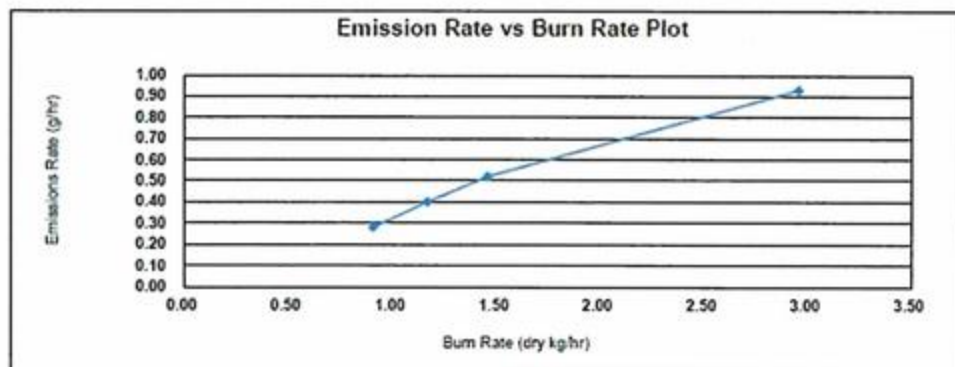
Client: Jotul
 Stove Model: F 500 V3
 Test Dates: 10/1/2018 - 10/5/2018
 Job Number: 18-425

Signature/Date:  10/17/2018

Weighted Average Particulate Emissions (g/hr):	0.5
Weighted Average HHV Efficiency (%):	78.4%
Weighted Average LHV Efficiency (%):	84.7%
Average CO Emissions (g/min):	0.5

Individual Run Summaries

Run Number: 4	Run Number: 2
Burn Rate (dry kg/hr): 0.91	Burn Rate (dry kg/hr): 1.17
Emissions Rate (g/hr): 0.28	Emissions Rate (g/hr): 0.40
HHV Efficiency (%): 83.2%	HHV Efficiency (%): 80.6%
LHV Efficiency (%): 89.6%	LHV Efficiency (%): 87.1%
Weighting Percentage (%): 30.62%	Weighting Percentage (%): 25.14%
Run Number: 1	Run Number: 5
Burn Rate (dry kg/hr): 1.46	Burn Rate (dry kg/hr): 2.96
Emissions Rate (g/hr): 0.52	Emissions Rate (g/hr): 0.93
HHV Efficiency (%): 75.7%	HHV Efficiency (%): 70.5%
LHV Efficiency (%): 81.9%	LHV Efficiency (%): 76.2%
Weighting Percentage (%): 28.00%	Weighting Percentage (%): 16.23%



Test Run Narrative

Run 1

Run 1 was performed on 10/1/2018 as a category 3 test, per EPA Method 28R. The total test time was 250 minutes. The particulate emissions rate for the test was 0.52 g/hr, the burn rate was 1.46 kg/hr with an HHV efficiency of 75.7%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 2

Run 2 was performed on 10/2/2018 as a category 2 test, per EPA Method 28R. The total test time was 300 minutes. The particulate emissions rate for the test was 0.40 g/hr, the burn rate was 1.17 kg/hr with an HHV efficiency of 80.6%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 3

Run 3 was performed on 10/3/2018 as an attempted category 2 test, per EPA Method 28R. During testing this fire went out as defined in EPA Method 28 8.1.1.3.2, more than 30 minutes elapsed without any measurable weight loss. Another category 2 test (Run 4) was performed in lieu of this test.

Run 4

Run 4 was performed on 10/4/2018 as a category 2 test, per EPA Method 28R. The total test time was 410 minutes. The particulate emissions rate for the test was 0.28 g/hr, the burn rate was 0.91 kg/hr with an HHV efficiency of 83.2%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

This test meets the burn rate requirements described in EPA Method 28 Section 8.1.1.3.2 as a category 2 test with a burn rate of 1.00 kg/hr or less for wood stoves that cannot be operated at burn rates less than 0.8 kg/hr. This test was performed with the air control set to its lowest setting, it is not possible to operate the stove at a lower air setting. Therefore, this test will be used in lieu of a category 1 test.

Run 5

Run 5 was performed on 10/5/2018 as a category 4 test, per EPA Method 28R. The total test time was 120 minutes. The particulate emissions rate for the test was 0.93 g/hr, the burn rate was 2.96 kg/hr with an HHV efficiency of 70.5%. The Train A front filter was changed at 1 hr to determine 1st hour emissions. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 6

Run 6 was performed on 10/16/2018 as a category 2 fan confirmation test, per EPA Method 28R. The total test time was 300 minutes. The particulate emissions rate for the test was 0.45 g/hr with a burn rate of 1.21 kg/hr. All test results were appropriate and valid. There were no anomalies and all test criteria were met. Since the particulate emissions rate is within 1.0 g/hr of the other category 2 test (run 2, 0.40 g/hr) the blower is determined not to have a significant impact on emissions performance and may therefore be approved as an optional accessory. This test run is not included in the weighted average calculations presented in the results summary.

Test Conditions Summary

Testing conditions for all runs fell within allowable specifications of ASTM E2780 and ASTM E2515. A summary of facility conditions, fuel burned, and run times is listed below.

Runs	Ambient (°F)		Relative Humidity (%)		Average Barometric Pressure (In. Hg.)	Preburn Fuel Weight (lbs)	Test Fuel Weight (lbs)	Test Fuel Moisture (%DB)	Test Run Time (Min)
	Pre	Post	Pre	Post					
1	73	76	45.6	33.1	29.67	13.10	16.20	22.5	250
2	73	74	42.0	22.5	29.65	18.56	15.61	22.1	300
3	73	74	28.6	22.4	29.76	17.04	15.90	21.6	590
4	72	74	30.6	20.4	29.91	19.53	16.42	21.6	410
5	75	77	27.7	25.4	29.92	17.75	15.52	20.1	120
6	73	77	21.7	15.8	30.10	19.05	15.94	20.5	300

Appliance Operation and Test Settings

The appliance was operated according to procedures as described in the Operations Manual, found in Appendix B submitted with this report. Detailed run information can be found in Appendix A submitted with this report.

Settings & Run Notes

	Pre-Burn Air Setting	Test Run Air and Fan Settings*
Run 1	Adjustable Primary Air Control (PAC) open 0.383" from fully closed	Adjustable PAC open 0.383" from fully closed, fan on turned on to low setting.
Run 2	Adjustable PAC open 0.133"	Adjustable PAC open 0.133", fan on turned on to low setting.
Run 3	Adjustable PAC open 5/64"	Adjustable PAC open 5/64", fan on turned on to low setting.
Run 4	Adjustable PAC open 0.126"	Adjustable PAC open 0.126", fan on turned on to low setting.
Run 5	Adjustable PAC fully open	Adjustable PAC fully open fan on high setting.
Run 6	Adjustable PAC open 0.126"	Adjustable PAC open 0.126", fan off, fan confirmation test.

*The fixed stop on this prototype design was moved several times during testing in attempts to meet burn rate requirements. All measurements above are references from a completely closed position, production models have a fixed stop at 0.126" from completely closed, see Appendix D for further detail.

Appliance Description

Model(s): F 500 V3

Additional Models Discussion: None

Appliance Type: Catalytic Wood-Fired Room Heater

Firebox Volume: 2.41 ft³

Air Introduction System: Primary Air enters the firebox from the rear bottom of the appliance and is channeled up the sides of the appliance and down through the air wash, as well as through a fixed pilot air opening in the front of the firebox, and a small amount of bleed air up through the ash grate. Primary air is controlled via a damper arm located above the ashlip which moves right (open) to left (closed). Secondary air is pulled through an opening in the back of the appliance and channeled up through the secondary air baffle. Secondary air is automatically metered into the firebox fire a control damper that opens and closes via a bimetallic damper. Dimensions on all these features can be found in Appendix D.

Baffles: A secondary air manifold/baffle plate is constructed of 0.075" thick Stainless Steel.

Refractory Insulation: The firebox is lined with 1.25" thick firebrick.

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

Catalytic Combustor: Applied Ceramics corrugated metal combustor, measuring 23.25" x 4.26" x 2.12", 25 cells per square inch.

Fan: The appliance is optionally offered with a convection fan that attached to the bottom rear on the appliance.

Gasketing: The cast iron appliance utilizes and assortment of gasket material for sealing of various seems, see drawings in Appendix D for a full breakdown.

Appliance Dimensions

F 500 V3 Unit Dimensions

Height	Width	Depth	Firebox Volume
28.12"	28.2"	17.42"	2.41 ft ³

Appliance design drawings can be found in Appendix D submitted with the CBI copy of this report.

Appliance Front



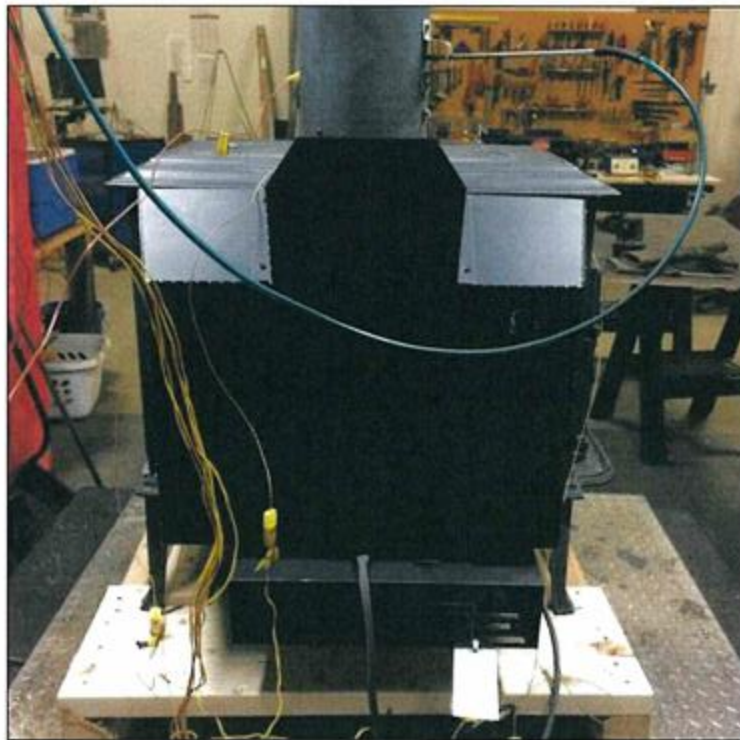
Appliance Left



Appliance Right



Appliance Rear



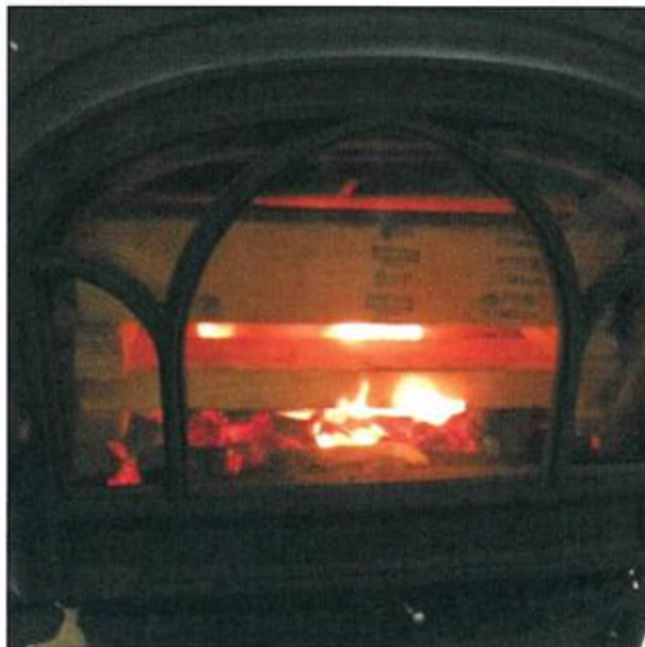
Test Fuel Properties

Test fuel used was dimensional Doug fir lumber, air-dried to the specified moisture content range. Typical fuel loads are pictured below:

Typical Test Fuel Load Configuration



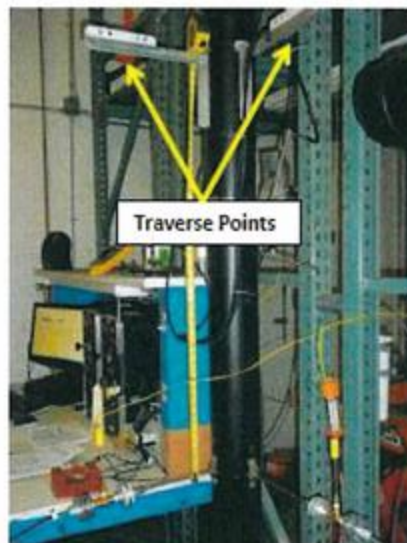
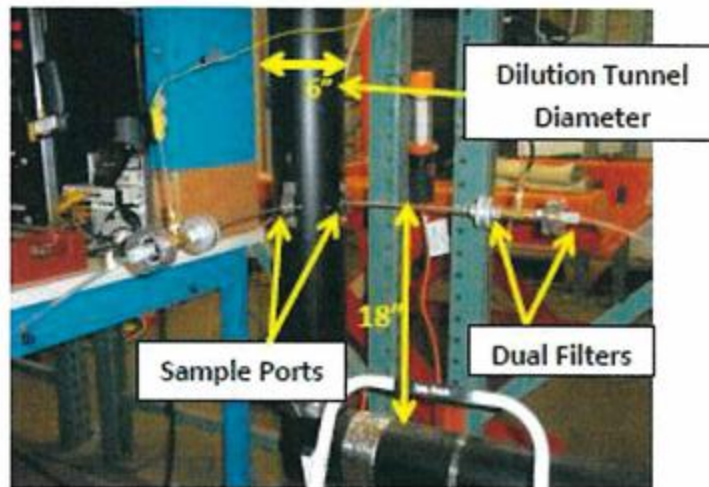
Typical Test Fuel Loaded in Test Stove



Sampling Locations and Descriptions

Sample ports are located 16.5 feet downstream from any disturbances and 1 foot upstream from any disturbances. Flow rate traverse data was collected 12 feet downstream from any disturbances and 5.5 feet upstream from any disturbances. (See below).

Sample Points



Sampling Methods

ASTM E2515 was used in collecting particulate samples. The dilution tunnel is 6 inches in diameter. All sampling conditions per ASTM E2515 were followed. No alternate procedures were used, and no sampling intervals fell outside of proportional rates of +/- 10%.

Analytical Methods Description

All sample recovery and analysis procedures followed ASTM E2515 procedures. At the end of each test run, filters, O-Rings and probes were removed from their housings, dessicated for a minimum of 24 hours, and then weighed at 6 hour intervals to a constant weight per ASTM E2515-11 Section 10.

Calibration, Quality Control and Assurances

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

Appliance Sealing and Storage

Upon completion of testing, the appliance was secured with metal strapping and the seal below was applied, the appliance was then returned to the manufacturer's location at: 55 Hutcherson Drive, Gorham, ME 04038, for archival.

Sealing Label

ATTENTION:

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

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

REPORT # _____

DATE SEALED _____

MANUFACTURER _____

MODEL # _____

Sealed Unit



List of Appendices

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

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

Appendix B – Labels and Manuals

Appendix C –Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)

Conditioning Data

Client: Jotul

Job #: 18-425

Model: F 500 V3

Tracking #: 0011

Date(s): 9/25/18 - 9/28/18

Technician: SJB

Elapsed Time (hrs)	Scale Reading (lbs)	Weight Change (lbs)	Average:		
			334.6	75.3	729
			Flue (°F)	Ambient (°F)	Catalyst Exit (°F)
0	7.9	-	482	71	736
1	6.8	-1.1	593	75	988
2	23.7	16.9	503	76	1115
3	13.7	-10.0	440	77	953
4	10.8	-2.9	320	77	690
5	8.8	-2.0	273	76	610
6	7.8	-1.0	262	76	598
7	6.9	-1.0	256	76	579
8	5.9	-1.0	218	75	508
9	5.9	0.0	216	75	499
10	4.7	-1.2	202	74	450
11	4.7	0.0	147	74	343
12	5.9	1.2	329	70	414
13	13.7	7.8	534	65	1074
14	8.8	-4.9	381	70	849
15	13.7	4.9	473	72	1045
16	8.8	-4.9	373	74	841
17	5.9	-3.0	275	73	611
18	15.8	10.0	417	74	959
19	9.8	-6.1	355	76	806
20	7.8	-1.9	271	75	590
21	18.8	11.0	416	76	879
22	17.8	-1.0	449	77	991
23	11.8	-6.0	358	78	818
24	9.8	-2.0	267	78	600
25	8.8	-0.9	252	78	576
26	6.8	-2.0	250	77	571
27	5.9	-0.9	245	77	554
28	5.9	0.0	236	77	523
29	4.6	-1.3	206	76	435
30	8.5	3.9	400	73	959
31	4.6	-3.8	260	73	585
32	12.8	8.1	372	74	874
33	7.8	-5.0	355	74	782
34	4.6	-3.1	262	75	580
35	12.7	8.1	419	76	964
36	7.8	-4.9	315	77	692
37	10.8	3.0	368	78	860
38	6.9	-3.9	318	78	718
39	18.7	11.9	441	79	993
40	12.7	-6.1	382	79	835
41	9.1	-3.5	302	79	668
42	7.8	-1.3	259	79	581
43	6.8	-1.0	228	78	517
44	5.9	-0.9	220	78	494
45	5.9	0.1	204	77	452
46	9.8	3.8	361	71	823
47	17.8	8.0	408	72	935
48	10.7	-7.1	390	74	900
49	19.8	9.0	404	75	870
50	12.7	-7.1	394	76	885

Sample Calculations – ASTM E2780 & E2515

Client: Jotul
 Model: F 500 V3
 Run: 1

Equations used to calculate the parameters listed below are described in this appendix. Sample calculations are provided for each equation. The raw data and printout results from a sample run are also provided for comparison to the sample calculations.

M_{Sdb} – Weight of test fuel spacers, dry basis, kg

M_{Cdb} – Weight of test fuel crib, excluding nails and spacers, dry basis, kg

D_{Cdb} - Density of fuel crib, excluding spacers and nails, dry basis, lbs/ft³

M_{FTAdb} - Total weight of fuel crib excluding nails, dry basis, kg

BR – Dry burn rate, kg/hr

V_s – Average gas velocity in the dilution tunnel, ft/sec

Q_{sd} – Average gas flow rate in dilution tunnel, dscf/hr

$V_{m(std)}$ – Volume of gas sampled, corrected to dry standard conditions, dscf

m_n – Total particulate matter collected, mg

C_s - Concentration of particulate matter in tunnel gas, dry basis, corrected to STP, g/dscf

E_T – Total particulate emissions, g

PR - Proportional rate variation

PM_R – Particulate emissions for test run, g/hr

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned

M_{Sdb} – Weight of test fuel spacers, dry basis, kg

ASTM E2780 equation (1)

$$M_{Sdb} = (M_{Swb}) (100 / (100 + FM_S))$$

Where,

FM_S = average fuel moisture of test fuel spacers, % dry basis

M_{Swb} = weight of test fuel spacers, wet basis, kg

Sample Calculation:

$$FM_S = 9.4 \%$$

$$M_{Swb} = 1.4 \text{ lbs}$$

0.4536 = Conversion factor from lbs to kg

$$M_{Sdb} = [(1.4 \times 0.4536) (100 / (100 + 9.4))]$$

$$M_{Sdb} = 0.60 \text{ kg}$$

M_{Cdb} – Weight of test fuel crib, excluding nails and spacers, dry basis, kg
 ASTM E2780 equation (2)

$$M_{Cdb} = \Sigma[(M_{CPnwb})(100/(100 + FM_{CPn}))]$$

Where,

M_{CPnwb} = weight of each test fuel piece n in fuel crib, excluding nails and spacers, wet basis, kg

FM_{CPn} = Average fuel moisture of test fuel n in fuel crib, % dry basis

Sample Calculation (test fuel piece 1):

$$M_{CPnwb} = 2.01$$

$$FM_{CPn} = 24.9$$

$$= 2.0 (100/(100 + 24.9))$$

$$= 1.6 \text{ lbs}$$

Total dry crib weight, excluding spacers = 12.11 lbs

$$M_{Cdb} = 5.49 \text{ kg}$$

D_{Cdb} - Density of fuel crib, excluding spacers and nails, dry basis, lbs/ft³
ASTM E2780 equation (3)

$$D_{Cdb} = M_{Cdb} / V_C$$

Where,

$$V_C = \text{Volume of fuel crib, ft}^3$$

Sample calculation:

$$V_C = 724.5 \text{ in}^3$$

$$1728 = \text{conversion from in}^3 \text{ to ft}^3$$

$$D_{Cdb} = 12.11 / 724.5 * 1728$$

$$= \mathbf{28.88 \text{ lbs/ft}^3}$$

M_{FTAdb} - Total weight of fuel crib excluding nails, dry basis, kg
ASTM E2780 equation (4)

$$M_{\text{FTAdb}} = M_{\text{Sdb}} + M_{\text{Cdb}}$$

Sample calculation:

$$\begin{aligned} M_{\text{FTAdb}} &= 0.6 + 5.49 \\ &= 6.09 \text{ kg} \end{aligned}$$

BR – dry burn rate, kg/hr

ASTM E2780 equation (5)

$$BR = \frac{60 M_{FTAdb}}{\theta}$$

Where,

θ = Total length of test run, min

Sample Calculation:

$$M_{Bdb} = 6.09 \quad \text{kg}$$

$$\theta = 250 \quad \text{min}$$

$$BR = \frac{60 \times 6.09}{250}$$

$$BR = 1.46 \quad \text{kg/hr}$$

V_s – Average gas velocity in the dilution tunnel, ft/sec

ASTM E2515 equations (9)

$$V_s = F_p \times k_p \times C_p \times (\sqrt{\Delta P})_{avg} \times \sqrt{\frac{T_{s(avg)}}{P_s \times M_s}}$$

Where:

- F_p = Adjustment factor for pitot tube center point reading = $\frac{V_{strav}}{V_{scent}}$, ASTM E2515 Equation (1)
 V_{scent} = Dilution tunnel velocity calculated after the multi-point pitot traverse at the center, ft/sec
 V_{strav} = Dilution tunnel velocity calculated after the multi-point pitot traverse, ft/sec
 k_p = Pitot tube constant, 85.49
 C_p = Pitot tube coefficient: 0.99, unitless
 ΔP^* = Velocity pressure in the dilution tunnel, in H₂O
 T_s = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
 P_s = Absolute average gas static pressure in dilution tunnel, = $P_{bar} + P_g$, in Hg
 P_{bar} = Barometric pressure at test site, in. Hg
 P_g = Static pressure of tunnel, in. H₂O; (in Hg = in H₂O/13.6)
 M_s = **The dilution tunnel wet molecular weight; $M_s = 28.78$ assuming a dry weight of 29 lb/lb-mole

Sample calculation:

$$F_p = \frac{17.14}{18.17} = 0.943$$

$$V_s = 0.943 \times 85.49 \times 0.99 \times 0.265 \times \left(\left(\frac{100.5}{29.67} + \frac{460}{-0.22} \right) \times \frac{1}{13.6} \right)^{1/2}$$

$$V_s = 17.12 \text{ ft/s}$$

*The ASTM test standard mistakenly has the square root of the average delta p instead of the average of the square root of delta p. The current EPA Method 2 is also incorrect. This was verified by Mike Toney at EPA.

**The ASTM test standard mistakenly identifies M_s as the dry molecular weight. It should be the wet molecular weight as indicated in EPA Method 2.

Q_{sd} – Average gas flow rate in dilution tunnel, dscf/hr

ASTM E2515 equation (3)

$$Q_{sd} = 3600 \times (1 - B_{ws}) \times v_s \times A \times \frac{T_{std}}{T_{s(avg)}} \times \frac{P_s}{P_{std}}$$

Where:

- 3600 = Conversion from seconds to hours (ASTM method uses 60 to convert in minutes)
- B_{ws} = Water vapor in gas stream, proportion by volume; assume 2%
- A = Cross sectional area of dilution tunnel, ft²
- T_{std} = Standard absolute temperature, 528 °R
- P_s = Absolute average gas static pressure in dilution tunnel, = P_{bar} + P_g, in Hg
- T_{s(avg)} = Absolute average gas temperature in the dilution tunnel, °R; (°R = °F + 460)
- P_{std} = Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 17.12 \times 0.1963 \times \frac{528}{100.5 + 460} \times \frac{29.67 + \frac{-0.22}{13.6}}{29.92}$$

$$Q_{sd} = 11068.5 \quad \text{dscf/hr}$$

$V_{m(std)}$ – Volume of Gas Sampled Corrected to Dry Standard Conditions, dscf
 ASTM E2515 equation (6)

$$V_{m(std)} = K_1 V_m Y \frac{P_{bar} + \left(\frac{\Delta H}{13.6} \right)}{T_m}$$

Where:

K_1	=	17.64 °R/in. Hg
V_m	=	Volume of gas sample measured at the dry gas meter, dcf
Y	=	Dry gas meter calibration factor, dimensionless
P_{bar}	=	Barometric pressure at the testing site, in. Hg
ΔH	=	Average pressure differential across the orifice meter, in. H ₂ O
T_m	=	Absolute average dry gas meter temperature, °R

Sample Calculation:

Using equation for Train 1:

$$V_{m(std)} = 17.64 \times 37.479 \times 1.002 \times \frac{\left(29.67 + \frac{2.14}{13.6} \right)}{\left(94.6 + 460 \right)}$$

$$V_{m(std)} = 35.626 \text{ dscf}$$

Using equation for Train 2:

$$V_{m(std)} = 17.64 \times 36.646 \times 0.997 \times \frac{\left(29.67 + \frac{2.09}{13.6} \right)}{\left(93.0 + 460 \right)}$$

$$V_{m(std)} = 34.757 \text{ dscf}$$

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 33.31 \times 0.999 \times \frac{\left(29.667 + \frac{0.00}{13.6} \right)}{\left(75.3 + 460 \right)}$$

$$V_{m(std)} = 32.534 \text{ dscf}$$

m_n – Total Particulate Matter Collected, mg
 ASTM E2515 Equation (12)

$$m_n = m_p + m_f + m_g$$

Where:

- m_p = mass of particulate matter from probe, mg
- m_f = mass of particulate matter from filters, mg
- m_g = mass of particulate matter from filter seals, mg

Sample Calculation:

Using equation for Train A (first hour):

$$m_n = 0.0 + 0.6 + 0.0$$

$$m_n = 0.6 \text{ mg}$$

Using equation for Train A (post-first hour):

$$m_n = 0.2 + -0.1 + 0.7$$

$$m_n = 0.8 \text{ mg}$$

Train A aggregate:

$$m_n = 0.6 + 0.8$$

$$m_n = 1.4 \text{ mg}$$

Using equation for Train B:

$$m_n = 0 + 1.2 + 0.7$$

$$m_n = 1.9 \text{ mg}$$

C_s - Concentration of particulate matter in tunnel gas, dry basis, corrected to STP, g/dscf
 ASTM E2515 equation (13)

$$C_s = K_2 \times \frac{m_n}{V_{m(std)}}$$

Where:

K_2	=	Constant, 0.001 g/mg
m_n	=	Total mass of particulate matter collected in the sampling train, mg
$V_{m(std)}$	=	Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

For Train 1:

$$C_s = 0.001 \times \frac{1.4}{35.63}$$

$$C_s = 0.00004 \text{ g/dscf}$$

For Train 2

$$C_s = 0.001 \times \frac{1.9}{34.76}$$

$$C_s = 0.00005 \text{ g/dscf}$$

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{32.53}$$

$$C_r = 0.000000 \text{ g/dscf}$$

E_T – Total Particulate Emissions, g
 ASTM E2515 equation (15)

$$E_T = (C_s - C_r) \times Q_{std} \times \theta$$

Where:

C_s	=	Concentration of particulate matter in tunnel gas, g/dscf
C_r	=	Concentration particulate matter room air, g/dscf
Q_{std}	=	Average dilution tunnel gas flow rate, dscf/hr
θ	=	Total time of test run, minutes

Sample calculation:

For Train 1

$$E_T = (\underline{0.000039} - 0.000000) \times \underline{11068.5} \times \underline{250} / 60$$

$$E_T = \underline{1.81} \text{ g}$$

For Train 2

$$E_T = (\underline{0.000055} - 0.000000) \times \underline{11068.5} \times \underline{250} / 60$$

$$E_T = \underline{2.52} \text{ g}$$

Average

$$E = \underline{2.17} \text{ g}$$

Total emission values shall not differ by more than 7.5% from the total average emissions

$$7.5\% \text{ of the average} = \underline{0.16}$$

$$\text{Train 1 difference} = \underline{0.35}$$

$$\text{Train 2 difference} = \underline{0.35}$$

PR - Proportional Rate Variation

ASTM E2515 equation (16)

$$PR = \left[\frac{\theta \times V_m \times V_s \times T_m \times T_{si}}{\theta_i \times V_m \times V_s \times T_m \times T_s} \right] \times 100$$

Where:

- θ = Total sampling time, min
- θ_i = Length of recording interval, min
- V_{mi} = Volume of gas sample measured by the dry gas meter during the "ith" time interval, dcf
- V_m = Volume of gas sample as measured by dry gas meter, dcf
- V_{si} = Average gas velocity in the dilution tunnel during the "ith" time interval, ft/sec
- V_s = Average gas velocity in the dilution tunnel, ft/sec
- T_{mi} = Absolute average dry gas meter temperature during the "ith" time interval, °R
- T_m = Absolute average dry gas meter temperature, °R
- T_{si} = Absolute average gas temperature in the dilution tunnel during the "ith" time interval, °R
- T_s = Absolute average gas temperature in the dilution tunnel, °R

Sample calculation (for the first 1 minute interval of Train 1):

$$PR = \left(\frac{250 \times 1.454 \times 17.12 \times (105.0 + 460) \times (94.6 + 460)}{10 \times 37.479 \times 17.18 \times (100.5 + 460) \times (73.0 + 460)} \right) \times 100$$

$$PR = \underline{101} \%$$

PM_R – Particulate emissions for test run, g/hr
ASTM E2780 equation (6)

$$PM_R = 60 (E_T/\theta)$$

Where,

E_T = Total particulate emissions, grams

θ = Total length of full integrated test run, min

Sample Calculation:

$$E_T \text{ (Dual train average)} = 2.17 \text{ g}$$

$$\theta = 250 \text{ min}$$

$$PM_R = 60 \times (2.17 / 250)$$

$$PM_R = 0.52 \text{ g/hr}$$

PM_F – Particulate emission factor for test run, g/dry kg of fuel burned
ASTM E2780 equation (7)

$$PM_F = E_T / M_{FADB}$$

Sample Calculation:

$$E_T \text{ (Dual train average)} = 2.17 \text{ g}$$

$$M_{adb} = 6.09 \text{ kg}$$

$$PM_F = 2.17 / 6.09$$

$$PM_F = 0.36 \text{ g/kg}$$

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 1 Data Summary

Client: Jotul

Model: F 500 V3

Job #: 18-425

Tracking #: 0011

Test Date: 10/1/2018

A handwritten signature in black ink, appearing to be "JL" or similar, written over a horizontal line.

Techician Signature

10/17/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F 500 V3

Run #: 1

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/1/2018

Burn Rate (kg/hr):	1.46
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	33.310	37.479	36.646	8.867
Average Gas Velocity in Dilution Tunnel (ft/sec)	17.1			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	11068.5			
Average Gas Meter Temperature (°F)	75.3	94.6	93.0	81.4
Total Sample Volume (dscf)	32.534	35.626	34.757	10.321
Average Tunnel Temperature (°F)	100.5			
Total Time of Test (min)	250			
Total Particulate Catch (mg)	0.0	1.4	1.9	0.6
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000393	0.0000547	0.0000581
Total PM Emissions (g)	0.00	1.81	2.52	0.64
Particulate Emission Rate (g/hr)	0.00	0.43	0.61	0.64
Emissions Factor (g/kg)	-	0.30	0.41	-
Difference from Average Total Particulate Emissions (g)	-	0.35	0.35	-
Difference from Average Emissions Factor (g/kg)	-	0.06	0.06	-

Final Average Results	
Total Particulate Emissions (g)	2.17
Particulate Emission Rate (g/hr)	0.52
Emissions Factor (g/kg)	0.36
HHV Efficiency (%)	75.7%
LHV Efficiency (%)	81.9%
CO Emissions (g/min)	0.00

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	79.0	OK
Face Velocity	< 30 ft/min	8.1	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min: 73 / Max: 76	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	60.8	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F 500 V3
Date: 10/01/18
Run: 1
Control #: 18-425
Test Duration: 250
Output Category: 3

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	75.7%	81.9%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	76.1%	82.3%

Output Rate (kJ/h)	21,610	20,500	(Btu/h)
Burn Rate (kg/h)	1.44	3.17	(lb/h)
Input (kJ/h)	28,534	27,067	(Btu/h)

Test Load Weight (dry kg)	6.00	13.23	dry lb
MC wet (%)	18.35		
MC dry (%)	22.47		
Particulate (g)	2.17		
CO (g)	1		
Test Duration (h)	4.17		

Emissions	Particulate	CO
g/MJ Output	0.02	0.01
g/kg Dry Fuel	0.36	0.16
g/h	0.52	0.22
g/min	0.01	0.00
lb/MM Btu Output	0.06	0.02

Air/Fuel Ratio (A/F)	13.92
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 1

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	20.00	20.1		2x4	14.00	19.7
2x4	20.00	21.1		2x4	14.00	22.7
2x4	14.00	22.4				
2x4	14.00	20.6				
2x4	14.00	23.1				
2x4	14.00	21.5				
2x4	14.00	19.4				
2x4	14.00	18.6				
Total Fuel Weight (lbs):		13.1	Average Moisture (%DB):		20.9	

Firebox Volume (ft³): 2.41
 Total 2x4 Crib Weight, with spacers (lbs): 7.05
 Total 4x4 Crib Weight, with spacers (lbs): 9.15
 Total Wet Fuel Weight, with spacers (lbs): 16.20

Coal Bed Range (20-25%):
 Min (lbs): 3.24
 Max (lbs): 4.05

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.00	2.01	25.0	24.6	25.0	1.61
2x4	18.00	2.09	23.8	24.0	24.0	1.69
2x4	18.00	1.87	24.5	22.5	19.7	1.53
4x4	18.00	4.14	19.9	18.6	20.1	3.46
4x4	18.00	4.65	20.2	22.7	22.5	3.82
Total Dry Weight, no spacers (lbs):						12.11
Total Dry Weight, with spacers (lbs):						13.42

Spacer Moisture Readings (%DB)							
9.0	11.1	7.3	10.5				
10.1	10.4	7.6	11.4				
8.7	9.7	8.1	10.0				
7.8	8.4	9.8	9.9				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	28.9	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.72	OK
2x4 Fuel Mix	35 - 65 % of total weight	44%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 1

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

Preburn Start Time: 10:45
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	10.5	-0.081	460	405	310	587	207	393.8	483	72
10	10.5	-0.075	449	391	316	531	221	381.6	437	73
20	8.5	-0.071	434	379	323	493	255	376.8	397	74
30	7.6	-0.065	440	386	325	480	254	377.0	393	73
40	5.9	-0.076	448	414	311	504	249	385.2	497	73
50	4.6	-0.071	473	452	313	548	249	407.0	448	74
60	3.7	-0.053	484	462	318	519	253	407.2	409	72

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F 500 V3
 Run #: 1
 Test Start Time: 12:05

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

Total Sampling Time (min): 250
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.68	29.67	29.65	29.67

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.215 in H₂O

Post-Test Leak Check

(A) 0.002 cfm @ -13 in. Hg
 (B) 0.000 cfm @ -12 in. Hg
 (AMB) 0.002 cfm @ -14 in. Hg

Ambient Sample Volume: 33.310 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.058	0.068	0.064	0.056	0.060	0.066	0.070	0.050	0.07
Tunnel Temp (°F)	102	102	102	102	102	102	102	102	102

V_{strav}: 17.14 ft/sec
 V_{scent}: 18.17 ft/sec

F_p: 0.943 [ratio]
 Initial Tunnel Flow: 182.8 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	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

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	22.5

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 1

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.070	0.01	73	-0.02		16.2		129	413	76	73
10	1.454	0.145	0.070	2.25	75	0	101	14.8	-1.4	105	409	76	73
20	2.928	0.147	0.070	2.25	78	0	102	13.4	-1.4	106	435	76	74
30	4.404	0.148	0.070	2.22	81	-2.6	101	12.1	-1.3	106	430	76	74
40	5.885	0.148	0.070	2.23	85	-2.18	101	10.8	-1.3	106	420	77	74
50	7.372	0.149	0.070	2.21	88	-1.84	101	9.5	-1.3	105	433	74	74
60	8.867	0.150	0.070	2.25	90	-2.41	101	8.3	-1.2	105	428	75	75
70	10.359	0.149	0.070	2.23	92	-2.02	100	7.2	-1.1	105	432	75	75
80	11.858	0.150	0.070	2.22	94	0	100	6.1	-1.1	104	411	75	76
90	13.360	0.150	0.070	2.21	95	-1.24	100	5.3	-0.8	102	398	75	75
100	14.857	0.150	0.070	2.24	97	0	100	4.6	-0.7	102	388	76	76
110	16.364	0.151	0.070	2.22	98	-0.88	100	4.0	-0.6	101	383	76	76
120	17.868	0.150	0.070	2.23	98	-0.36	100	3.4	-0.6	100	375	75	76
130	19.373	0.151	0.070	2.22	99	-0.2	100	2.9	-0.5	100	372	74	76
140	20.882	0.151	0.070	2.24	100	-0.85	100	2.6	-0.3	100	364	75	76
150	22.386	0.150	0.070	2.23	100	0	99	2.2	-0.4	98	352	75	76
160	23.896	0.151	0.070	2.22	101	-1.46	99	1.9	-0.3	97	336	76	76
170	25.404	0.151	0.070	2.22	101	0	99	1.8	-0.1	96	323	77	76
180	26.913	0.151	0.070	2.22	101	0	99	1.5	-0.3	95	313	74	76
190	28.421	0.151	0.070	2.22	101	-0.8	99	1.2	-0.3	94	302	75	76
200	29.929	0.151	0.070	2.23	102	-0.41	99	1.0	-0.2	93	305	76	76
210	31.442	0.151	0.070	2.23	102	-0.23	99	0.8	-0.2	94	294	77	76
220	32.948	0.151	0.070	2.22	102	-2.38	98	0.5	-0.3	92	294	74	75
230	34.459	0.151	0.070	2.22	102	-0.43	99	0.2	-0.3	93	292	75	75
240	35.966	0.151	0.070	2.23	102	-0.87	98	0.1	-0.1	92	290	75	76
250	37.479	0.151	0.070	2.24	102	0	99	0.0	-0.1	94	290	76	76
Avg/Tot	37.479	0.150	0.070	2.14	95	-0.81	100			101	365	75	75.3

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 1

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	72	-1		78	0.000	6.19	0.03
10	1.401	0.140	2.22	74	-2.71	99	78	-0.070	7.49	0.00
20	2.843	0.144	2.19	77	-2.8	102	78	-0.080	10.32	0.00
30	4.287	0.144	2.19	80	-0.87	101	78	-0.070	11.01	0.00
40	5.733	0.145	2.19	83	-1.17	101	78	-0.080	11.24	0.00
50	7.187	0.145	2.18	86	-2.8	101	78	-0.060	12.02	0.00
60	8.645	0.146	2.18	89	-0.78	101	77	-0.070	11.95	0.01
70	10.106	0.146	2.17	91	-2.84	100	78	-0.070	12.25	0.00
80	11.571	0.147	2.18	92	-1.95	100	79	-0.080	10.10	0.00
90	13.037	0.147	2.18	94	-1.83	100	78	-0.060	9.39	0.00
100	14.505	0.147	2.17	95	-2.75	100	78	-0.060	9.70	0.00
110	15.976	0.147	2.17	96	-0.72	100	78	-0.060	9.52	0.00
120	17.449	0.147	2.17	97	-2.47	100	79	-0.060	8.62	0.00
130	18.922	0.147	2.17	97	-1.7	100	78	-0.060	8.08	0.00
140	20.396	0.147	2.17	98	-1.75	100	78	-0.060	8.07	0.00
150	21.873	0.148	2.17	98	-2.94	100	78	-0.060	7.23	0.00
160	23.350	0.148	2.18	99	-2.48	99	78	-0.050	6.87	0.00
170	24.826	0.148	2.18	99	-1.27	99	78	-0.060	6.71	0.00
180	26.304	0.148	2.18	99	-0.79	99	78	-0.060	7.31	0.01
190	27.779	0.148	2.16	100	-2.59	99	78	-0.060	7.86	0.00
200	29.257	0.148	2.17	100	-2.81	99	78	-0.050	7.88	0.03
210	30.733	0.148	2.17	100	-2.41	99	78	-0.060	7.86	0.00
220	32.211	0.148	2.16	100	-1.03	99	78	-0.060	7.60	0.00
230	33.688	0.148	2.16	100	-0.9	99	78	-0.050	7.62	0.00
240	35.168	0.148	2.17	100	-0.73	99	78	-0.050	7.94	0.00
250	36.646	0.148	2.16	101	-1.63	99	77	-0.040	7.81	0.01
Avg/Tot	36.646	0.147	2.09	93	-1.84	100	78	-0.059	8.79	0.00

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul
 Model: F 500 V3
 Run #: 1

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

Stove ΔT : 61

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
0	476	436	321	473	257	392.6	608
10	454	385	311	470	269	377.8	865
20	443	353	286	490	276	369.6	948
30	436	342	270	494	277	363.8	935
40	455	348	262	493	277	367.0	914
50	469	374	258	492	273	373.2	943
60	467	410	259	500	268	380.8	934
70	474	433	264	515	259	389.0	961
80	473	442	272	508	254	389.8	911
90	462	436	281	492	248	383.8	871
100	454	437	288	479	244	380.4	859
110	436	447	290	470	239	376.4	842
120	426	445	296	460	237	372.8	828
130	425	431	298	455	237	369.2	833
140	415	416	304	448	235	363.6	814
150	400	412	301	435	234	356.4	772
160	391	396	298	414	235	346.8	742
170	383	383	295	398	237	339.2	724
180	374	373	293	384	240	332.8	701
190	369	370	295	375	244	330.6	693
200	363	368	295	372	253	330.2	704
210	362	366	293	367	271	331.8	684
220	359	364	291	364	283	332.2	686
230	355	361	293	363	288	332.0	683
240	352	357	292	362	292	331.0	688
250	347	358	294	365	295	331.8	685
Average	416	394	288	440	259	359	801

LAB SAMPLE DATA - ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 1

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/1/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3332	123.7	123.1	0.6
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.6

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3333	120.0	119.7	0.3
B. Rear filter catch	Filter	3334	119.9	120.3	-0.4
C. Probe catch*	Probe	1A	115629.0	115628.8	0.2
D. O-Ring catch*	O-Ring	1A	3567.2	3566.5	0.7

Sub-Total Total Particulate, mg: 0.8

Train A Aggregate Total Particulate, mg: 1.4

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3335	124.1	122.8	1.3
B. Rear filter catch	Filter	3336	119.6	119.7	-0.1
C. Probe catch*	Probe	1B	115903.1	115903.1	0.0
D. O-Ring catch*	O-Ring	1B	3555.6	3554.9	0.7

Total Particulate, mg: 1.9

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3337	121.0	121.0	0.0

Total Particulate, mg: 0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and O-rings, negative numbers for filters are assumed to be part of the O-Ring weight.

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 1 Test Date: 10/1/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Open 0.383" from fully closed

Preburn Notes

Preburn Start Time: 10:45

Time	Notes
9:55	Loaded 7.6 lbs of kindling
10:30	At 2.2 lbs, scooped out coals, re-zeroed scale, loaded Pre-burn Fuel
10:45	Set air to test setting, turned fan on to low setting.
11:36	Stirred coals to ensure uniform charcoalization
12:04	Leveled coal bed, zeroed scale in preparation for fuel loading

Test Notes

Test Burn Start Time: 12:05
 Test Fuel Loaded by: 40 seconds
 Door Closed: 40 seconds
 Air Control Set at: 3 minutes
 Other Loading Notes: N/A

Time	Notes
60 min	Changed 1-hour filter.
250 min	End of Test

Test Burn End Time: 16:15
 Background Filter Volume (ft³): 33.310

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3332	3333	3334	1A	1A	3335	3336	1B	1B	3337
Tare (mg)	123.1	119.7	120.3	115628.8	3566.5	122.8	119.7	115903.1	3554.9	121.0
Final Weight (mg)	123.7	120.0	119.9	115629.0	3567.2	124.1	119.6	115903.1	3555.6	121.0

Sample Train Leak Check: A: 0.002 @ -13 "Hg B: 0.000 @ -12 "Hg AMB: 0.002 @ -14 "Hg

Technician Signature:  Date: 11/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 1 Test Date: 10/1/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 16.93 CO (%): 4.33
 Mid Gas CO₂ (%): 10.0 CO (%): 2.51

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	9:22	9:30	9:25	16:50	16:57	16:53
CO ₂	0.00	10.06	16.93	0.07	9.92	16.78
CO	0.000	2.549	4.330	-0.012	2.517	4.274

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.058	0.068	0.064	0.056	0.060	0.066	0.070	0.050	0.070
Temp (°F):	102	102	102	102	102	102	102	102	102

Dilution Tunnel Static Pressure (inH₂O): -0.215

Supplemental Data

Room Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 10/1/2018

	Initial	Middle	Ending
P _b (inHg)	29.68	29.67	29.65
RH (%)	45.6	37.8	33.1

Technician Signature:  Date: 11/16/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 2 Data Summary

Client: Jotul

Model: F 500 V3

Job #: 18-425

Tracking #: 0011

Test Date: 10/2/2018

A handwritten signature in black ink, appearing to be "JL", is written over a horizontal line.

Technician Signature

10/17/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F 500 V3

Run #: 2

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/2/2018

Burn Rate (kg/hr):	1.17
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	40.353	44.630	44.057	8.829
Average Gas Velocity in Dilution Tunnel (ft/sec)	17.1			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	11249.2			
Average Gas Meter Temperature (°F)	73.8	94.9	93.4	83.6
Total Sample Volume (dscf)	39.499	42.372	41.731	10.276
Average Tunnel Temperature (°F)	90.5			
Total Time of Test (min)	300			
Total Particulate Catch (mg)	0.0	1.5	1.5	0.5
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000354	0.0000359	0.0000487
Total PM Emissions (g)	0.00	1.99	2.02	0.55
Particulate Emission Rate (g/hr)	0.00	0.40	0.40	0.55
Emissions Factor (g/kg)	-	0.34	0.34	-
Difference from Average Total Particulate Emissions (g)	-	0.02	0.02	-
Difference from Average Emissions Factor (g/kg)	-	0.00	0.00	-

Final Average Results	
Total Particulate Emissions (g)	2.01
Particulate Emission Rate (g/hr)	0.40
Emissions Factor (g/kg)	0.34
HHV Efficiency (%)	80.6%
LHV Efficiency (%)	87.1%
CO Emissions (g/min)	0.09

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	79.0	OK
Face Velocity	< 30 ft/min	8.0	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min: 72 / Max: 75	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	9.0	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F 500 V3
Date: 10/02/18
Run: 2
Control #: 18-425
Test Duration: 300
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	80.6%	87.1%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	81.0%	87.6%

Output Rate (kJ/h)	18,516	17,565	(Btu/h)
Burn Rate (kg/h)	1.16	2.56	(lb/h)
Input (kJ/h)	22,969	21,788	(Btu/h)

Test Load Weight (dry kg)	5.80	12.78	dry lb
MC wet (%)	18.10		
MC dry (%)	22.09		
Particulate (g)	2.01		
CO (g)	28		
Test Duration (h)	5.00		

Emissions	Particulate	CO
g/MJ Output	0.02	0.31
g/kg Dry Fuel	0.35	4.90
g/h	0.40	5.68
g/min	0.01	0.09
lb/MM Btu Output	0.05	0.71

Air/Fuel Ratio (A/F)	12.30
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 2

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/2/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	20.00	21.5		2x4	14.00	23.2
2x4	20.00	18.6		2x4	14.00	24.1
2x4	14.00	19.9		2x4	20.00	19.4
2x4	14.00	19.7		2x4	20.00	18.4
2x4	14.00	19.8				
2x4	14.00	22.8				
2x4	14.00	25.0				
2x4	14.00	20.6				
Total Fuel Weight (lbs):		18.56	Average Moisture (%DB):		21.1	

Firebox Volume (ft³): 2.41
 Total 2x4 Crib Weight, with spacers (lbs): 7.14
 Total 4x4 Crib Weight, with spacers (lbs): 8.47
 Total Wet Fuel Weight, with spacers (lbs): 15.61

Coal Bed Range (20-25%):
 Min (lbs): 3.12
 Max (lbs): 3.90

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.00	1.80	20.3	20.0	21.5	1.49
2x4	18.00	1.98	21.0	22.6	22.4	1.62
2x4	18.00	2.09	23.8	24.4	22.2	1.69
4x4	18.00	3.76	20.6	20.5	22.4	3.10
4x4	18.00	4.32	22.3	23.3	24.1	3.51
Total Dry Weight, no spacers (lbs):						11.42
Total Dry Weight, with spacers (lbs):						12.93

Spacer Moisture Readings (%DB)						
8.4	8.4	9.5	9.9			
10.1	9.8	7.7	10.1			
9.8	10.4	10.7	10.3			
9.3	9.0	9.8	9.5			

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	27.2	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.48	OK
2x4 Fuel Mix	35 - 65 % of total weight	46%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 2

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/2/2018

Preburn Start Time: 10:44
 Recording Interval (min): 5
 Run Time (min): 90

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	7.6	-0.066	424	429	312	480	183	365.6	394	62
5	7.2	-0.073	424	426	319	479	188	367.2	351	62
10	7.0	-0.052	422	421	324	482	192	368.2	354	62
15	6.7	-0.055	421	407	324	486	195	366.6	360	62
20	6.5	-0.056	421	396	321	488	198	364.8	363	61
25	6.0	-0.062	418	396	318	485	203	364.0	390	62
30	5.5	-0.060	422	409	316	499	206	370.4	377	62
35	5.2	-0.068	418	411	314	490	208	368.2	355	61
40	5.0	-0.063	411	407	312	474	211	363.0	336	61
45	4.8	-0.050	406	400	310	454	214	356.8	318	61
50	4.6	-0.059	398	392	307	435	218	350.0	301	61
55	4.5	-0.045	390	384	305	416	222	343.4	287	60
60	4.3	-0.049	383	378	302	402	227	338.4	275	60
65	4.2	-0.047	378	372	299	388	232	333.8	261	60
70	4.1	-0.044	369	368	296	373	236	328.4	250	60
75	4.1	-0.032	361	362	295	364	240	324.4	241	60
80	4.0	-0.034	355	357	293	355	244	320.8	235	60
85	3.9	-0.037	350	353	291	350	247	318.2	225	60
90	3.8	-0.037	345	348	289	344	249	315.0	220	60

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F 500 V3
 Run #: 2
 Test Start Time: 12:15

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/2/2018

Total Sampling Time (min): 300
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.65	29.65	29.65	29.65

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.205 in H₂O

Post-Test Leak Check

(A) 0.001 cfm @ -13 in. Hg
 (B) 0.000 cfm @ -12 in. Hg
 (AMB) 0.002 cfm @ -14 in. Hg

Ambient Sample Volume: 40.353 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.060	0.064	0.070	0.064	0.058	0.068	0.064	0.052	0.07
Tunnel Temp (°F)	100	100	100	100	100	100	100	100	100

V_{strav}: 17.24 ft/sec
 V_{scent}: 18.14 ft/sec

F_p: 0.950 [ratio]
 Initial Tunnel Flow: 184.7 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	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

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	22.1

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 2

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/2/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.070	0.01	78	-0.2		15.6		113	308	74	73
10	1.462	0.146	0.070	2.24	78	-1.44	101	14.8	-0.8	88	252	75	72
20	2.933	0.147	0.070	2.20	80	-1.02	101	14.0	-0.8	87	260	76	72
30	4.403	0.147	0.070	2.21	83	-1.88	101	13.4	-0.6	88	272	77	73
40	5.876	0.147	0.070	2.20	86	-2.56	101	12.6	-0.8	90	284	77	73
50	7.350	0.147	0.070	2.19	89	-0.11	100	11.5	-1.1	90	296	77	73
60	8.829	0.148	0.070	2.20	91	-1.77	100	10.5	-1	92	325	77	73
70	10.320	0.149	0.070	2.19	93	-0.07	101	9.4	-1.1	93	328	76	74
80	11.802	0.148	0.070	2.20	94	-2.45	100	8.5	-0.9	93	331	75	74
90	13.288	0.149	0.070	2.21	95	-2.4	100	7.7	-0.8	94	323	75	74
100	14.777	0.149	0.070	2.18	96	-1.37	100	6.7	-1	95	338	74	74
110	16.265	0.149	0.070	2.19	97	-2.55	100	5.7	-1	96	346	74	75
120	17.752	0.149	0.070	2.18	97	-2.45	100	4.9	-0.8	95	341	74	75
130	19.243	0.149	0.070	2.19	98	-0.38	100	4.3	-0.6	95	331	75	75
140	20.736	0.149	0.070	2.17	98	-0.33	100	3.6	-0.7	95	327	76	75
150	22.226	0.149	0.070	2.18	99	-0.78	100	3.3	-0.3	94	312	76	75
160	23.715	0.149	0.070	2.21	99	-0.9	100	2.7	-0.6	93	305	77	75
170	25.208	0.149	0.070	2.19	99	0	100	2.5	-0.2	92	291	77	75
180	26.703	0.150	0.070	2.19	99	-0.27	100	2.2	-0.3	91	270	76	75
190	28.194	0.149	0.070	2.19	99	-0.26	99	2.0	-0.2	89	254	75	74
200	29.686	0.149	0.070	2.20	99	-2.29	99	1.7	-0.3	88	243	74	74
210	31.182	0.150	0.070	2.19	100	0	99	1.6	-0.1	88	237	75	74
220	32.676	0.149	0.070	2.19	100	-2.5	99	1.3	-0.3	87	229	75	74
230	34.169	0.149	0.070	2.20	100	-1.66	99	1.2	-0.1	86	226	75	74
240	35.663	0.149	0.070	2.21	100	-1.95	99	1.0	-0.2	86	225	75	74
250	37.159	0.150	0.070	2.20	100	-1.05	99	0.8	-0.2	85	224	75	73
260	38.653	0.149	0.070	2.18	99	-0.19	99	0.7	-0.1	85	215	75	73
270	40.147	0.149	0.070	2.20	99	-2.48	99	0.4	-0.3	85	217	75	73
280	41.644	0.150	0.070	2.20	99	-0.57	99	0.4	0	85	214	75	73
290	43.139	0.150	0.070	2.17	99	-2.16	99	0.2	-0.2	84	210	75	73
300	44.630	0.149	0.070	2.23	99	-0.57	99	0.0	-0.2	85	209	75	74
Avg/Tot	44.630	0.149	0.070	2.13	95	-1.25	100			91	276	75	73.8

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 2

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/2/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	77	-1		77	0.000	3.77	0.21
10	1.443	0.144	2.22	77	-1.76	101	79	-0.040	5.62	0.03
20	2.889	0.145	2.20	79	-0.6	101	78	-0.040	8.75	0.04
30	4.340	0.145	2.19	82	-2.33	101	78	-0.050	9.69	0.06
40	5.793	0.145	2.17	85	-1.68	100	77	-0.050	11.71	0.06
50	7.251	0.146	2.17	87	-2.86	100	77	-0.060	14.27	0.07
60	8.710	0.146	2.17	89	-0.7	100	78	-0.060	13.83	0.13
70	10.173	0.146	2.16	91	-2.12	100	79	-0.060	12.15	0.03
80	11.638	0.147	2.18	92	-1.23	100	79	-0.060	11.40	0.02
90	13.105	0.147	2.17	93	-2.16	100	79	-0.060	10.56	0.04
100	14.573	0.147	2.18	94	-0.74	100	78	-0.060	13.22	0.09
110	16.042	0.147	2.17	95	-1.49	100	78	-0.060	13.29	0.08
120	17.513	0.147	2.16	96	-1.27	100	77	-0.060	11.95	0.00
130	18.984	0.147	2.17	96	-0.8	100	77	-0.050	9.25	0.01
140	20.455	0.147	2.17	97	-1.47	100	78	-0.050	11.47	0.00
150	21.927	0.147	2.16	97	-1.73	100	79	-0.060	8.72	0.08
160	23.401	0.147	2.16	97	-2.62	100	79	-0.050	9.94	0.02
170	24.875	0.147	2.17	97	-0.75	100	79	-0.060	7.99	0.00
180	26.349	0.147	2.16	98	-2.72	100	79	-0.040	9.04	0.05
190	27.824	0.148	2.17	98	-0.82	99	78	-0.040	8.76	0.00
200	29.301	0.148	2.17	98	-2.24	100	77	-0.040	8.98	0.02
210	30.776	0.148	2.17	98	-1.04	99	78	-0.040	8.95	0.03
220	32.252	0.148	2.18	98	-1.27	99	79	-0.040	9.05	0.01
230	33.728	0.148	2.17	98	-2	99	79	-0.040	9.00	0.06
240	35.203	0.148	2.16	98	-2.15	99	78	-0.040	9.37	0.06
250	36.679	0.148	2.16	98	-1.24	99	78	-0.040	9.20	0.05
260	38.153	0.147	2.18	98	-2.41	99	77	-0.040	9.08	0.05
270	39.629	0.148	2.18	98	-1.82	99	77	-0.050	9.61	0.03
280	41.104	0.148	2.18	98	-2.91	99	77	-0.030	9.49	0.04
290	42.580	0.148	2.16	98	-0.77	99	78	-0.040	9.69	0.00
300	44.057	0.148	2.16	98	-2.74	99	79	-0.040	9.42	0.03
Avg/Tot	44.057	0.147	2.10	93	-1.66	100	78	-0.047	9.91	0.05

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 18-425

Model: F 500 V3

Tracking #: 0011

Run #: 2

Technician: SJB

Date: 10/2/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Model: F 500 V3

Run #: 2

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/2/2018

Stove ΔT: 9

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
0	343	348	289	340	249	313.8	467
10	335	311	278	352	255	306.2	645
20	324	284	259	366	261	298.8	728
30	323	270	244	387	263	297.4	774
40	331	266	236	406	263	300.4	809
50	341	275	234	423	259	306.4	825
60	374	310	236	455	253	325.6	897
70	409	339	242	466	244	340.0	871
80	421	361	247	459	236	344.8	850
90	424	383	253	452	229	348.2	821
100	416	398	259	466	222	352.2	892
110	418	423	266	487	217	362.2	909
120	423	430	276	487	216	366.4	873
130	428	428	284	467	216	364.6	819
140	422	419	289	455	217	360.4	837
150	415	420	291	447	218	358.2	790
160	405	419	294	431	221	354.0	770
170	396	405	294	415	227	347.4	724
180	381	393	293	392	234	338.6	678
190	372	386	292	373	243	333.2	649
200	364	378	294	363	250	329.8	633
210	356	368	294	355	253	325.2	617
220	351	361	291	349	255	321.4	609
230	347	355	288	345	254	317.8	605
240	344	350	285	345	254	315.6	609
250	345	346	282	344	253	314.0	608
260	342	345	279	343	251	312.0	593
270	340	342	276	344	248	310.0	607
280	339	340	275	343	246	308.6	601
290	340	339	272	339	244	306.8	592
300	338	336	270	338	242	304.8	586
Average	371	359	273	398	242	329	719

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Model: F 500 V3

Run #: 2

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/2/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3338	124.0	123.5	0.5
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.5

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3339	118.9	118.9	0.0
B. Rear filter catch	Filter	3340	121.0	121.1	-0.1
C. Probe catch*	Probe	2A	116240.5	116240.5	0.0
D. O-Ring catch*	O-Ring	2A	3553.5	3552.4	1.1

Sub-Total Total Particulate, mg: 1.0

Train A Aggregate Total Particulate, mg: 1.5

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3341	123.6	123.0	0.6
B. Rear filter catch	Filter	3342	119.8	119.7	0.1
C. Probe catch*	Probe	2B	116330.6	116330.6	0.0
D. O-Ring catch*	O-Ring	2B	3571.8	3571.0	0.8

Total Particulate, mg: 1.5

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3343	120.7	120.7	0.0

Total Particulate, mg: 0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and O-rings, negative numbers for filters are assumed to be part of the O-Ring weight.

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 2 Test Date: 10/2/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Open 0.133" from fully closed

Preburn Notes

Preburn Start Time: 10:44

Time	Notes
8:40	Loaded 7.5 lbs of kindling
9:06	At 2.2 lbs, loaded Pre-burn Fuel
10:44	Set air to test setting, turned fan on to low setting
11:07	Stirred coals to ensure uniform charcoalization
12:14	Leveled coal bed, zeroed scale in preparation for fuel loading

Test Notes

Test Burn Start Time: 12:15
 Test Fuel Loaded by: 40 seconds
 Door Closed: 45 Seconds
 Air Control Set at: 4 minutes
 Other Loading Notes: N/A

Time	Notes
60 min	Changed 1-hour filter.
300 min	End of Test

Test Burn End Time: 17:15
 Background Filter Volume (ft³): 40.353

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3338	3339	3340	2A	2A	3341	3342	2B	2B	3343
Tare (mg)	123.5	118.9	121.1	116240.5	3552.4	123.0	119.7	116330.6	3571.0	120.7
Final Weight (mg)	124.0	118.9	121.0	116240.5	3553.5	123.6	119.8	116330.6	3571.8	120.7

Sample Train Leak Check: A: 0.000 @ -14 "Hg B: 0.000 @ -12 "Hg AMB: 0.002 @ -14 "Hg

Technician Signature:  Date: 11/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 2 Test Date: 10/2/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 16.93 CO (%): 4.33
 Mid Gas CO₂ (%): 10.0 CO (%): 2.510

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	9:15	9:20	9:18	17:30	17:32	17:35
CO ₂	0.00	10.07	16.93	0.01	10.12	17.05
CO	0.000	2.543	4.330	0.015	2.523	4.437

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.060	0.064	0.070	0.064	0.058	0.068	0.064	0.052	0.070
Temp (°F):	100	100	100	100	100	100	100	100	100

Dilution Tunnel Static Pressure (inH₂O): -0.205

Supplemental Data

Room Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 10/1/2018

	Initial	Middle	Ending
P _b (inHg)	29.65	29.65	29.65
RH (%)	42.0	28.4	22.5

Technician Signature: 

Date: 11/16/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 3 Data Summary

Client: Jotul
Model: F 500 V3
Job #: 18-425
Tracking #: 0011
Test Date: 10/3/2018



Technician Signature

10/17/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F 500 V3

Run #: 3

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/3/2018

Burn Rate (kg/hr):	0.61
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	78.761	88.249	87.186	8.833
Average Gas Velocity in Dilution Tunnel (ft/sec)	16.9			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	11377.8			
Average Gas Meter Temperature (°F)	74.0	100.2	99.0	83.4
Total Sample Volume (dscf)	77.354	83.304	82.068	10.312
Average Tunnel Temperature (°F)	81.6			
Total Time of Test (min)	590			
Total Particulate Catch (mg)	0.0	0.0	0.0	0.0
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000000	0.0000000	0.0000000
Total PM Emissions (g)	0.00	0.00	0.00	0.00
Particulate Emission Rate (g/hr)	0.00	0.00	0.00	0.00
Emissions Factor (g/kg)	-	0.00	0.00	-
Difference from Average Total Particulate Emissions (g)	-	0.00	0.00	-
Difference from Average Emissions Factor (g/kg)	-	0.00	0.00	-

Final Average Results	
Total Particulate Emissions (g)	0.00
Particulate Emission Rate (g/hr)	0.00
Emissions Factor (g/kg)	0.00
HHV Efficiency (%)	85.0%
LHV Efficiency (%)	91.9%
CO Emissions (g/min)	0.21

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	79.0	OK
Face Velocity	< 30 ft/min	8.1	OK
Leakage Rate	Less than 4% of average sample rate	0 cfm	OK
Ambient Temp	55-90 °F	Min: 72 / Max: 76	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	145.2	Not Acceptable

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F 500 V3
Date: 10/03/18
Run: 3
Control #: 18-425
Test Duration: 590
Output Category: 1

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	85.0%	91.9%
Combustion Efficiency	98.9%	98.9%
Heat Transfer Efficiency	86.0%	92.9%

Output Rate (kJ/h)	10,160	9,638	(Btu/h)
Burn Rate (kg/h)	0.60	1.33	(lb/h)
Input (kJ/h)	11,955	11,341	(Btu/h)

Test Load Weight (dry kg)	5.93	13.08	dry lb
MC wet (%)	17.74		
MC dry (%)	21.57		
Particulate (g)	0.00		
CO (g)	125		
Test Duration (h)	9.83		

Emissions	Particulate	CO
g/MJ Output	0.00	1.25
g/kg Dry Fuel	0.00	21.04
g/h	0.00	12.70
g/min	0.00	0.21
lb/MM Btu Output	0.00	2.90

Air/Fuel Ratio (A/F)	11.91
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	20.00	24.3		2x4	14.00	21.9
2x4	20.00	21.7		2x4	14.00	20.1
2x4	14.00	22.6		2x4	20.00	19.0
2x4	14.00	24.5		2x4	20.00	19.7
2x4	14.00	18.4				
2x4	14.00	24.3				
2x4	14.00	19.2				
2x4	14.00	19.9				
Total Fuel Weight (lbs):		17.04	Average Moisture (%DB):		21.3	

Firebox Volume (ft³): 2.41
 Total 2x4 Crib Weight, with spacers (lbs): 6.83
 Total 4x4 Crib Weight, with spacers (lbs): 9.06
 Total Wet Fuel Weight, with spacers (lbs): 15.90

Coal Bed Range (20-25%):

Min (lbs): 3.18
 Max (lbs): 3.98

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.00	1.90	21.5	23.2	22.3	1.55
2x4	18.00	1.87	19.3	18.8	19.7	1.57
2x4	18.00	1.85	19.1	18.8	20.5	1.55
4x4	18.00	4.19	23.8	23.8	22.6	3.40
4x4	18.00	4.45	23.8	22.5	23.8	3.61
Total Dry Weight, no spacers (lbs):						11.67
Total Dry Weight, with spacers (lbs):						13.19

Spacer Moisture Readings (%DB)							
7.7	9.0	7.9	9.4				
8.3	8.4	7.8	8.7				
6.3	8.7	8.3	8.3				
7.3	8.0	7.6	10.1				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	27.8	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.60	OK
2x4 Fuel Mix	35 - 65 % of total weight	43%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Preburn Start Time: 7:43
 Recording Interval (min): 10
 Run Time (min): 100

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	7.6	-0.069	540	465	295	589	279	433.6	398	66
10	7.0	-0.076	494	429	297	556	271	409.4	380	67
20	6.2	-0.066	475	405	290	554	261	397.0	372	66
30	5.6	-0.077	454	392	285	535	255	384.2	358	66
40	4.8	-0.064	441	392	285	506	252	375.2	364	66
50	4.3	-0.060	431	395	287	479	254	369.2	326	66
60	4.0	-0.042	412	380	284	454	255	357.0	304	66
70	3.8	-0.050	396	369	279	427	259	346.0	284	65
80	3.6	-0.040	382	363	275	393	265	335.6	247	64
90	3.3	-0.031	366	355	273	362	271	325.4	223	63
100	3.2	-0.023	351	340	269	335	277	314.4	195	62

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F 500 V3
 Run #: 3
 Test Start Time: 9:24

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Total Sampling Time (min): 590
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.83	29.74	29.71	29.76

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.220 in H₂O

Post-Test Leak Check

(A) 0.000 cfm @ - in. Hg
 (B) 0.000 cfm @ - in. Hg
 (AMB) 0.000 cfm @ - in. Hg

Ambient Sample Volume: 78.761 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.058	0.070	0.068	0.052	0.060	0.070	0.068	0.056	0.07
Tunnel Temp (°F)	89	89	89	89	89	89	89	89	89

V_{strav}: 17.04 ft/sec
 V_{scnt}: 17.91 ft/sec

F_p: 0.952 [ratio]
 Initial Tunnel Flow: 187.1 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	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

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	21.6

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.070	0.01	76	-0.11		15.9		108	278	76	73
10	1.448	0.145	0.070	2.27	77	-1.99	101	15.4	-0.5	84	202	75	72
20	2.919	0.147	0.070	2.25	80	0	102	14.8	-0.6	83	192	75	72
30	4.392	0.147	0.070	2.23	83	-0.55	102	14.3	-0.5	82	192	75	72
40	5.869	0.148	0.070	2.20	87	-1.44	101	13.8	-0.5	82	189	75	73
50	7.349	0.148	0.070	2.22	89	-0.73	101	13.2	-0.6	81	183	74	73
60	8.833	0.148	0.070	2.22	92	-2.55	101	12.7	-0.5	81	188	74	73
70	10.327	0.149	0.070	2.20	94	-0.03	101	12.0	-0.7	82	198	75	73
80	11.814	0.149	0.070	2.23	95	-0.1	100	11.5	-0.5	82	190	76	73
90	13.305	0.149	0.070	2.21	96	-1.17	100	11.0	-0.5	81	185	76	73
100	14.798	0.149	0.070	2.22	97	-0.01	100	10.5	-0.5	81	181	77	73
110	16.290	0.149	0.070	2.19	98	-1.92	100	10.1	-0.4	81	177	77	73
120	17.782	0.149	0.070	2.21	99	-2.56	100	9.7	-0.4	81	173	77	73
130	19.279	0.150	0.070	2.20	99	-0.22	100	9.5	-0.2	81	167	77	73
140	20.774	0.150	0.070	2.19	100	0	100	9.0	-0.5	81	165	77	73
150	22.266	0.149	0.070	2.21	100	-0.88	100	8.6	-0.4	81	165	77	73
160	23.762	0.150	0.070	2.21	100	-2.39	100	8.3	-0.3	81	163	77	73
170	25.260	0.150	0.070	2.20	101	-2.48	100	8.0	-0.3	81	159	77	73
180	26.755	0.150	0.070	2.21	101	0	100	7.6	-0.4	80	156	77	73
190	28.251	0.150	0.070	2.21	101	-2.26	100	7.4	-0.2	80	155	77	73
200	29.749	0.150	0.070	2.22	101	-2.55	100	7.1	-0.3	81	156	77	73
210	31.243	0.149	0.070	2.21	101	0	100	6.7	-0.4	81	168	77	73
220	32.739	0.150	0.070	2.19	102	-2.4	100	6.0	-0.7	82	186	77	73
230	34.238	0.150	0.070	2.19	102	-2.53	100	5.3	-0.7	83	191	77	74
240	35.732	0.149	0.070	2.19	102	-0.13	100	4.7	-0.6	83	195	77	73
250	37.226	0.149	0.070	2.19	102	-1.11	100	4.3	-0.4	83	199	77	74
260	38.725	0.150	0.070	2.19	102	-1.89	100	3.8	-0.5	85	221	77	74
270	40.222	0.150	0.070	2.19	102	-2.39	100	3.5	-0.3	86	229	77	74
280	41.716	0.149	0.070	2.20	102	-0.45	100	3.2	-0.3	85	216	74	74
290	43.213	0.150	0.070	2.19	103	-0.38	100	3.0	-0.2	85	203	74	74
300	44.712	0.150	0.070	2.20	103	0	100	2.8	-0.2	84	181	74	75
310	46.208	0.150	0.070	2.21	103	-1.82	100	2.7	-0.1	83	160	75	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
320	47.704	0.150	0.070	2.21	103	-2.15	100	2.6	-0.1	82	144	76	75
330	49.206	0.150	0.070	2.19	103	-0.3	100	2.5	-0.1	82	132	77	76
340	50.702	0.150	0.070	2.20	103	-0.77	100	2.5	0	82	125	74	75
350	52.198	0.150	0.070	2.18	104	0	99	2.3	-0.2	82	125	75	75
360	53.698	0.150	0.070	2.19	104	-0.79	100	2.2	-0.1	81	119	75	75
370	55.196	0.150	0.070	2.19	104	-2.55	99	2.0	-0.2	81	121	76	75
380	56.694	0.150	0.070	2.18	104	0	99	2.0	0	81	121	76	75
390	58.197	0.150	0.070	2.20	104	-1.64	100	1.9	-0.1	81	122	74	75
400	59.696	0.150	0.070	2.18	104	-1.89	99	1.8	-0.1	81	124	75	75
410	61.196	0.150	0.070	2.20	104	-0.98	100	1.8	0	81	114	76	75
420	62.699	0.150	0.070	2.19	104	-2.39	100	1.7	-0.1	80	112	77	75
430	64.197	0.150	0.070	2.21	104	0	99	1.7	0	80	111	75	75
440	65.701	0.150	0.070	2.17	105	-2.28	100	1.6	-0.1	80	109	74	75
450	67.202	0.150	0.070	2.19	105	0	99	1.5	-0.1	80	108	75	75
460	68.703	0.150	0.070	2.19	105	-1.62	99	1.5	0	80	107	76	75
470	70.208	0.151	0.070	2.19	105	-0.05	100	1.4	-0.1	80	106	76	75
480	71.709	0.150	0.070	2.20	105	0	99	1.4	0	80	106	77	75
490	73.211	0.150	0.070	2.19	105	-2.34	99	1.3	-0.1	80	105	74	75
500	74.716	0.151	0.070	2.18	105	0	100	1.4	0.1	79	105	75	75
510	76.216	0.150	0.070	2.19	105	-0.04	99	1.3	-0.1	80	103	75	75
520	77.723	0.151	0.070	2.19	105	-2.09	100	1.3	0	79	102	76	75
530	79.225	0.150	0.070	2.18	105	-0.12	99	1.1	-0.2	79	101	76	75
540	80.728	0.150	0.070	2.19	105	-2.53	99	1.2	0.1	79	96	77	75
550	82.233	0.151	0.070	2.20	105	-2.35	100	1.1	-0.1	79	94	76	75
560	83.736	0.150	0.070	2.17	105	-2.08	99	1.0	-0.1	78	95	74	74
570	85.239	0.150	0.070	2.19	105	-0.08	99	1.0	0	78	94	74	74
580	86.746	0.151	0.070	2.20	104	0	100	1.0	0	78	95	75	74
590	88.249	0.150	0.070	2.19	104	0	99	1.0	0	78	94	75	74
Avg/Tot	88.249	0.150	0.070	2.16	100	-1.10	100			82	151	76	74.0

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	75	-1		77	0.000	6.87	0.02
10	1.415	0.142	2.24	76	-2.16	100	78	-0.050	4.96	0.03
20	2.870	0.146	2.25	79	-0.71	102	79	-0.040	9.57	0.05
30	4.324	0.145	2.21	82	-1.65	102	78	-0.040	10.37	0.04
40	5.783	0.146	2.20	86	-0.68	101	77	-0.050	11.24	0.06
50	7.247	0.146	2.20	88	-2.37	101	77	-0.030	11.37	0.08
60	8.714	0.147	2.20	91	-1.05	101	77	-0.050	12.88	0.04
70	10.182	0.147	2.19	92	-2.3	101	78	-0.040	14.48	0.27
80	11.653	0.147	2.21	94	-0.81	100	79	-0.040	12.11	0.06
90	13.126	0.147	2.18	95	-2.82	100	78	-0.040	11.78	0.05
100	14.602	0.148	2.20	96	-0.77	100	77	-0.040	11.84	0.04
110	16.075	0.147	2.20	97	-0.62	100	77	-0.030	11.23	0.06
120	17.552	0.148	2.20	97	-2.68	100	77	-0.030	10.98	0.08
130	19.030	0.148	2.19	98	-2.74	100	78	-0.030	10.62	0.08
140	20.510	0.148	2.20	98	-2.09	100	79	-0.030	10.69	0.09
150	21.990	0.148	2.20	99	-1.67	100	79	-0.030	11.19	0.07
160	23.469	0.148	2.19	99	-2.74	100	77	-0.020	11.01	0.03
170	24.948	0.148	2.19	99	-1.64	100	77	-0.040	10.85	0.09
180	26.428	0.148	2.19	99	-1.82	100	78	-0.030	10.66	0.06
190	27.907	0.148	2.18	100	-2.55	100	79	-0.030	10.72	0.07
200	29.388	0.148	2.19	100	-2.8	100	79	-0.030	12.07	0.06
210	30.870	0.148	2.18	100	-1.31	100	78	-0.030	14.45	0.09
220	32.352	0.148	2.18	100	-2.82	100	77	-0.040	14.35	2.58
230	33.833	0.148	2.19	100	-0.75	100	77	-0.040	14.88	1.83
240	35.311	0.148	2.19	101	-2.78	100	78	-0.040	14.19	0.36
250	36.792	0.148	2.19	101	-1.55	100	79	-0.040	13.33	0.05
260	38.272	0.148	2.17	101	-1.17	100	78	-0.040	12.37	0.07
270	39.752	0.148	2.18	101	-1.88	100	77	-0.030	9.93	0.04
280	41.234	0.148	2.18	101	-0.91	100	77	-0.040	8.96	0.02
290	42.716	0.148	2.18	101	-1.08	100	78	-0.040	9.01	0.02
300	44.198	0.148	2.17	102	-2.91	100	79	-0.030	9.10	0.02
310	45.678	0.148	2.17	102	-1.16	100	79	-0.020	8.89	0.01

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
320	47.157	0.148	2.17	102	-0.94	100	78	-0.030	8.74	0.04
330	48.639	0.148	2.18	102	-2.63	100	77	-0.020	8.50	0.04
340	50.120	0.148	2.19	102	-2.8	100	77	-0.020	8.39	0.04
350	51.604	0.148	2.18	103	-0.71	100	78	-0.020	11.62	0.02
360	53.085	0.148	2.17	103	-2.58	99	79	-0.020	11.58	0.02
370	54.566	0.148	2.16	103	-0.99	99	79	-0.020	11.10	0.00
380	56.048	0.148	2.19	103	-0.74	100	79	-0.020	10.76	0.03
390	57.528	0.148	2.18	103	-2.75	99	79	-0.010	10.69	0.02
400	59.010	0.148	2.17	103	-1.65	100	78	-0.020	10.51	0.04
410	60.494	0.148	2.17	103	-2.52	100	77	-0.020	10.06	0.00
420	61.976	0.148	2.16	103	-0.93	99	77	-0.010	10.13	0.00
430	63.458	0.148	2.18	103	-2.65	99	78	0.000	10.12	0.02
440	64.940	0.148	2.17	103	-2.15	99	79	-0.020	9.99	0.00
450	66.421	0.148	2.16	103	-1.3	99	79	-0.010	10.10	0.01
460	67.904	0.148	2.17	104	-1.34	99	79	-0.010	9.51	0.01
470	69.389	0.149	2.18	104	-0.68	99	79	-0.020	8.59	0.02
480	70.872	0.148	2.17	104	-2.67	99	78	-0.010	7.98	0.03
490	72.354	0.148	2.17	104	-1.45	99	77	-0.010	7.21	0.00
500	73.836	0.148	2.16	104	-0.73	99	77	-0.020	6.61	0.04
510	75.318	0.148	2.18	104	-0.78	99	78	-0.010	6.24	0.02
520	76.801	0.148	2.17	104	-1.63	99	79	-0.020	6.14	0.01
530	78.287	0.149	2.19	104	-1.27	99	79	0.000	6.56	0.00
540	79.770	0.148	2.17	103	-0.77	99	78	-0.010	11.15	0.05
550	81.253	0.148	2.17	103	-2.67	99	78	-0.010	9.74	0.02
560	82.735	0.148	2.18	103	-2.8	99	77	-0.010	8.79	0.04
570	84.218	0.148	2.18	103	-2.8	99	77	-0.010	7.66	0.10
580	85.701	0.148	2.17	103	-2.18	99	78	-0.020	6.86	0.18
590	87.186	0.149	2.18	103	-1.56	99	79	-0.010	6.57	0.21
Avg/Tot	87.186	0.148	2.15	99	-1.74	100	78	-0.025	10.15	0.13

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Model: F 500 V3

Run #: 3

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/3/2018

Stove ΔT : 145

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
0	348	338	269	332	278	313.0	467
10	324	303	259	320	276	296.4	524
20	304	275	243	321	271	282.8	584
30	299	257	230	331	265	276.4	595
40	300	249	221	340	257	273.4	598
50	298	245	216	340	250	269.8	585
60	300	244	213	348	244	269.8	626
70	309	247	212	372	237	275.4	700
80	318	253	213	378	231	278.6	653
90	321	258	216	372	225	278.4	637
100	319	264	216	367	219	277.0	627
110	316	270	220	361	214	276.2	616
120	312	276	223	355	209	275.0	597
130	307	281	226	348	205	273.4	582
140	304	282	229	341	201	271.4	571
150	302	287	231	336	197	270.6	570
160	301	287	233	335	193	269.8	565
170	301	288	236	330	190	269.0	554
180	299	287	238	326	187	267.4	545
190	297	288	240	322	183	266.0	539
200	295	288	241	322	180	265.2	551
210	296	291	244	336	177	268.8	614
220	312	297	246	368	173	279.2	686
230	330	308	251	393	171	290.6	717
240	347	318	257	410	169	300.2	737
250	360	325	262	419	167	306.6	732
260	365	329	265	425	169	310.6	755
270	368	331	266	425	172	312.4	730
280	362	330	264	395	176	305.4	649
290	349	327	262	372	182	298.4	607
300	339	322	260	349	187	291.4	557
310	330	316	258	328	192	284.8	514
320	318	310	254	308	196	277.2	477
330	306	302	251	288	198	269.0	445
340	295	293	246	273	197	260.8	418
350	285	282	241	259	196	252.6	419
360	277	274	235	257	196	247.8	412
370	274	267	231	255	197	244.8	414
380	268	262	227	252	197	241.2	407
390	264	258	225	249	196	238.4	404
400	261	256	222	249	195	236.6	406
410	258	253	220	241	193	233.0	377
420	252	250	218	235	190	229.0	367
430	248	248	215	231	186	225.6	359
440	243	247	212	226	182	222.0	351
450	239	246	210	223	178	219.2	345
460	233	246	206	219	174	215.6	340
470	230	245	204	216	170	213.0	332

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul
 Model: F 500 V3
 Run #: 3

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/3/2018

Stove ΔT : 145

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
480	224	243	201	212	166	209.2	324
490	219	239	196	207	162	204.6	315
500	215	234	192	202	158	200.2	305
510	210	228	187	197	154	195.2	297
520	205	221	182	193	150	190.2	290
530	201	214	177	189	147	185.6	284
540	196	209	172	187	144	181.6	280
550	193	206	168	185	142	178.8	274
560	191	205	165	183	140	176.8	272
570	186	202	161	180	139	173.6	265
580	185	198	158	177	137	171.0	260
590	180	194	155	174	136	167.8	254
Average	281	268	223	295	191	252	468

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Job #: 18-425

Model: F 500 V3

Tracking #: 0011

Run #: 3

Technician: SJB

Date: 10/3/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter				0.0
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.0

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter				0.0
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.0

Train A Aggregate Total Particulate, mg: 0.0

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter				0.0
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Total Particulate, mg: 0.0

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter				0.0

Total Particulate, mg: 0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and O-rings, negative numbers for filters are assumed to be part of the O-Ring weight.

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 3 Test Date: 10/3/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Open 5/64" from Fully closed

Preburn Notes

Preburn Start Time: 7:43

Time	Notes
6:15	Loaded 7.5 lbs of kindling
6:55	At 2.2 lbs, Loaded Pre-burn Fuel
7:43	Set air to test setting, turned fan on to low setting
8:21	Stirred coals to ensure uniform charcoalization
9:07	Stirred coals to ensure uniform charcoalization
9:23	Leveled coal bed, zeroed scale in preparation for fuel loading

Test Notes

Test Burn Start Time: 9:24
 Test Fuel Loaded by: 40 seconds
 Door Closed: 40 seconds
 Air Control Set at: 4 minutes
 Other Loading Notes: N/A

Time	Notes
60 min	Changed 1-hour filter.
340 min	Adjusted fuel load – 10 minutes without measurable weight loss, door open 10 seconds.
590 min	FIRE OUT - 30 minutes without a measurable weight loss; test aborted.

Test Burn End Time: 19:14
 Background Filter Volume (ft³): 78.761

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3344	3345	3346	3A	3A	3347	3348	3B	3B	3349
Tare (mg)	122.7	121.0	121.8	116073.9	3580.0	122.5	119.3	116340.8	3568.3	121.5
Final Weight (mg)	-	-	-	-	-	-	-	-	-	-

Sample Train Leak Check: A: - @ - "Hg B: - @ - "Hg AMB: - @ - "Hg

Technician Signature:  Date: 11/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 3 Test Date: 10/3/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 16.93 CO (%): 4.33
 Mid Gas CO₂ (%): 10.0 CO (%): 2.510

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	7:48	7:54	7:50	-	-	-
CO ₂	0.00	10.06	16.93	-	-	-
CO	0.000	2.496	4.330	-	-	-

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.058	0.070	0.068	0.052	0.060	0.070	0.068	0.056	0.070
Temp (°F):	89	89	89	89	89	89	89	89	89

Dilution Tunnel Static Pressure (inH₂O): -0.22

Supplemental Data

Room Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Stack Diameter (in): 6


Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 10/1/2018

	Initial	Middle	Ending
P _b (inHg)	29.83	29.74	29.71
RH (%)	28.6	21.4	22.4

Technician Signature:  Date: 11/16/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 4 Data Summary

Client: Jotul
Model: F 500 V3
Job #: 18-425
Tracking #: 0011
Test Date: 10/4/2018

A handwritten signature in black ink, appearing to be "JL", is written over a horizontal line.

Techician Signature

10/17/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F 500 V3

Run #: 4

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/4/2018

Burn Rate (kg/hr):	0.91
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	55.026	61.312	60.684	8.843
Average Gas Velocity in Dilution Tunnel (ft/sec)	16.8			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	11252.1			
Average Gas Meter Temperature (°F)	74.2	98.7	97.7	82.4
Total Sample Volume (dscf)	54.303	58.328	57.548	10.366
Average Tunnel Temperature (°F)	84.9			
Total Time of Test (min)	410			
Total Particulate Catch (mg)	0.0	1.7	1.2	0.3
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000291	0.0000209	0.0000289
Total PM Emissions (g)	0.00	2.24	1.60	0.33
Particulate Emission Rate (g/hr)	0.00	0.33	0.23	0.33
Emissions Factor (g/kg)	-	0.36	0.26	-
Difference from Average Total Particulate Emissions (g)	-	0.32	0.32	-
Difference from Average Emissions Factor (g/kg)	-	0.05	0.05	-

Final Average Results	
Total Particulate Emissions (g)	1.92
Particulate Emission Rate (g/hr)	0.28
Emissions Factor (g/kg)	0.31
HHV Efficiency (%)	83.2%
LHV Efficiency (%)	89.9%
CO Emissions (g/min)	0.11

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	79.0	OK
Face Velocity	< 30 ft/min	8.1	OK
Leakage Rate	Less than 4% of average sample rate	0 cfm	OK
Ambient Temp	55-90 °F	Min: 72 / Max: 76	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	82.4	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F 500 V3
Date: 10/04/18
Run: 4
Control #: 18-425
Test Duration: 410
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	83.2%	89.9%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	83.6%	90.4%

Output Rate (kJ/h)	14,760	14,001	(Btu/h)
Burn Rate (kg/h)	0.90	1.97	(lb/h)
Input (kJ/h)	17,741	16,829	(Btu/h)

Test Load Weight (dry kg)	6.12	13.49	dry lb
MC wet (%)	17.76		
MC dry (%)	21.59		
Particulate (g)	1.92		
CO (g)	46		
Test Duration (h)	6.83		

Emissions	Particulate	CO
g/MJ Output	0.02	0.46
g/kg Dry Fuel	0.31	7.60
g/h	0.28	6.80
g/min	0.00	0.11
lb/MM Btu Output	0.04	1.07

Air/Fuel Ratio (A/F)	11.36
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	20.00	22.5		2x4	14.00	22.3
2x4	20.00	19.1		2x4	14.00	25.4
2x4	14.00	19.2		2x4	20.00	21.5
2x4	14.00	23.1		2x4	20.00	18.8
2x4	14.00	24.3				
2x4	14.00	21.9				
2x4	14.00	25.1				
2x4	14.00	18.7				
Total Fuel Weight (lbs):		19.53	Average Moisture (%DB):		21.8	

Firebox Volume (ft³): 2.41
 Total 2x4 Crib Weight, with spacers (lbs): 7.07
 Total 4x4 Crib Weight, with spacers (lbs): 9.35
 Total Wet Fuel Weight, with spacers (lbs): 16.42

Coal Bed Range (20-25%):

Min (lbs): 3.28
 Max (lbs): 4.11

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.00	1.92	22.4	21.7	22.9	1.57
2x4	18.00	1.98	22.4	22.5	23.1	1.61
2x4	18.00	1.94	22.7	23.0	22.1	1.58
4x4	18.00	4.37	22.4	19.7	18.9	3.63
4x4	18.00	4.52	20.5	19.7	19.9	3.77
Total Dry Weight, no spacers (lbs):						12.16
Total Dry Weight, with spacers (lbs):						13.72

Spacer Moisture Readings (%DB)							
7.1	7.6	8.4	8.7				
9.0	8.1	7.8	7.3				
9.1	9.9	9.3	8.1				
8.9	8.0	8.0	8.5				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.0	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.81	OK
2x4 Fuel Mix	35 - 65 % of total weight	43%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Preburn Start Time: 10:21
 Recording Interval (min): 10
 Run Time (min): 100

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	7.6	-0.068	487	430	273	480	244	382.8	405	65
10	7.0	-0.043	466	424	276	458	243	373.4	324	64
20	6.5	-0.054	443	399	275	432	237	357.2	300	63
30	5.7	-0.052	431	390	275	439	234	353.8	330	62
40	5.3	-0.052	430	388	277	437	235	353.4	304	61
50	4.9	-0.064	400	372	275	418	242	341.4	280	61
60	4.6	-0.052	381	361	274	394	253	332.6	252	61
70	4.4	-0.035	362	352	271	365	263	322.6	223	60
80	4.2	-0.038	350	344	270	342	271	315.4	196	61
90	3.6	-0.018	337	333	268	315	275	305.6	183	61
100	3.5	-0.024	327	321	264	300	273	297.0	157	61

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F 500 V3
 Run #: 4
 Test Start Time: 12:02

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Total Sampling Time (min): 410
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.91	29.91	29.92	29.91

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.195 in H₂O

Post-Test Leak Check

(A) 0.000 cfm @ -14 in. Hg
 (B) 0.000 cfm @ -12 in. Hg
 (AMB) 0.001 cfm @ -14 in. Hg

Ambient Sample Volume: 55.026 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.054	0.068	0.066	0.052	0.062	0.066	0.068	0.054	0.07
Tunnel Temp (°F)	87	87	87	87	87	87	87	87	87

V_{strav}: 16.81 ft/sec
 V_{scent}: 17.85 ft/sec

F_p: 0.941 [ratio]
 Initial Tunnel Flow: 185.7 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	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

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	21.6

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.070	0.00	74	0		16.4		98	238	74	72
10	1.465	0.147	0.070	2.27	76	0	102	15.9	-0.5	83	181	74	72
20	2.934	0.147	0.070	2.23	79	-2.05	101	15.7	-0.2	81	158	75	72
30	4.406	0.147	0.070	2.23	82	-2.47	101	15.4	-0.3	81	162	76	72
40	5.882	0.148	0.070	2.23	86	-0.54	101	15.0	-0.4	81	175	77	72
50	7.360	0.148	0.070	2.20	89	-2.33	100	14.5	-0.5	81	182	77	72
60	8.843	0.148	0.070	2.23	91	0	100	13.9	-0.6	81	188	77	72
70	10.340	0.150	0.070	2.22	93	-0.42	101	13.2	-0.7	82	196	76	72
80	11.832	0.149	0.070	2.21	95	-1.16	100	12.7	-0.5	82	209	74	73
90	13.323	0.149	0.070	2.21	96	-1.38	100	11.9	-0.8	83	219	74	73
100	14.815	0.149	0.070	2.21	97	-0.24	100	11.0	-0.9	85	240	74	73
110	16.312	0.150	0.070	2.21	98	-2.42	100	10.0	-1	87	270	75	73
120	17.807	0.150	0.070	2.20	99	-0.06	100	8.6	-1.4	90	319	76	74
130	19.300	0.149	0.070	2.20	100	0	100	7.5	-1.1	93	342	76	74
140	20.794	0.149	0.070	2.19	100	-0.04	101	6.3	-1.2	95	349	74	75
150	22.292	0.150	0.070	2.20	101	-2.21	101	5.4	-0.9	95	351	74	75
160	23.787	0.150	0.070	2.18	101	-2.62	100	4.5	-0.9	95	340	75	75
170	25.284	0.150	0.070	2.19	101	-2.49	101	3.8	-0.7	95	320	77	75
180	26.782	0.150	0.070	2.20	102	-0.08	100	3.4	-0.4	93	296	74	75
190	28.279	0.150	0.070	2.21	102	-1.48	100	3.1	-0.3	91	272	75	75
200	29.778	0.150	0.070	2.19	103	-2.04	100	2.9	-0.2	90	251	77	75
210	31.279	0.150	0.070	2.21	103	0	100	2.7	-0.2	88	228	74	75
220	32.777	0.150	0.070	2.19	103	-1.13	100	2.5	-0.2	87	212	75	75
230	34.277	0.150	0.070	2.21	103	-1.85	100	2.4	-0.1	86	195	77	75
240	35.779	0.150	0.070	2.20	104	0	100	2.3	-0.1	85	175	75	76
250	37.279	0.150	0.070	2.19	104	-1.58	99	2.2	-0.1	84	155	76	75
260	38.779	0.150	0.070	2.18	104	-0.25	99	2.0	-0.2	83	152	75	76
270	40.283	0.150	0.070	2.19	104	-0.43	99	1.9	-0.1	83	151	75	75
280	41.780	0.150	0.070	2.19	104	-1.7	99	1.7	-0.2	82	144	76	75
290	43.285	0.151	0.070	2.20	104	-2.45	99	1.5	-0.2	82	142	74	75
300	44.786	0.150	0.070	2.21	104	-1.63	99	1.4	-0.1	82	141	75	75
310	46.286	0.150	0.070	2.17	104	-2.49	99	1.2	-0.2	81	137	76	75

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft ³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
320	47.791	0.151	0.070	2.21	104	-2.09	99	1.0	-0.2	81	135	74	75
330	49.292	0.150	0.070	2.19	104	-0.07	99	0.9	-0.1	81	132	75	75
340	50.793	0.150	0.070	2.21	104	-0.92	99	0.8	-0.1	81	128	76	75
350	52.298	0.151	0.070	2.21	104	-0.05	99	0.7	-0.1	81	127	76	75
360	53.799	0.150	0.070	2.20	104	-0.82	99	0.6	-0.1	80	126	75	75
370	55.302	0.150	0.070	2.22	104	-1.03	99	0.5	-0.1	80	124	75	75
380	56.806	0.150	0.070	2.21	104	-2.61	99	0.4	-0.1	80	122	76	75
390	58.305	0.150	0.070	2.22	104	0	99	0.3	-0.1	80	121	77	74
400	59.812	0.151	0.070	2.20	104	-0.02	99	0.1	-0.2	79	119	74	74
410	61.312	0.150	0.070	2.19	104	-0.1	99	0.0	-0.1	79	116	75	74
Avg/Tot	61.312	0.150	0.070	2.15	99	-1.08	100			85	199	75	74.2

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	74	-1		77	0.000	8.85	0.00
10	1.438	0.144	2.25	75	-2.42	101	79	-0.030	5.27	0.00
20	2.894	0.146	2.25	78	-2.1	102	78	-0.040	5.88	0.01
30	4.352	0.146	2.24	82	-0.96	101	77	-0.040	7.79	0.00
40	5.813	0.146	2.22	85	-2.68	101	77	-0.030	9.44	0.01
50	7.279	0.147	2.21	88	-2.5	100	78	-0.040	10.30	0.00
60	8.750	0.147	2.22	90	-2.08	100	79	-0.040	11.06	0.00
70	10.222	0.147	2.21	92	-1.36	100	78	-0.040	11.25	0.00
80	11.696	0.147	2.20	94	-2.73	100	78	-0.030	13.31	0.09
90	13.174	0.148	2.20	95	-2.34	100	77	-0.040	13.77	0.06
100	14.653	0.148	2.21	96	-2.57	100	77	-0.050	14.07	0.94
110	16.132	0.148	2.21	97	-1.89	100	79	-0.050	14.30	0.08
120	17.611	0.148	2.21	98	-2.76	100	78	-0.070	14.75	0.26
130	19.090	0.148	2.19	98	-0.67	101	77	-0.050	14.31	0.15
140	20.568	0.148	2.21	99	-0.72	101	77	-0.060	12.81	0.00
150	22.049	0.148	2.21	99	-2.8	101	78	-0.070	11.76	0.00
160	23.530	0.148	2.20	100	-0.72	101	78	-0.060	11.82	0.00
170	25.014	0.148	2.21	100	-2.77	101	79	-0.060	10.44	0.00
180	26.497	0.148	2.20	101	-2.14	100	79	-0.060	8.42	0.01
190	27.978	0.148	2.20	101	-1.42	100	78	-0.060	8.00	0.00
200	29.462	0.148	2.20	101	-0.73	100	78	-0.040	7.97	0.00
210	30.946	0.148	2.19	102	-2.34	100	77	-0.040	7.86	0.00
220	32.431	0.149	2.19	102	-2.73	100	77	-0.050	8.13	0.00
230	33.917	0.149	2.20	102	-1.32	100	78	-0.030	8.26	0.00
240	35.403	0.149	2.19	103	-1.1	99	79	-0.030	8.67	0.00
250	36.889	0.149	2.20	103	-1.07	99	79	-0.030	9.54	0.00
260	38.374	0.149	2.20	103	-0.97	99	79	-0.040	10.08	0.00
270	39.860	0.149	2.19	103	-2.58	99	78	-0.020	11.19	0.00
280	41.348	0.149	2.19	103	-2.12	99	78	-0.030	11.12	0.00
290	42.834	0.149	2.21	103	-2.4	99	77	-0.020	12.23	0.00
300	44.320	0.149	2.21	103	-2.52	99	78	-0.010	12.53	0.00
310	45.807	0.149	2.21	103	-2.43	99	79	-0.010	12.32	0.00

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
320	47.295	0.149	2.21	103	-0.96	99	79	-0.010	12.10	0.00
330	48.783	0.149	2.20	103	-1.19	99	79	-0.010	11.98	0.00
340	50.269	0.149	2.20	103	-0.76	99	78	-0.010	12.51	0.00
350	51.754	0.149	2.20	103	-1.31	99	77	-0.010	11.90	0.00
360	53.243	0.149	2.20	103	-0.97	99	77	-0.010	11.29	0.00
370	54.732	0.149	2.21	103	-2.42	99	78	-0.020	9.99	0.00
380	56.221	0.149	2.21	103	-2.77	99	79	-0.020	11.17	0.00
390	57.708	0.149	2.22	103	-2.11	99	79	-0.010	10.67	0.00
400	59.195	0.149	2.20	103	-2.11	99	78	-0.010	11.67	0.02
410	60.684	0.149	2.21	103	-0.92	99	77	-0.010	10.03	0.02
Avg/Tot	60.684	0.148	2.15	98	-1.82	100	78	-0.033	10.73	0.04

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Model: F 500 V3

Run #: 4

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/4/2018

Stove ΔT : 82

Elapsed Time (min)	Temperature Data (*F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
0	324	320	263	299	272	295.6	471
10	306	290	251	291	270	281.6	490
20	285	266	234	277	265	265.4	452
30	270	248	218	277	258	254.2	478
40	265	236	207	294	251	250.6	539
50	269	230	200	311	245	251.0	578
60	275	229	195	329	240	253.6	616
70	286	232	193	349	235	259.0	657
80	300	238	193	375	229	267.0	720
90	320	246	195	405	226	278.4	779
100	341	258	199	439	224	292.2	851
110	366	275	205	473	223	308.4	934
120	395	321	212	479	223	326.0	899
130	420	358	224	489	224	343.0	931
140	441	382	238	493	226	356.0	902
150	450	390	256	492	230	363.6	914
160	442	401	270	488	236	367.4	881
170	430	407	281	476	243	367.4	827
180	422	402	287	447	246	360.8	777
190	407	384	286	414	253	348.8	707
200	390	369	286	390	260	339.0	669
210	373	357	284	367	265	329.2	622
220	361	348	281	353	262	321.0	595
230	353	340	276	341	257	313.4	564
240	338	331	271	326	251	303.4	531
250	326	328	269	309	247	295.8	487
260	314	324	272	294	241	289.0	459
270	305	321	278	282	235	284.2	443
280	296	323	282	274	228	280.6	431
290	287	327	282	267	220	276.6	419
300	280	327	278	260	213	271.6	407
310	273	323	274	254	206	266.0	398
320	266	319	271	249	199	260.8	391
330	260	316	267	245	193	256.2	384
340	254	312	261	241	186	250.8	380
350	250	306	253	238	180	245.4	375
360	246	300	246	234	175	240.2	368
370	241	293	238	229	170	234.2	358
380	237	286	232	224	165	228.8	350
390	232	280	225	220	161	223.6	342
400	228	274	217	216	157	218.4	335
410	223	268	211	211	153	213.2	326
Average	318	312	247	331	225	286	572

LAB SAMPLE DATA - ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 4

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/4/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3350	123.6	123.3	0.3
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.3

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3351	124.1	123.3	0.8
B. Rear filter catch	Filter	3352	119.4	119.5	-0.1
C. Probe catch*	Probe	4A	116183.4	116183.3	0.1
D. O-Ring catch*	O-Ring	4A	3593.8	3593.2	0.6

Sub-Total Total Particulate, mg: 1.4

Train A Aggregate Total Particulate, mg: 1.7

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3353	122.0	121.1	0.9
B. Rear filter catch	Filter	3354	122.8	123.2	-0.4
C. Probe catch*	Probe	4B	116366.1	116366.0	0.1
D. O-Ring catch*	O-Ring	4B	3581.6	3581.0	0.6

Total Particulate, mg: 1.2

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3355	119.5	119.5	0.0

Total Particulate, mg: 0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and O-rings, negative numbers for filters are assumed to be part of the O-Ring weight.

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 4 Test Date: 10/4/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Open 0.126" from fully closed

Preburn Notes

Preburn Start Time: 10:21

Time	Notes
8:29	Loaded 7.5 lbs of kindling
9:04	At 2.2 lbs, Loaded Pre-burn Fuel
10:21	Set air to test setting, turned fan on to low setting
10:46	Stirred coals to ensure uniform charcoalization
11:46	Stirred coals to ensure uniform charcoalization, removed 0.6 lbs of coals.
12:01	Leveled coal bed, zeroed scale in preparation for fuel loading

Test Notes

Test Burn Start Time: 12:02
 Test Fuel Loaded by: 40 seconds
 Door Closed: 40 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: N/A

Time	Notes
60 min	Changed 1-hour filter.
410 min	End of Test

Test Burn End Time: 18:52
 Background Filter Volume (ft³): 55.026

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3350	3351	3352	4A	4A	3353	3354	4B	4B	3355
Tare (mg)	123.3	123.3	119.5	116183.3	3593.2	121.1	123.2	116366.0	3581.0	119.5
Final Weight (mg)	123.6	124.1	119.4	116183.4	3593.8	122.0	122.8	116366.1	3581.6	119.5

Sample Train Leak Check: A: 0.000 @ -14 "Hg B: 0.000 @ -12 "Hg AMB: 0.001 @ -14 "Hg

Technician Signature:  Date: 11/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 4 Test Date: 10/4/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 16.93 CO (%): 4.33
 Mid Gas CO₂ (%): 10.0 CO (%): 2.510

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	9:57	10:02	10:00	10:10	10:12	10:15
CO ₂	0.00	10.07	16.93	-0.02	10.05	16.97
CO	0.000	2.497	4.330	-0.026	2.464	4.336

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.054	0.068	0.066	0.052	0.062	0.066	0.068	0.054	0.070
Temp (°F):	87	87	87	87	87	87	87	87	87

Dilution Tunnel Static Pressure (inH₂O): -0.195

Supplemental Data

Room Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 10/1/2018

	Initial	Middle	Ending
P _b (inHg)	29.91	29.91	29.92
RH (%)	30.6	26.4	20.4

Technician Signature:  Date: 11/16/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 5 Data Summary

Client: Jotul
Model: F 500 V3
Job #: 18-425
Tracking #: 0011
Test Date: 10/5/2018

A handwritten signature in black ink, appearing to be "JL", is written over a horizontal line.

Techician Signature

10/17/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 5

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/5/2018

Burn Rate (kg/hr):	2.96
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	16.311	18.140	17.843	8.890
Average Gas Velocity in Dilution Tunnel (ft/sec)	17.4			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	10783.2			
Average Gas Meter Temperature (°F)	76.4	90.5	89.5	83.3
Total Sample Volume (dscf)	16.034	17.517	17.176	10.425
Average Tunnel Temperature (°F)	129.1			
Total Time of Test (min)	120			
Total Particulate Catch (mg)	0.0	1.6	1.4	0.4
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000913	0.0000815	0.0000384
Total PM Emissions (g)	0.00	1.97	1.76	0.41
Particulate Emission Rate (g/hr)	0.00	0.98	0.88	0.41
Emissions Factor (g/kg)	-	0.33	0.30	-
Difference from Average Total Particulate Emissions (g)	-	0.11	0.11	-
Difference from Average Emissions Factor (g/kg)	-	0.02	0.02	-

Final Average Results	
Total Particulate Emissions (g)	1.86
Particulate Emission Rate (g/hr)	0.93
Emissions Factor (g/kg)	0.31
HHV Efficiency (%)	70.5%
LHV Efficiency (%)	76.2%
CO Emissions (g/min)	1.91

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	79.0	OK
Face Velocity	< 30 ft/min	8.3	OK
Leakage Rate	Less than 4% of average sample rate	0 cfm	OK
Ambient Temp	55-90 °F	Min: 75 / Max: 77	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	92.2	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F 500 V3
Date: 10/05/18
Run: 5
Control #: 18-425
Test Duration: 120
Output Category: 4

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	70.5%	76.2%
Combustion Efficiency	97.3%	97.3%
Heat Transfer Efficiency	72.5%	78.3%

Output Rate (kJ/h)	40,906	38,804	(Btu/h)
Burn Rate (kg/h)	2.93	6.45	(lb/h)
Input (kJ/h)	58,017	55,035	(Btu/h)

Test Load Weight (dry kg)	5.86	12.91	dry lb
MC wet (%)	16.71		
MC dry (%)	20.07		
Particulate (g)	1.86		
CO (g)	230		
Test Duration (h)	2.00		

Emissions	Particulate	CO
g/MJ Output	0.02	2.81
g/kg Dry Fuel	0.32	39.20
g/h	0.93	114.82
g/min	0.02	1.91
lb/MM Btu Output	0.05	6.52

Air/Fuel Ratio (A/F)	11.53
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 5

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/5/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	20.00	20.0		2x4	14.00	21.2
2x4	20.00	20.5		2x4	14.00	19.4
2x4	14.00	19.7		2x4	20.00	20.4
2x4	14.00	20.3		2x4	20.00	22.1
2x4	14.00	18.8				
2x4	14.00	19.7				
2x4	14.00	21.2				
2x4	14.00	22.1				
Total Fuel Weight (lbs):		17.75	Average Moisture (%DB):		20.5	

Firebox Volume (ft³): 2.41
 Total 2x4 Crib Weight, with spacers (lbs): 6.15
 Total 4x4 Crib Weight, with spacers (lbs): 9.37
 Total Wet Fuel Weight, with spacers (lbs): 15.52

Coal Bed Range (20-25%):
 Min (lbs): 3.10
 Max (lbs): 3.88

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.00	1.41	18.9	19.1	19.4	1.18
2x4	18.00	1.50	18.9	20.2	19.6	1.25
2x4	18.00	2.05	21.5	20.8	19.9	1.70
4x4	18.00	4.48	19.3	18.9	20.5	3.75
4x4	18.00	4.45	21.7	20.4	21.9	3.67
Total Dry Weight, no spacers (lbs):						11.55
Total Dry Weight, with spacers (lbs):						13.05

Spacer Moisture Readings (%DB)							
7.8	8.7	8.4	9.4				
8.1	8.8	8.8	9.1				
7.4	9.1	8.2	8.5				
9.2	8.9	8.2	7.4				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	27.5	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.44	OK
2x4 Fuel Mix	35 - 65 % of total weight	40%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 5

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/5/2018

Preburn Start Time: 10:10
 Recording Interval (min): 10
 Run Time (min): 65

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	19.7	-0.063	376	332	165	424	105	280.4	405	64
10	17.0	-0.081	411	334	174	536	136	318.2	572	64
20	14.1	-0.099	463	361	188	620	178	362.0	621	65
30	11.0	-0.105	514	409	206	689	227	409.0	658	64
40	8.1	-0.096	564	478	227	724	285	455.6	662	64
50	5.5	-0.094	595	563	256	726	342	496.4	651	63
60	4.0	-0.089	601	591	271	658	373	498.8	579	63
65	3.5	-0.089	601	591	271	658	373	498.8	579	63

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F 500 V3
 Run #: 5
 Test Start Time: 11:15

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/5/2018

Total Sampling Time (min): 120
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	29.94	29.91	29.91	29.92

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.215 in H₂O

Post-Test Leak Check

(A) 0.000 cfm @ -14 in. Hg
 (B) 0.000 cfm @ -14 in. Hg
 (AMB) 0.001 cfm @ -14 in. Hg

Ambient Sample Volume: 16.311 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.058	0.062	0.070	0.052	0.058	0.070	0.064	0.052	0.07
Tunnel Temp (°F)	146	146	146	146	146	146	146	146	146

V_{strav}: 17.62 ft/sec
 V_{scent}: 18.78 ft/sec

F_p: 0.938 [ratio]
 Initial Tunnel Flow: 175.7 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	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

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	20.1

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 5

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/5/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.000		0.070	0.01	75	-0.08		15.5		173	553	76	75
10	1.443	0.144	0.070	2.20	76	-2.2	99	12.6	-2.9	145	659	77	75
20	2.904	0.146	0.070	2.31	79	-1.82	100	9.7	-2.9	146	659	74	75
30	4.391	0.149	0.070	2.27	83	-1.61	100	7.5	-2.2	138	604	75	77
40	5.885	0.149	0.070	2.29	87	-0.12	100	6.1	-1.4	133	575	76	77
50	7.387	0.150	0.070	2.28	90	-1.8	100	4.6	-1.5	130	562	74	76
60	8.890	0.150	0.070	2.29	93	-0.2	99	3.4	-1.2	126	537	75	76
70	10.433	0.154	0.070	2.35	95	-2.56	101	2.4	-1	122	508	74	77
80	11.972	0.154	0.070	2.37	97	-1.92	100	1.8	-0.6	118	477	75	77
90	13.509	0.154	0.070	2.36	99	0	99	1.2	-0.6	115	464	76	77
100	15.049	0.154	0.070	2.34	100	-2.21	99	0.7	-0.5	113	444	75	77
110	16.593	0.154	0.070	2.36	101	-0.12	99	0.3	-0.4	110	424	77	77
120	18.140	0.155	0.070	2.36	102	-2.45	99	0.0	-0.3	109	413	75	77
Avg/Tot	18.140	0.151	0.070	2.14	91	-1.31	99			129	529	75	76.4

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 18-425

Model: F 500 V3

Tracking #: 0011

Run #: 5

Technician: SJB

Date: 10/5/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.000		0.00	74	-1		79	0.000	7.23	0.03
10	1.418	0.142	2.21	75	-1.87	99	78	-0.100	16.04	1.28
20	2.867	0.145	2.32	79	-2.77	101	78	-0.090	15.85	1.42
30	4.347	0.148	2.29	82	-2.5	102	78	-0.090	11.33	0.00
40	5.832	0.149	2.29	86	-1.43	101	78	-0.090	11.17	0.00
50	7.324	0.149	2.29	89	-2.92	101	78	-0.090	11.69	0.01
60	8.817	0.149	2.29	92	-1.09	100	78	-0.100	9.96	0.03
70	10.315	0.150	2.30	94	-2.71	99	77	-0.080	9.66	0.00
80	11.818	0.150	2.29	96	-1.09	99	78	-0.070	8.61	0.01
90	13.321	0.150	2.28	97	-2.97	99	77	-0.070	8.56	0.00
100	14.825	0.150	2.28	99	-2.83	98	78	-0.070	8.46	0.00
110	16.335	0.151	2.28	100	-1.69	98	78	-0.070	8.21	0.02
120	17.843	0.151	2.27	100	-2.43	98	79	-0.070	8.29	0.00
Avg/Tot	17.843	0.149	2.11	89	-2.10	99	78	-0.076	10.39	0.22

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Model: F 500 V3

Run #: 5

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/5/2018

Stove ΔT : 92

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
0	581	583	277	607	392	488.0	762
10	582	523	276	674	396	490.2	1265
20	613	506	263	718	389	497.8	1251
30	620	539	261	683	385	497.6	1103
40	596	540	257	627	378	479.6	1050
50	571	539	254	598	371	466.6	1052
60	548	540	259	576	368	458.2	997
70	522	521	263	539	367	442.4	949
80	502	508	266	506	364	429.2	901
90	489	495	272	483	355	418.8	888
100	472	483	277	463	346	408.2	846
110	464	474	282	441	351	402.4	818
120	453	466	286	422	352	395.8	798
Average	539	517	269	564	370	452	975

LAB SAMPLE DATA - ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 5

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/5/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3356	121.2	120.8	0.4
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.4

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3357	123.4	123.2	0.2
B. Rear filter catch	Filter	3358	119.6	119.7	-0.1
C. Probe catch*	Probe	5A	116770.4	116770.2	0.2
D. O-Ring catch*	O-Ring	5A	3535.3	3534.4	0.9

Sub-Total Total Particulate, mg: 1.2

Train A Aggregate Total Particulate, mg: 1.6

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3359	122.3	121.7	0.6
B. Rear filter catch	Filter	3360	120.9	121.3	-0.4
C. Probe catch*	Probe	5B	116880.7	116880.5	0.2
D. O-Ring catch*	O-Ring	5B	3531.7	3530.7	1.0

Total Particulate, mg: 1.4

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3361	119.9	119.9	0.0

Total Particulate, mg: 0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and O-rings, negative numbers for filters are assumed to be part of the O-Ring weight.

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 5 Test Date: 10/5/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Fully open

Preburn Notes

Preburn Start Time: 10:10

Time	Notes
9:42	Loaded 7.5 lbs of kindling
10:10	At 2.2 lbs, Loaded Pre-burn Fuel, set air to test setting, turned fan on to high setting
10:55	Stirred coals to ensure uniform charcoalization
11:15	Leveled coal bed, zeroed scale in preparation for fuel loading

Test Notes

Test Burn Start Time: 11:15
 Test Fuel Loaded by: 40 seconds
 Door Closed: 40 seconds
 Air Control Set at: 0 seconds
 Other Loading Notes: N/A

Time	Notes
60 min	Changed 1-hour filter.
120 min	End of Test

Test Burn End Time: 13:15
 Background Filter Volume (ft³): 16.311

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3356	3357	3358	5A	5A	3359	3360	5B	5B	3361
Tare (mg)	120.8	123.2	119.7	116770.2	3534.4	121.7	121.3	116880.5	3530.7	119.9
Final Weight (mg)	121.2	123.4	119.6	116770.4	3535.3	122.3	120.9	116880.7	3531.7	119.9

Sample Train Leak Check: A: 0.000 @ -14 "Hg B: 0.000 @ -14 "Hg AMB: 0.001 @ -14 "Hg

Technician Signature:  Date: 11/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 5 Test Date: 10/5/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 16.93 CO (%): 4.33
 Mid Gas CO₂ (%): 10.0 CO (%): 2.510

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	10:20	10:25	10:22	13:40	13:42	13:45
CO ₂	0.00	10.05	16.93	0.07	10.07	16.99
CO	0.000	2.464	4.330	-0.011	2.473	4.318

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.058	0.062	0.070	0.052	0.058	0.070	0.064	0.052	0.070
Temp (°F):	146	146	146	146	146	146	146	146	146

Dilution Tunnel Static Pressure (inH₂O): -0.215

Supplemental Data

Room Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 10/1/2018

	Initial	Middle	Ending
P _b (inHg)	29.94	29.91	29.91
RH (%)	27.7	25.6	25.4

Technician Signature:  Date: 11/16/2018

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 6 Data Summary

Client: Jotul
Model: F 500 V3
Job #: 18-425
Tracking #: 0011
Test Date: 10/16/2018

A handwritten signature in black ink, appearing to be "JL" or similar, written over a horizontal line.

Techician Signature

10/19/2018

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F 500 V3

Run #: 6

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/16/2018

Burn Rate (kg/hr):	1.21
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	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	40.462	43.972	44.736	8.641
Average Gas Velocity in Dilution Tunnel (ft/sec)	16.9			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	11161.5			
Average Gas Meter Temperature (°F)	75.1	81.4	95.8	76.1
Total Sample Volume (dscf)	40.102	43.427	42.832	10.169
Average Tunnel Temperature (°F)	97.3			
Total Time of Test (min)	300			
Total Particulate Catch (mg)	0.0	1.9	1.6	0.6
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000438	0.0000374	0.0000590
Total PM Emissions (g)	0.00	2.44	2.08	0.66
Particulate Emission Rate (g/hr)	0.00	0.49	0.42	0.66
Emissions Factor (g/kg)	-	0.40	0.34	-
Difference from Average Total Particulate Emissions (g)	-	0.18	0.18	-
Difference from Average Emissions Factor (g/kg)	-	0.03	0.03	-

Final Average Results	
Total Particulate Emissions (g)	2.26
Particulate Emission Rate (g/hr)	0.45
Emissions Factor (g/kg)	0.37
HHV Efficiency (%)	77.5%
LHV Efficiency (%)	83.7%
CO Emissions (g/min)	0.03

Quality Checks	Requirement	Observed	Result
Dual Train Precision	Each train within 7.5% of average emissions (in grams), or emission factors within 0.5 g/kg	See Above	OK
Filter Temps	<90 °F	80.0	OK
Face Velocity	< 30 ft/min	8.1	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min: 72 / Max: 77	OK
Negative Probe Weight Evaluation	<5% of Total Catch	Probe Catch Not Negative	OK
Pro-Rate Variation	90% of readings between 90-110%; none greater than 120% or less than 80%	See Data Tabs	OK
Stove Surface ΔT	<126°F	65.6	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F 500 V3
Date: 10/16/18
Run: 6
Control #: 18-425
Test Duration: 300
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	77.5%	83.7%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	77.9%	84.2%

Output Rate (kJ/h)	18,382	17,437	(Btu/h)
Burn Rate (kg/h)	1.20	2.64	(lb/h)
Input (kJ/h)	23,725	22,506	(Btu/h)

Test Load Weight (dry kg)	5.99	13.20	dry lb
MC wet (%)	16.99		
MC dry (%)	20.47		
Particulate (g)	2.26		
CO (g)	9		
Test Duration (h)	5.00		

Emissions	Particulate	CO
g/MJ Output	0.02	0.10
g/kg Dry Fuel	0.38	1.58
g/h	0.45	1.89
g/min	0.01	0.03
lb/MM Btu Output	0.06	0.24

Air/Fuel Ratio (A/F)	14.21
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VERSION:

2.2

12/14/2009

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 6

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/16/2018

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	20.00	22.0		2x4	14.00	20.1
2x4	20.00	19.9		2x4	14.00	20.4
2x4	14.00	18.7		2x4	20.00	19.4
2x4	14.00	18.9		2x4	20.00	18.7
2x4	14.00	19.8				
2x4	14.00	22.7				
2x4	14.00	20.3				
2x4	14.00	19.4				
Total Fuel Weight (lbs):		19.05	Average Moisture (%DB):		20.0	

Firebox Volume (ft³): 2.41
 Total 2x4 Crib Weight, with spacers (lbs): 6.79
 Total 4x4 Crib Weight, with spacers (lbs): 9.15
 Total Wet Fuel Weight, with spacers (lbs): 15.94

Coal Bed Range (20-25%):

Min (lbs): 3.19
 Max (lbs): 3.99

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.00	1.76	20.4	20.0	19.3	1.47
2x4	18.00	1.34	19.4	19.0	19.1	1.12
2x4	18.00	2.36	22.1	22.9	21.9	1.93
4x4	18.00	4.23	20.6	19.7	18.8	3.53
4x4	18.00	4.45	20.5	22.0	21.4	3.67
Total Dry Weight, no spacers (lbs):						11.72
Total Dry Weight, with spacers (lbs):						13.37

Spacer Moisture Readings (%DB)						
7.8	10.0	9.5	8.0			
10.0	9.2	8.9	8.5			
9.8	8.7	9.6	9.5			
8.7	8.7	9.6	9.2			

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	28.0	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.61	OK
2x4 Fuel Mix	35 - 65 % of total weight	43%	OK

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F 500 V3
 Run #: 6

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/16/2018

Preburn Start Time: 9:25
 Recording Interval (min): 10
 Run Time (min): 60

Elapsed Time (min)	Scale Reading (lbs)	Flue Draft (in H ₂ O)	Temperatures (°F)							
			FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Flue	Ambient
0	6.4	-0.086	597	522	393	693	333	507.6	559	68
10	5.5	-0.070	573	522	419	616	338	493.6	419	67
20	4.8	-0.056	526	492	426	552	333	465.8	379	66
30	4.2	-0.068	487	467	425	512	328	443.8	347	65
40	3.8	-0.057	463	444	420	477	324	425.6	328	65
50	3.6	-0.045	440	425	413	446	323	409.4	309	65
60	3.4	-0.058	421	408	403	420	322	394.8	299	64

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F 500 V3
 Run #: 6
 Test Start Time: 11:26

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/16/2018

Total Sampling Time (min): 300
 Recording Interval (min): 10

	Beginning	Middle	End	Avg.
P _{bar} (in Hg):	30.13	30.1	30.06	30.10

Meter Box γ Factor: 1.002 (A)
 Meter Box γ Factor: 0.997 (B)
 Meter Box γ Factor: 0.999 (Amb)

Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.1963 ft²
 Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 6 inches
 Pitot Tube Cp: 0.99
 Dilution Tunnel Static: -0.210 in H₂O

Post-Test Leak Check

(A) 0.001 cfm @ -14 in. Hg
 (B) 0.000 cfm @ -14 in. Hg
 (AMB) 0.001 cfm @ -14 in. Hg

Ambient Sample Volume: 40.462 ft³

Tunnel Traverse Information									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (in H ₂ O)	0.058	0.066	0.068	0.054	0.058	0.066	0.068	0.052	0.07
Tunnel Temp (°F)	96	96	96	96	96	96	96	96	96

V_{strav}: 16.89 ft/sec
 V_{scant}: 17.94 ft/sec

F_p: 0.942 [ratio]
 Initial Tunnel Flow: 184.8 scf/min

Test Fuel Properties

Default Fuel Values

Fuel Type:	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

Actual Fuel Used Properties

Fuel Type:	D. Fir
HHV (kJ/kg)	19,810
%C	48.73
%H	6.87
%O	43.9
%Ash	0.5
MC (%DB)	20.5

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 6

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/16/2018

Elapsed Time (min)	Particulate Sampling Data							Fuel Weight (lb)		Temperature Data (°F)			
	Gas Meter (ft³)	Sample Rate (cfm)	Dilution Tunnel dP (in H ₂ O)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Scale Reading	Weight Change	Dilution Tunnel	Flue	Filter	Ambient
0	0.001		0.070	0.00	74	-0.14		15.9		120	355	74	73
10	1.406	0.141	0.070	2.19	75	0	97	14.7	-1.2	101	372	74	72
20	2.849	0.144	0.070	2.15	75	-2.52	100	13.9	-0.8	101	373	74	73
30	4.289	0.144	0.070	2.15	76	-2.37	99	12.5	-1.4	100	386	75	73
40	5.734	0.145	0.070	2.16	77	-2.64	100	11.3	-1.2	102	394	76	73
50	7.185	0.145	0.070	2.16	78	-2.5	100	9.9	-1.4	104	412	75	74
60	8.642	0.146	0.070	2.14	78	-1.42	100	8.6	-1.3	102	382	75	74
70	10.110	0.147	0.070	2.15	80	-2.49	101	7.7	-0.9	100	369	74	74
80	11.574	0.146	0.070	2.17	81	-2.37	100	6.8	-0.9	100	361	74	74
90	13.039	0.147	0.070	2.15	80	-2.1	100	5.9	-0.9	99	356	74	74
100	14.506	0.147	0.070	2.14	80	-1.33	100	5.1	-0.8	99	352	75	75
110	15.973	0.147	0.070	2.15	81	-0.22	100	4.5	-0.6	98	343	76	75
120	17.441	0.147	0.070	2.16	82	-2.57	100	3.9	-0.6	98	336	77	76
130	18.911	0.147	0.070	2.16	83	-1.65	100	3.4	-0.5	98	325	78	75
140	20.381	0.147	0.070	2.16	83	0	100	3.1	-0.3	96	319	76	75
150	21.852	0.147	0.070	2.14	82	-1.13	100	2.7	-0.4	97	317	75	75
160	23.323	0.147	0.070	2.14	83	-0.91	100	2.4	-0.3	96	306	75	76
170	24.796	0.147	0.070	2.16	84	-2.49	100	2.2	-0.2	95	287	76	76
180	26.271	0.148	0.070	2.16	84	0	100	2.0	-0.2	94	280	77	76
190	27.745	0.147	0.070	2.18	84	-1.31	100	1.8	-0.2	93	278	74	76
200	29.219	0.147	0.070	2.16	83	-0.36	100	1.6	-0.2	93	274	75	76
210	30.696	0.148	0.070	2.15	83	-0.3	100	1.4	-0.2	93	273	77	76
220	32.170	0.147	0.070	2.16	83	-0.86	100	1.2	-0.2	93	270	75	76
230	33.646	0.148	0.070	2.15	83	-0.62	100	1.1	-0.1	93	271	75	76
240	35.122	0.148	0.070	2.14	84	0	100	0.9	-0.2	93	273	77	76
250	36.595	0.147	0.070	2.14	84	-2.56	100	0.8	-0.1	93	272	74	77
260	38.071	0.148	0.070	2.15	85	-2.52	100	0.6	-0.2	93	274	75	76
270	39.546	0.148	0.070	2.15	84	-0.12	100	0.5	-0.1	93	273	77	77
280	41.020	0.147	0.070	2.14	85	-2.38	100	0.3	-0.2	94	273	75	76
290	42.496	0.148	0.070	2.15	84	-0.24	100	0.1	-0.2	93	270	76	77
300	43.972	0.148	0.070	2.15	85	0	100	0.0	-0.1	93	272	76	77
Avg/Tot	43.972	0.147	0.070	2.08	81	-1.29	100			97	319	75	75.1

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 6

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/16/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)
0	0.001		0.00	73	-1		78	0.000	7.16	0.08
10	1.423	0.142	2.32	74	-0.65	100	78	-0.070	5.50	0.02
20	2.887	0.146	2.30	78	-0.87	102	79	-0.070	9.25	0.03
30	4.353	0.147	2.29	81	-0.72	101	79	-0.070	11.26	0.01
40	5.825	0.147	2.29	85	-0.69	101	78	-0.060	13.09	0.01
50	7.301	0.148	2.26	88	-2.67	101	78	-0.070	14.00	0.08
60	8.782	0.148	2.28	90	-2.93	101	78	-0.060	10.87	0.00
70	10.266	0.148	2.26	92	-2.87	100	79	-0.060	10.41	0.00
80	11.753	0.149	2.27	94	-0.8	100	79	-0.060	10.56	0.00
90	13.244	0.149	2.27	95	-2.11	100	80	-0.060	10.72	0.00
100	14.738	0.149	2.27	97	-0.76	100	80	-0.060	10.15	0.00
110	16.230	0.149	2.27	97	-2.76	100	79	-0.050	9.24	0.00
120	17.725	0.150	2.27	98	-1.66	100	78	-0.060	9.71	0.02
130	19.223	0.150	2.27	99	-1.83	100	79	-0.060	8.39	0.01
140	20.720	0.150	2.28	100	-2.84	100	78	-0.050	7.53	0.00
150	22.217	0.150	2.28	100	-0.7	100	78	-0.060	7.82	0.00
160	23.718	0.150	2.27	101	-0.75	100	78	-0.060	7.01	0.00
170	25.217	0.150	2.25	101	-2.74	99	79	-0.050	6.99	0.00
180	26.716	0.150	2.27	101	-1.69	99	79	-0.050	7.58	0.00
190	28.218	0.150	2.26	101	-0.85	99	80	-0.050	7.51	0.02
200	29.718	0.150	2.26	101	-2.22	99	80	-0.040	7.92	0.00
210	31.218	0.150	2.26	102	-2.74	99	79	-0.050	7.60	0.00
220	32.722	0.150	2.25	102	-2.82	99	78	-0.030	7.48	0.00
230	34.221	0.150	2.27	102	-1.07	99	78	-0.060	7.81	0.01
240	35.723	0.150	2.26	102	-1.55	99	77	-0.050	7.47	0.00
250	37.227	0.150	2.26	102	-2.25	99	78	-0.050	7.48	0.02
260	38.725	0.150	2.27	102	-2.79	99	79	-0.050	7.42	0.00
270	40.230	0.151	2.24	103	-2.78	99	79	-0.040	7.15	0.00
280	41.731	0.150	2.26	103	-0.98	99	80	-0.050	7.21	0.00
290	43.232	0.150	2.25	103	-1.72	99	79	-0.050	7.08	0.00
300	44.736	0.150	2.26	103	-1.08	99	78	-0.050	7.54	0.00
Avg/Tot	44.736	0.149	2.20	96	-1.74	100	79	-0.053	8.61	0.01

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 18-425

Model: F 500 V3

Tracking #: 0011

Run #: 6

Technician: SJB

Date: 10/16/2018

Elapsed Time (min)	Particulate Sampling Data							Flue Gas Data		
	Gas Meter (ft ³)	Sample Rate (cfm)	Orifice dH (in H ₂ O)	Meter Temp (°F)	Meter Vacuum (in Hg)	Pro. Rate (%)	Filter (°F)	Flue Draft (in H ₂ O)	CO ₂ (%)	CO (%)

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Model: F 500 V3

Run #: 6

Job #: 18-425

Tracking #: 0011

Technician: SJB

Date: 10/16/2018

Stove ΔT : 66

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
0	418	407	403	417	322	393.4	570
10	401	370	382	440	316	381.8	804
20	372	341	348	436	306	360.6	824
30	369	343	324	463	297	359.2	907
40	379	367	312	488	289	367.0	966
50	399	409	308	528	283	385.4	1020
60	428	434	312	523	276	394.6	894
70	456	428	317	494	271	393.2	865
80	460	429	322	480	265	391.2	840
90	453	441	326	474	261	391.0	845
100	459	436	331	471	258	391.0	850
110	455	430	334	466	259	388.8	827
120	446	424	335	457	261	384.6	828
130	434	422	336	448	264	380.8	796
140	423	411	337	439	266	375.2	784
150	411	397	335	431	269	368.6	784
160	408	388	335	422	271	364.8	743
170	394	378	335	399	272	355.6	694
180	376	373	338	384	270	348.2	683
190	369	372	342	376	269	345.6	671
200	365	370	347	369	268	343.8	665
210	361	371	347	365	271	343.0	665
220	357	370	346	362	271	341.2	659
230	355	370	344	361	271	340.2	660
240	354	366	342	363	269	338.8	671
250	355	364	338	363	266	337.2	673
260	354	360	335	365	261	335.0	680
270	356	357	331	365	257	333.2	675
280	353	356	328	364	253	330.8	672
290	347	357	329	360	250	328.6	660
300	342	359	329	362	247	327.8	672
Average	394	387	336	420	272	362	760

LAB SAMPLE DATA - ASTM E2515

Client: Jotul
 Model: F 500 V3
 Run #: 6

Job #: 18-425
 Tracking #: 0011
 Technician: SJB
 Date: 10/16/2018

TRAIN A (1st Hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3392	123.2	122.6	0.6
B. Rear filter catch	Filter				0.0
C. Probe catch*	Probe				0.0
D. O-Ring catch*	O-Ring				0.0

Sub-Total Total Particulate, mg: 0.6

TRAIN A (Post 1st hour)

Sample Component	Sample Type	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3393	119.3	119.2	0.1
B. Rear filter catch	Filter	3394	120.5	120.6	-0.1
C. Probe catch*	Probe	12A	116888.1	116888.1	0.0
D. O-Ring catch*	O-Ring	12A	3433.9	3432.6	1.3

Sub-Total Total Particulate, mg: 1.3

Train A Aggregate Total Particulate, mg: 1.9

TRAIN B

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Front filter catch	Filter	3395	123.0	122.5	0.5
B. Rear filter catch	Filter	3396	119.0	119.1	-0.1
C. Probe catch*	Probe	12B	117052.0	117051.9	0.1
D. O-Ring catch*	O-Ring	12B	3405.7	3404.6	1.1

Total Particulate, mg: 1.6

AMBIENT

Sample Component	Reagent	Filter, Probe, or O-Ring #	Weights		
			Final, mg	Tare, mg	Particulate, mg
A. Filter catch*	Filter	3397	120.6	120.6	0.0

Total Particulate, mg: 0.0

*Particulate catch that results in a negative number, is assumed to be zero for probes and O-rings, negative numbers for filters are assumed to be part of the O-Ring weight.

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 6 Test Date: 10/16/2018

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Open 0.126" from fully closed

Preburn Notes

Preburn Start Time: 9:25

Time	Notes
8:12	Loaded 7.5 lbs of kindling
8:35	At 2.2 lbs, Loaded Pre-burn Fuel
9:25	At 6.5 lbs set air to test setting
10:25	Leveled coal bed, zeroed scale in preparation for fuel loading
	FAN CONFIRMATION TEST – FAN OFF FOR DURATION OF TEST

Test Notes

Test Burn Start Time: 10:26
 Test Fuel Loaded by: 30 seconds
 Door Closed: 35 seconds
 Air Control Set at: 5 minutes
 Other Loading Notes: N/A

Time	Notes
60 min	Changed 1-hour filter.
300 min	End of Test
	FAN CONFIRMATION TEST – FAN OFF FOR DURATION OF TEST

Test Burn End Time: 15:26
 Background Filter Volume (ft³): 40.462

Filter Data

Train	A	A	A	A	A	B	B	B	B	AMB
Element	Front Filter (First Hour)	Front Filter (Remainder)	Rear Filter	Probe	O-Ring Pair	Front Filter	Rear Filter	Probe	O-Ring Pair	Filter
ID #	3392	3393	3394	12A	12A	3395	3396	12B	12B	3397
Tare (mg)	122.6	119.2	120.6	116888.1	3432.6	122.5	119.1	117051.9	3404.6	120.6
Final Weight (mg)	123.2	119.3	120.5	116888.1	3433.9	123.0	119.0	117052.0	3405.7	120.6

Sample Train Leak Check: A: 0.001 @ -14 "Hg B: 0.000 @ -14 "Hg AMB: 0.001 @ -14 "Hg

Technician Signature:  Date: 11/16/2018

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 18-425 Tracking #: 0011
 Model: F 500 V3 Run Number: 6 Test Date: 10/16/2018

Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 16.93 CO (%): 4.33
 Mid Gas CO₂ (%): 10.0 CO (%): 2.510

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	8:50	8:55	8:52	15:50	15:52	15:55
CO ₂	0.00	10.07	16.93	0.04	10.10	16.97
CO	0.000	2.494	4.330	-0.008	2.397	4.287

Flue Gas Probe Leak Check: Initial: No Leakage Final: No Leakage

Dilution Tunnel Flow

Pitot Tube Leak Test: Initial: No Leakage Final: No Leakage

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Center
dP (inH ₂ O):	0.058	0.066	0.068	0.054	0.058	0.066	0.068	0.052	0.070
Temp (°F):	96	96	96	96	96	96	96	96	96

Dilution Tunnel Static Pressure (inH₂O): -0.210

Supplemental Data

Room Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs): Initial: 10 Final: 10

Stack Diameter (in): 6

Induced Draft (in H₂O): 0

% Smoke Capture: 100

Flue Pipe Cleaned Prior to First Test in

Series: Date: 10/1/2018

	Initial	Middle	Ending
P _b (inHg)	30.13	30.10	30.06
RH (%)	21.7	16.9	15.8

Technician Signature: [Signature] Date: 11/16/2018

Sample Pre-Test Tare Sheet: ☐ Probes☒ Filters☐ O-RingsDate/Time In Desiccator: 9/17 - 16:00 Balance ID#: 107 Audit Weight ID# / Weight(mg): 104 A - 10mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
3321	9/15/18 - 12:30	121.4	9/26-7:15	121.5	-	-	-	-	SB	18-433 #1
3322		121.4		121.5	-	-	-	-	SB	18-433 #2
3323		123.9		123.9	-	-	-	-	SB	
3324		119.6		119.5	-	-	-	-	SB	
3325		121.2		121.2	-	-	-	-	SB	
3326		122.2		122.1	-	-	-	-	SB	
3327		119.4		119.4	-	-	-	-	SB	18-433 #3
3328		121.1		120.9	-	-	-	-	SB	
3329		122.7		122.6	-	-	-	-	SB	
3330		119.4		119.2	-	-	-	-	SB	
3331		121.0		121.1	-	-	-	-	SB	
3332		123.0		123.1	-	-	-	-	SB	18-425 #1
3333		119.9		119.7	-	-	-	-	SB	
3334		120.4		120.3	-	-	-	-	SB	
3335		122.9		122.8	-	-	-	-	SB	
3336		119.7		119.7	-	-	-	-	SB	
3337		121.1		121.0	-	-	-	-	SB	
3338		123.4		123.5	-	-	-	-	SB	18-425 #2
3339		119.1		118.9	-	-	-	-	SB	
3340		120.9		121.1	-	-	-	-	SB	
3341		123.2		123.0	-	-	-	-	SB	
3342		119.9		119.7	-	-	-	-	SB	
3343		120.7	10/1-7:40	120.7	-	-	-	-	SB	
3344		122.7		122.7	-	-	-	-	SB	18-425 #3
3345		120.9		121.0	-	-	-	-	SB	
3346		121.9		121.8	-	-	-	-	SB	
3347		122.6		122.5	-	-	-	-	SB	
3348		119.2		119.3	-	-	-	-	SB	
3349		121.7		121.5	-	-	-	-	SB	
3350		123.5		123.3	-	-	-	-	SB	18-425 #4

Sample Post-Test Analysis Sheet: ☐ Probes☒ Filters☐ O-Rings

Balance ID#: 107 Audit Weight ID# / Weight (mg): 1094-10mg

Sample ID	Tare (mg)	Date/Time in Desiccator	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials
3321	121.3	9/26-15:45	9/28-9:50	121.3	10/1-7:40	121.3					SB
3322	121.5	9/27-12:35	10/1-7:40	125.8	10/1-15:00	125.9					SB
3323	123.9			123.8		123.9					SB
3324	119.5			124.4		124.4					SB
3325	121.2			120.6		120.8					SB
3326	122.1			122.1		122.1					SB
3327	114.4	9/27-17:05		124.9		125.0					SB
3328	120.9			120.6		120.7					SB
3329	122.6			128.1		128.3					SB
3330	119.2			119.2		119.2					SB
3331	121.1			121.1		121.1					SB
3332	123.1	10/1-16:30	10/2-15:00	123.6	10/3-7:15	123.7	-	-	-	-	SB
3333	119.7			119.9		120.0	-	-	-	-	SB
3334	120.3			119.9		119.9	-	-	-	-	SB
3335	122.8			124.2		124.1	-	-	-	-	SB
3336	119.7			119.7		119.6	-	-	-	-	SB
3337	121.0			121.1		121.0	-	-	-	-	SB
3338	123.5	10/2-17:25	10/3-18:00	124.0	10/4-9:00	124.0	-	-	-	-	SB
3339	118.9			118.8		118.9	-	-	-	-	SB
3340	121.1			120.9		121.0	-	-	-	-	SB
3341	123.0			123.6		123.6	-	-	-	-	SB
3342	119.7			119.8		119.8	-	-	-	-	SB
3343	120.7			120.7		120.7	-	-	-	-	SB
3344	122.7	-	-	-	-	-	-	-	-	-	-
3345	121.0	-	-	-	-	-	-	-	-	-	-
3346	121.8	-	-	-	-	-	-	-	-	-	-
3347	122.5	-	-	-	-	-	-	-	-	-	-
3348	119.3	-	-	-	-	-	-	-	-	-	-
3349	121.5	-	-	-	-	-	-	-	-	-	-
3350	123.3	10/5-7:30	10/15-18:00	123.6	10/15-8:00	123.6	-	-	-	-	SB

Sample Pre-Test Tare Sheet: ☐ Probes☒ Filters☐ O-RingsDate/Time In Desiccator: 9/22 - 10/30 Balance ID#: 107 Audit Weight ID# / Weight(mg): 109A-100mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
3351	10/2 - 13:30	123.4	10/3 - 7:15	123.3	—	—	—	—	SB	18-425 #2
3352		119.7		119.5	—	—	—	—	SB	
3353		121.1		121.1	—	—	—	—	SB	
3354		123.0		123.4	10/4 - 9:00	123.2	—	—	SB	
3355		119.4		119.5	—	—	—	—	SB	18-425 #5
3356		120.9		120.8	—	—	—	—	SB	
3357		123.3		123.0	10/4 - 9:00	123.2	—	—	SB	
3358		119.9		119.5	10/4 - 9:00	119.7	—	—	SB	
3359		121.7		121.7	—	—	—	—	SB	
3360		121.5		121.3	—	—	—	—	SB	
3361		119.8		119.9	—	—	—	—	SB	
3362		122.8		122.7	—	—	—	—	SB	18-421 #1
3363		120.6		120.6	—	—	—	—	SB	
3364		120.0		119.9	—	—	—	—	SB	
3365		123.4		123.5	—	—	—	—	SB	
3366		120.5		120.6	—	—	—	—	SB	
3367		121.0		121.0	—	—	—	—	SB	18-421 #2
3368		122.4		122.4	—	—	—	—	SB	
3369		119.2		119.3	—	—	—	—	SB	
3370		121.5		121.4	—	—	—	—	SB	
3371		123.0		123.0	—	—	—	—	SB	
3372		119.5		119.3	—	—	—	—	SB	18-421 #3
3373		121.4		121.3	—	—	—	—	SB	
3374		122.8		122.8	—	—	—	—	SB	
3375		119.9		119.9	—	—	—	—	SB	
3376		121.2		121.3	—	—	—	—	SB	
3377		122.9		123.0	—	—	—	—	SB	18-421 #4
3378		121.1		121.1	—	—	—	—	SB	
3379		119.6		119.7	—	—	—	—	SB	
3380		120.9		120.9	—	—	—	—	SB	

Sample Post-Test Analysis Sheet: ☐ Probes☒ Filters☐ O-RingsBalance ID#: 107 Audit Weight ID# / Weight (mg): 109A-100mg

Sample ID	Tare (mg)	Date/ Time in Desiccator	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Tech. Initials
3351	123.3	10/5-7:30	10/13-11:00	124.0	10/15-8:00	123.4 124.1	-	-	-	-	SB
3352	119.5			119.4		119.4	-	-	-	-	SB
3353	121.1			122.0		122.0	-	-	-	-	SB
3354	123.2			122.3		122.3	-	-	-	-	SB
3355	119.5			119.4		119.5	-	-	-	-	SB
3356	122.8	10/5-13:30		121.3		121.2	-	-	-	-	SB
3357	124.2			123.4		123.4	-	-	-	-	SB
3358	119.3			119.6		119.6	-	-	-	-	SB
3359	121.3			122.2		122.3	-	-	-	-	SB
3360	121.3			121.0		120.9	-	-	-	-	SB
3361	119.9			119.9		119.9	-	-	-	-	SB
3362	122.7	10/13-11:00	10/15-8:00	123.3	10/15-16:00	123.3	-	-	-	-	SB
3363	120.6			121.3		121.4	-	-	-	-	SB
3364	119.9			119.9		119.9	-	-	-	-	SB
3365	123.5			124.0		124.1	-	-	-	-	SB
3366	120.6			120.7		120.7	-	-	-	-	SB
3367	121.0			121.2		121.3	-	-	-	-	SB
3368	122.4			122.7		122.7	-	-	-	-	SB
3369	119.3			118.9		118.9	-	-	-	-	SB
3370	121.4			122.3		122.3	-	-	-	-	SB
3371	123.0			122.5		122.6	-	-	-	-	SB
3372	119.3			120.5		120.6	-	-	-	-	SB
3373	121.3			122.3		122.3	-	-	-	-	SB
3374	122.6			122.7		122.6	-	-	-	-	SB
3375	119.9			23+22 121.2		121.2	-	-	-	-	SB
3376	121.3			121.2		121.2	-	-	-	-	SB
3377	123.0			126.4		126.5	-	-	-	-	SB
3378	121.1			121.2		121.2	-	-	-	-	SB
3379	119.7			119.4		119.4	-	-	-	-	SB
3380	120.9			125.0		124.9	-	-	-	-	SB

Sample Pre-Test Tare Sheet: ☐ Probes☒ Filters☐ O-RingsDate/Time In Desiccator: 9/27 - 10:30 Balance ID#: 107 Audit Weight ID# / Weight(mg): 109A-100mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
3381	10/4 - 9/100	123.0	10/5 - 845	122.9	-	-	-	-	SB	18-421 #4
3382		120.1		120.0	-	-	-	-	SB	18-421 #5
3383		121.0		121.1	-	-	-	-	SB	18-421 #5
3384		123.2		123.1	-	-	-	-	SB	
3385		120.8		120.7	-	-	-	-	SB	
3386		123.2		123.3	-	-	-	-	SB	
3387		119.4		119.4	-	-	-	-	SB	18-421 #6
3388		119.8		119.9	-	-	-	-	SB	
3389		123.3		123.4	-	-	-	-	SB	
3390		119.4		119.5	-	-	-	-	SB	
3391		120.9		120.9	-	-	-	-	SB	
3392		122.7		122.6	-	-	-	-	SB	18-421 #6
3393		119.2		119.2	-	-	-	-	SB	
3394		120.7		120.6	-	-	-	-	SB	
3395		122.4		122.5	-	-	-	-	SB	
3396		119.1		119.1	-	-	-	-	SB	
3397		120.7		120.6	-	-	-	-	SB	
3398		120.2		120.4	-	-	-	-	SB	18-421 #7
3399		123.5		123.5	-	-	-	-	SB	
3400		120.6		120.7	-	-	-	-	SB	
3401		119.9		120.0	-	-	-	-	SB	
3402		123.2	10/5 - 13:00	123.3	-	-	-	-	SB	
3403		121.4		121.4	-	-	-	-	SB	18-421 #8
3404		119.1		119.2	-	-	-	-	SB	
3405		120.9		120.9	-	-	-	-	SB	
3406		117.4		117.4	-	-	-	-	SB	
3407		121.2		121.4	-	-	-	-	SB	
3408		122.3		122.3	-	-	-	-	SB	18-421 #8
3409		118.4		118.4	-	-	-	-	SB	
3410		119.7		119.5	-	-	-	-	SB	

Sample Post-Test Analysis Sheet: ☐ Probes☒ Filters☐ O-RingsBalance ID#: 107 Audit Weight ID# / Weight (mg): 109A-100mg

Sample ID	Tare (mg)	Date/ Time in Desiccator	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Tech. Initials
3381	122.9	10/13-11:00	10/15-9:00	122.8	10/15-16:00	122.9	-	-	-	-	SB
3382	120.0			120.3		120.4	-	-	-	-	SB
3383	121.1			126.2		126.1	-	-	-	-	SB
3384	123.1			122.9		122.9	-	-	-	-	SB
3385	120.7			126.8		126.7	-	-	-	-	SB
3386	123.3			123.4		123.4	-	-	-	-	SB
3387	119.4			120.4		120.4	-	-	-	-	SB
3388	119.9			122.5		122.6	-	-	-	-	SB
3389	123.4			122.9		123.0	-	-	-	-	SB
3390	119.5			122.9		123.0	-	-	-	-	SB
3391	120.9			120.5		120.6	-	-	-	-	SB
3392	122.6	10/16-15:40	10/17-16:00	123.2	10/19-8:00	123.2	-	-	-	-	SB
3393	119.2			119.3		119.3	-	-	-	-	SB
3394	120.6			120.6		120.5	-	-	-	-	SB
3395	122.5			122.9		123.0	-	-	-	-	SB
3396	119.1			119.0		119.0	-	-	-	-	SB
3397	120.6			120.7		120.6	-	-	-	-	SB
3398	120.4	10/25-8:15	10/26/18-8:30	120.4	10/28-14:30	120.5	-	-	-	-	SB
3399	123.5			124.1		124.1	-	-	-	-	SB
3400	120.7			120.4		120.3	-	-	-	-	SB
3401	120.0			121.1		121.1	-	-	-	-	SB
3402	123.3			123.0		123.1	-	-	-	-	SB
3403	121.4			123.3		123.3	-	-	-	-	SB
3404	119.2			119.0		119.0	-	-	-	-	SB
3405	120.9			121.0		121.0	-	-	-	-	SB
3406	117.4			120.8		120.8	-	-	-	-	SB
3407	121.4			121.7		121.7	-	-	-	-	SB
3408	-	-	-	-	-	-	-	-	-	-	-
3409	-	-	-	-	-	-	-	-	-	-	-
3410	-	-	-	-	-	-	-	-	-	-	-

Sample Pre-Test Tare Sheet: ☒ Probes☐ Filters☐ O-RingsDate/Time In Desiccator: 9/24-8:00 Balance ID#: 107 Audit Weight ID# / Weight(mg): 1098-200mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
1A	9/27-7:30	115629.0	9/28-9:30	115628.6	10/1-7:40	115628.8	-	-	JB	18-425 #1
1B		115909.1		115909.1	-	-	-	-	JB	18-425 #1
2A		116240.5		116240.5	-	-	-	-	SB	18-425 #2
2B		116330.5		116330.6	-	-	-	-	SB	18-425 #2
3A		116073.9		116073.9	-	-	-	-	SB	18-425 #3
3B		116340.6		116340.9	10/1-7:40	116340.8	-	-	JB	18-425 #3
4A		116185.2		116185.3	-	-	-	-	SB	18-425 #4
4B		116365.9		116366.0	-	-	-	-	SB	18-425 #4
5A		116730.2		116730.2	-	-	-	-	SB	18-425 #5
5B		116880.4		116880.5	-	-	-	-	JB	18-425 #5
6A		116564.9		116565.1	-	-	-	-	SB	18-421 #1
6B		116117.4		116117.4	-	-	-	-	SB	18-421 #1
7A	10/3-7:15	116740.0		116740.1	-	-	-	-	SB	18-421 #2
7B		117304.9		117305.0	-	-	-	-	SB	18-421 #2
8A		116829.7		116829.9	-	-	-	-	SB	18-421 #3
8B		116825.4		116825.4	-	-	-	-	SB	18-421 #3
9A		116713.4		116713.2	-	-	-	-	SB	18-421 #4
9B		117134.9		117135.2	10/6-8:25	117135.3	-	-	SB	18-421 #4
10A		116826.5		116826.3	-	-	-	-	SB	18-421 #5
10B		117168.0		117167.5	10/5-5:25	117167.5	-	-	SB	18-421 #5
11A		117074.7		117074.8	-	-	-	-	SB	18-421 #6
11B		116673.9		116674.0	-	-	-	-	SB	18-421 #6
12A		116888.0		116888.1	-	-	-	-	SB	18-425 #6
12B		117051.8		117051.9	-	-	-	-	SB	18-425 #6
13A		117456.4		117456.5	-	-	-	-	SB	18-421 #7
13B		117065.3		117065.2	-	-	-	-	SB	18-421 #7
14A	10/19-8:50	116816.1	10/22-8:50	116816.2	-	-	-	-	SB	18-421 #8
14B	10/19-8:00	116740.3	10/22-8:00	116740.2	-	-	-	-	SB	18-421 #8

Sample Post-Test Analysis Sheet: ☒ Probes☐ Filters☐ O-Rings

Balance ID#: 107 Audit Weight ID# / Weight (mg): 1028-200 mg

Sample ID	Tare (mg)	Date/Time in Desiccator*	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials
1A	115228.8	10/1-14:30	10/2-17:00	115224.7	10/3-7:15	115229.1	10/4-9:00	115229.0	-	-	SB
1B	115903.1	10/1-14:30	10/2-17:00	115903.9	10/3-7:15	115903.2	10/4-9:00	115903.1	-	-	SB
2A	116240.5	10/1-14:30	10/3-18:00	116240.4	10/4-9:00	116240.5	-	-	-	-	JS
2B	116330.6	10/1-17:45	10/3-13:00	116330.7	10/4-9:00	116330.6	-	-	-	-	SB
3A	116073.9	-	-	-	-	-	-	-	-	-	SB
3B	116340.8	-	-	-	-	-	-	-	-	-	SB
4A	116183.3	10/5-7:30	10/13-11:00	116183.5	10/15-8:00	116183.4	-	-	-	-	SB
4B	116366.0	10/5-7:30	10/13-11:00	116366.2	10/15-8:00	116366.1	-	-	-	-	SB
5A	116320.2	10/5-13:30	10/13-11:00	116320.4	10/15-8:00	116320.4	-	-	-	-	SB
5B	116380.5	10/5-13:30	10/13-11:00	116380.3	10/15-8:00	116380.7	-	-	-	-	SB
6A	116565.1	10/13-11:00	10/15-8:00	116565.0	10/15-16:00	116565.1	-	-	-	-	SB
6B	116117.4	-	10/15-8:00	116117.4	10/15-16:00	116117.4	-	-	-	-	SB
7A	116340.1	-	10/15-8:00	116340.2	10/15-16:00	116340.1	-	-	-	-	SB
7B	117303.0	-	10/15-8:00	117303.1	10/15-16:00	117303.2	-	-	-	-	SB
8A	116829.7	-	10/15-8:00	116829.7	10/15-16:00	116829.8	-	-	-	-	SB
8B	116825.4	-	10/15-8:00	116825.2	10/15-16:00	116825.3	-	-	-	-	SB
9A	116713.2	-	10/15-8:00	116713.6	10/15-16:00	116713.6	-	-	-	-	SB
9B	117135.2	-	10/15-8:00	117135.6	10/15-16:00	117135.6	-	-	-	-	SB
10A	116826.3	-	10/15-8:00	116826.5	10/15-16:00	116826.4	-	-	-	-	SB
10B	117467.3	-	10/15-8:00	117468.1	10/15-16:00	117467.9	-	-	-	-	SB
11A	117034.8	-	10/15-8:00	117034.9	10/15-16:00	117034.9	-	-	-	-	SB
11B	116674.0	-	10/15-8:00	116673.3	10/15-16:00	116673.9	-	-	-	-	SB
12A	116886.1	10/16-15:40	10/17-16:00	116889.0	10/17-8:00	116888.1	-	-	-	-	SB
12B	117051.9	10/16-15:40	10/17-16:00	117052.1	10/17-8:00	117052.0	-	-	-	-	SB
13A	117456.5	10/15-8:15	10/26-8:30	117456.5	10/28-14:30	117456.6	-	-	-	-	SB
13B	117065.2	10/15-8:15	10/26-8:30	117065.1	10/28-14:30	117065.3	-	-	-	-	SB
14A	116810.2	10/15-8:15	10/26-8:30	116816.3	10/28-14:30	116816.3	-	-	-	-	SB
14B	116730.2	10/15-8:15	10/26-8:30	116730.2	10/28-14:30	116730.1	-	-	-	-	SB

Sample Pre-Test Tare Sheet: ☐ Probes☐ Filters☒ O-Rings

Date/Time In Desiccator: 9/24 - 8:00

Balance ID#: 107

Audit Weight ID# / Weight(mg): 109B-200mg

Sample ID	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Date/Time	Weight (mg)	Tech. Initials	Project/Run #
1A	9/27-7:30	3566.5	9/28-9:30	3566.5	-	-	-	-	SB	18-425 #1
1B		3555.0		3554.9	-	-	-	-	SB	18-425 #1
2A		3552.5		3552.4	-	-	-	-	SB	18-425 #2
2B		3571.2		3571.0	-	-	-	-	SB	18-425 #2
3A		3580.5		3579.8	10/1-7:40	3580.0	-	-	SB	18-425 #3
3B		3568.8		3568.3	10/1-7:40	3568.3	-	-	SB	18-425 #3
4A		3593.2		3593.2	-	-	-	-	SB	18-425 #4
4B		3580.9		3581.0	-	-	-	-	SB	18-425 #4
5A		3534.3		3534.4	-	-	-	-	SB	18-425 #5
5B		3530.7		3530.7	-	-	-	-	SB	18-425 #5
6A		3615.5		3615.6	-	-	-	-	SB	18-425 #1
6B		3396.5		3396.5	-	-	-	-	SB	18-425 #1
7A	10/3-7:15	3573.4	10/4-9:00	3573.4	-	-	-	-	SB	18-421 #2
7B		3521.4		3521.7	10/3-8:25	3521.8	-	-	SD	18-421 #2
8A		3551.5		3551.3	-	-	-	-	SB	18-421 #3
8B		3584.8		3584.8	-	-	-	-	SB	18-421 #3
9A		3581.0		3581.1	-	-	-	-	SB	18-421 #4
9B		3523.8		3523.8	-	-	-	-	SB	18-421 #4
10A		3430.9		3430.9	-	-	-	-	SB	18-421 #5
10B		3569.9		3570.1	-	-	-	-	SB	18-421 #5
11A		3423.8		3424.0	-	-	-	-	SB	18-421 #6
11B		4234.7		4234.6	-	-	-	-	SB	18-421 #6
12A		3432.4		3432.6	-	-	-	-	SD	18-425 #6
12B		3404.6		3404.6	-	-	-	-	SB	18-425 #6
13A		3461.7		3460.7	10/5-8:05	3460.8	-	-	SB	18-421 #7
13B		3501.1		3500.5	10/5-8:25	3500.6	-	-	SB	18-421 #7
14A	10/19-8:00	3367.2	10/22-8:00	3366.8	-	-	-	-	SB	18-421 #8
14B	10/19-8:00	3341.6	10/22-8:00	3340.6	-	-	-	-	SB	18-421 #8

Sample Post-Test Analysis Sheet: ☐ Probes☐ Filters☒ O-RingsBalance ID#: 107 Audit Weight ID# / Weight (mg): 1048-2amg

Sample ID	Tare (mg)	Date/ Time in Desiccator	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Date/ Time	Weight (mg)	Tech. Initials
1A	3566.5	10/11-16:30	10/12-17:00	3567.3	10/13-7:15	3567.2	-	-	-	-	JB
1B	3554.9	10/11-16:30	10/12-17:00	3555.6	10/13-7:15	3555.6	-	-	-	-	JB
2A	3552.4	10/12-17:15	10/13-18:00	3553.4	10/14-9:00	3553.5	-	-	-	-	JB
2B	3571.0	10/12-17:15	10/13-18:00	3571.8	10/14-9:00	3571.8	-	-	-	-	JB
3A	3580.0	-	-	-	-	-	-	-	-	-	JB
3B	3568.3	-	-	-	-	-	-	-	-	-	JB
4A	3593.2	10/15-7:30	10/15-10:00	3593.9	10/15-9:00	3593.8	-	-	-	-	JB
4B	3581.0	10/15-7:30	10/15-11:00	3581.6	10/15-8:00	3581.6	-	-	-	-	JB
5A	3594.4	10/15-13:30	10/15-11:00	3595.2	10/15-9:00	3595.3	-	-	-	-	JB
5B	3590.7	10/15-13:30	10/15-11:00	3591.7	10/15-9:00	3591.7	-	-	-	-	JB
6A	3615.6	10/15-12:00	10/15-8:00	3615.9	10/15-16:00	3615.8	-	-	-	-	JB
6B	3596.5	-	10/15-8:00	3597.3	10/15-11:00	3597.3	-	-	-	-	JB
7A	3573.4	-	10/15-8:00	3574.5	10/15-16:00	3574.5	-	-	-	-	JB
7B	3571.8	-	10/15-8:00	3572.9	10/15-16:00	3573.0	-	-	-	-	JB
8A	3591.3	-	10/15-8:00	3592.0	10/15-16:00	3592.0	-	-	-	-	JB
8B	3584.8	-	10/15-8:00	3585.9	10/15-16:00	3586.0	-	-	-	-	JB
9A	3581.1	-	10/15-8:00	3582.2	10/15-16:00	3582.2	-	-	-	-	JB
9B	3523.8	-	10/15-8:00	3525.0	10/15-16:00	3524.9	-	-	-	-	JB
10A	3430.9	-	10/15-8:00	3432.1	10/15-16:00	3432.2	-	-	-	-	JB
10B	3530.1	-	10/15-8:00	3531.2	10/15-16:00	3531.1	-	-	-	-	JB
11A	3414.0	-	10/15-8:00	3425.1	10/15-16:00	3425.1	-	-	-	-	JB
11B	4254.6	-	10/15-8:00	4236.2	10/15-16:00	4236.2	-	-	-	-	JB
12A	3432.6	10/16-15:40	10/17-10:00	3434.0	10/19-8:00	3433.9	-	-	-	-	JB
12B	3404.6	10/16-15:40	10/17-16:00	3405.7	10/19-8:00	3405.7	-	-	-	-	JB
13A	3410.8	10/16-8:15	10/16-8:30	3411.7	10/18-14:30	3411.7	-	-	-	-	JB
13B	3500.6	10/15-8:15	10/16-8:30	3501.4	10/18-14:30	3501.3	-	-	-	-	JB
14A	3366.8	10/15-8:15	10/16-8:30	3367.9	10/18-14:30	3367.9	-	-	-	-	JB
14B	3340.6	10/15-8:15	10/16-8:30	3342.0	10/18-14:30	3342.1	-	-	-	-	JB

EPA Method 28R Weighted Average Emissions

Client: Jotul
 Stove Model: F 500 V3
 Test Dates: 10/1/2018 - 10/5/2018
 Job Number: 18-425

Signature/Date: _____

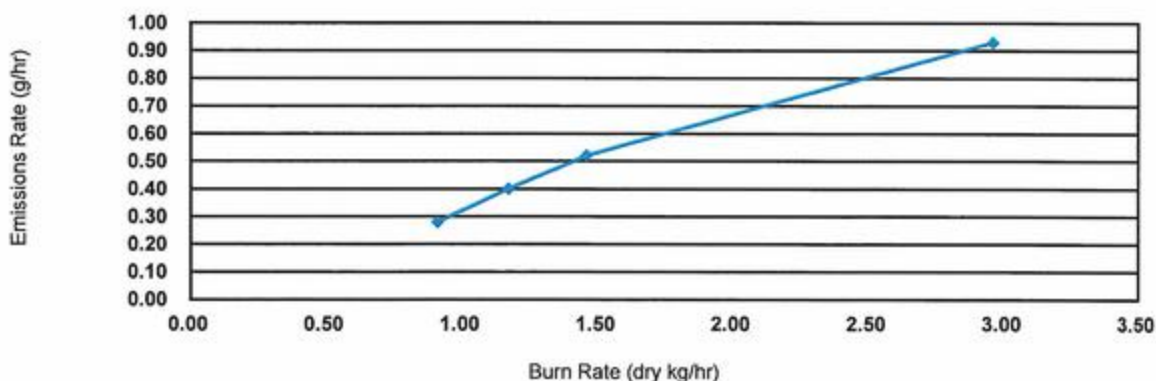
10/17/2018

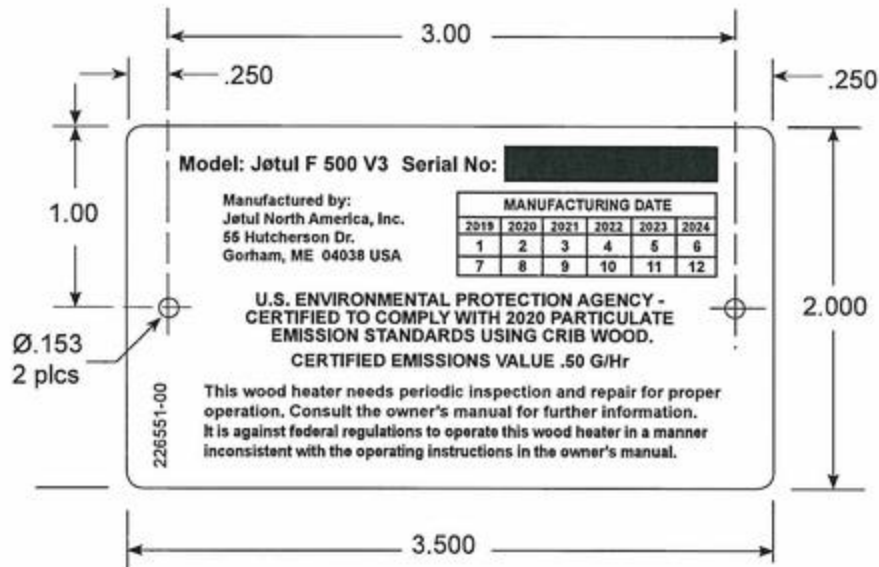
Weighted Average Particulate Emissions (g/hr):	0.5
Weighted Average HHV Efficiency (%):	78.4%
Weighted Average LHV Efficiency (%):	84.7%
Average CO Emissions (g/min):	0.5

Individual Run Summaries

Run Number:	4	Run Number:	2
Burn Rate (dry kg/hr):	0.91	Burn Rate (dry kg/hr):	1.17
Emissions Rate (g/hr):	0.28	Emissions Rate (g/hr):	0.40
HHV Efficiency (%):	83.2%	HHV Efficiency (%):	80.6%
LHV Efficiency (%):	89.9%	LHV Efficiency (%):	87.1%
Weighting Percentage (%):	30.62%	Weighting Percentage (%):	25.14%
Run Number:	1	Run Number:	5
Burn Rate (dry kg/hr):	1.46	Burn Rate (dry kg/hr):	2.96
Emissions Rate (g/hr):	0.52	Emissions Rate (g/hr):	0.93
HHV Efficiency (%):	75.7%	HHV Efficiency (%):	70.5%
LHV Efficiency (%):	81.9%	LHV Efficiency (%):	76.2%
Weighting Percentage (%):	28.00%	Weighting Percentage (%):	16.23%

Emission Rate vs Burn Rate Plot





EPA 2020 Serial Label - F 500 V3 PN 226551 REV 00

SPECIFICATIONS:

- 3.5" x 2.0"
- .013" aluminum
- .153" clearance hole, Two
- Corners radiused .125"
- Serialization begins at 00001001
- Prints one side only, 100% Black



Jøtul North America, Inc.
55 Hutcherson Dr. Gorham, ME 04084

207-591-6601
FAX: 207-591-6606

Jøtul F 500 V3

Jøtul F 500 V3 Catalytic Wood Heater

Classic and Clean Face Models

Installation and Operating Instructions for the United States and Canada



Classic



Clean Face

- The Jøtul F 500 V3 wood stove is listed to burn solid wood only. Do not burn any other fuels.
- Read this entire manual before you install and use this appliance.
- Save these instructions for future reference and make them available to anyone using or servicing the fireplace insert.
- This wood heater contains a catalytic combustor that requires periodic inspection and repair for proper operation. See this manual for specific maintenance information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in this owner's manual, or if the catalytic element is deactivated or removed.



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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 OPERATING INSTRUCTIONS IN THIS MANUAL.

This heater meets the 2020 U.S. Environmental Protection Agency's emission limits for wood heaters manufactured after May 15, 2020.

Standards

The Jøtul F 500 V3 solid fuel heater has been tested and listed to:
U.S. Standards: ANSI/UL 737 and ANSI/UL 1482.
Canada Standards: CAN/ULC-S627-M09 and CAN/ULC-S628-M00

Certified Safety Tests performed by:

Intertek Testing Services, Middleton, Wisconsin U.S.A.

Manufactured by:

Jøtul North America, Inc.
55 Hutcherson Drive
Gorham, Maine 04038, USA

A French language version of this manual is available to download at www.jotul.ca.

Télécharger la version française de ce manuel à l'adresse www.jotul.ca.

NOTE: It is normal for a new, painted stove to emit odor and smoke during initial fires, depending upon temperatures over time. This is caused by the curing of high temperature paint and manufacturing materials. This condition can be alleviated by opening a window or door to provide additional ventilation. See Break-in Procedure, Sect. 5 for details.

Combustion Specifications

Heat Output Range: ¹	13,200 to 37,000 BTU/hr. (3.9-10.8 kW)
Max. Heat Output:	70,000 BTU/hr.
Heating Capacity: ²	Up to 2000 sq. ft.
Maximum Burn Time: ²	Up to 9 hours
EPA Efficiency: ³	HHV: 78.40% LHV: 84.73%
CO Emissions: ⁴	.50 g/min.
Pariculate Emissions: ⁵	.50 g/hr.
Fuel:	Up to 24" Logs (609 mm)

- ¹ Heat Output Range results are determined during specific emissions tests established by the EPA. The Maximum Heat Output value is representative of a more frequent re-fueling cycle than specified in the EPA High Heat Output test method.
- ² Heating Capacity and Maximum Burn Time will vary depending on design of home, climate, wood type and operation
- ³ EPA Validated Efficiency:
High Heat Value and Low Heat Value are obtained per CSA B415.1-10 test method. HHV calculation encompasses all products of combustion, including H₂O condensation. LHV calculation includes H₂O in its vapor state. Simply put, HHV assumes all the water component is in a liquid state (condensed) at the end of combustion and that heat recovered from condensation can be put to use.
- ⁴ Carbon Monoxide Emissions rate results from Test Method CSA B415.1-10.
- ⁵ Particulate Emissions rate is obtained using EPA Test Method 28-R.

See Sect. 5.0 of this manual for important information regarding the safe, proper, and most efficient operation of your stove.

Always follow the guidelines presented in this manual when installing, operating, and maintaining this appliance and make them available to anyone using or servicing the stove.

Check Building Codes

Your city, town, county or province may require a building permit to install a solid fuel burning appliance.

In the U.S., the National Fire Protection Association's Code, NFPA 211, *Standards for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances*, or similar regulations, may apply to the installation of a solid fuel burning appliance in your area.

In Canada, the guideline is established by the CSA Standard, CAN/CSA-B365-M93, *Installation Code for Solid-Fuel-Burning Appliances and Equipment*.

Always consult your local building inspector or authority having jurisdiction to determine what regulations apply in your area.

Safety Notices

- BURN SOLID, NATURAL WOOD FUEL ONLY. DO NOT BURN ANY OTHER FUEL.
- DO NOT USE CHEMICALS OR FLUIDS TO START A FIRE. DO NOT BURN GARBAGE OR FLAMMABLE FUELS.
- DO NOT USE A GRATE OR ELEVATE THE FIRE. BUILD THE FIRE DIRECTLY ON THE HEARTH.
- IF THIS ROOM HEATER IS NOT PROPERLY INSTALLED, A HOUSE FIRE MAY RESULT. TO REDUCE THE RISK OF FIRE, FOLLOW THE INSTRUCTIONS IN THIS MANUAL. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY, OR LOSS OF LIFE.
- CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION REQUIREMENTS IN YOUR AREA.
- ANY EXISTING CHIMNEY SYSTEM MUST BE INSPECTED BEFORE INSTALLATION OF THIS APPLIANCE.
- DO NOT CONNECT THIS STOVE TO ANY AIR DISTRIBUTION DUCT OR SYSTEM.
- EXTREMELY HOT WHILE IN OPERATION! KEEP CHILDREN, CLOTHING, AND FURNITURE AWAY. CONTACT WILL CAUSE SKIN BURNS. USE A CHILD GUARD SCREEN TO PREVENT ACCIDENTAL CONTACT BY SMALL CHILDREN.
- INSTALL SMOKE DETECTORS IN THE LIVING AREA AND BEDROOMS OF YOUR HOME. TEST THEM REGULARLY AND INSTALL FRESH BATTERIES TWICE ANNUALLY.

WHEN INSTALLED IN THE SAME ROOM AS THE STOVE, A SMOKE OR CARBON MONOXIDE DETECTOR SHOULD BE LOCATED AS FAR FROM THE STOVE AS POSSIBLE TO PREVENT THE ALARM SOUNDING WHEN ADDING FUEL.

- Avoid creating a low pressure condition in the room where the stove is operating. Be aware that operation of an exhaust fan or clothes dryer can create a low pressure area and consequently promote flow reversal through the stove and chimney system. In some cases, the optional Outside Air Kit #154335 can be used to alleviate this condition. The chimney and building, however, always work together as a system - provision of outside air, directly or indirectly to an atmospherically vented appliance will not guarantee proper chimney performance. Consult your local Jøtul authorized dealer regarding specific installation/performance issues.
- Jøtul strongly recommends that this stove be installed by a professional solid fuel technician, or that you consult one if you do the work yourself. Also, consult your insurance company regarding any other specific requirements.



We suggest that our woodburning hearth products be installed and serviced by professionals who are certified in the U.S. by the National Fireplace Institute® (NFI) as NFI Woodburning Specialists or who are certified in Canada by Wood Energy Technical Training (WETT).



1. Installation

1.1 Assembly before Installation

The Jøtul F 500 V3 is shipped with the flue collar, gasket, and combustor monitor inside the stove.

- **Flue Collar Gasket:** Remove the protective tape and apply the gasket to the channel around the flue opening.
- **Install Flue Collar:** Use the supplied M8 bolt, washer and nut to secure the collar to the stove in the appropriate top or rear exit position. Reach through the collar opening to fasten the washer and nut to each bolt.
- Take out the ash lips, which are inside the burn chamber, and install. The one in front is placed loosely on top of the base plate, while the side ash lip is fastened with the screw that is pre-installed on the base plate.

2. Chimney and Chimney Connector Requirements

2.1 Chimney Connector

The chimney connector is a single walled pipe used to connect the stove to the chimney. For use with the Jøtul F 500 V3, the chimney connector **must** be 6" (152mm) in diameter, with a minimum thickness of 24 gauge black steel.

- Aluminum and Galvanized steel pipe is not acceptable for use with the Jøtul F 500 V3. These materials cannot withstand the extreme temperatures of a wood fire and can give off toxic fumes when heated.
- **Do not use the connector pipe as a chimney.**
- Each chimney connector or stove pipe section must be installed to the stove flue collar and to each other with the male (crimped) end toward the stove. See **figure 2**. This prevents any amount of condensed or liquid creosote from running down the outside of the pipe or the stove top.
- All joints, including the flue collar connection must be secured with three sheet metal screws.
- For the best performance the chimney connector should be as short and direct as possible, with no more than two 90° elbows.
- **The maximum horizontal run is 36" (915mm) and a recommended total length of stove pipe should not exceed 10 feet.**
- Horizontal runs must slope upward 1/4" (6,35mm) per foot toward the chimney.

- No part of the chimney connector may pass through an attic or roof space, closet or other concealed space, or through a floor or ceiling.
- All sections of the chimney connectors must be accessible for cleaning.
- Where passage through a wall or partition of combustible construction is desired, the installation must conform with NFPA 211 or CAN/CSA-B365, and is also addressed in this manual.
- **Do not connect this unit to a chimney flue servicing another appliance.**

2.2 General Chimney Requirements

There are two types of chimneys suitable for the Jøtul F 500 V3:

1. A code-approved masonry chimney and flue liner.
2. A prefabricated chimney complying with the requirements for Type HT (2100°F) chimneys per UL 103 or ULC S629.

An existing chimney system must pass a UL 1482 Level II inspection conducted by a qualified technician or building official.

The chimney flue size should not be less than the cross-sectional area of the stove flue collar, and not more than three times greater than the cross-sectional area of the flue collar.

Chimney Considerations

When choosing a chimney type and location in the house, keep this in mind: it is the chimney that makes the stove work, **not** the stove that makes the chimney work. The chimney allows the temperature difference between inside and outside air to create suction, called "draft", which pulls air through the stove necessary to support combustion. Since draft is the force which moves air from the stove up through the chimney, its strength is critical to proper stove function. Besides air pressure differential, draft strength is affected other factors including:

- chimney condition and height
- surrounding construction, other buildings
- nearby trees, local geography
- wind conditions and climate

Any of the preceding conditions can adversely affect performance. Weak or erratic draft can cause "backpuffing" - a condition when smoke leaks into the room through the stove or chimney connector joints. Poor draft will also make it difficult to maintain a steady, controlled burn and lead to creosote accumulation in the chimney or combustor.

A short, masonry chimney on the exterior of a house will promote poor performance. This is because

it will be difficult to initiate and maintain temperatures warm enough to sustain adequate draft. In extremely cold northern areas, it may be necessary to reline the chimney or extend its height to help improve performance. Conversely, a tall, masonry chimney inside the house will warm more quickly and retain heat longer.

On the other hand, overly strong draft can also cause a different set of issues such as excessive temperatures and short burn times.

Ideally, whether masonry or prefabricated, the chimney should be centrally located inside the house where it will be least affected by exterior conditions and the stove's radiant heat can be most evenly dispersed.

The following guidelines give the necessary chimney requirements based on the national code (ANSI-NFPA 211 for the US. And CSA CAN-B365 for Canada). However, many local codes differ from the national code to take into account climate, altitude, or other factors.

NOTE: Consult your local code authority to determine what building and fire codes apply in your area before installing your new stove. Your local inspector has final authority in approving your installation.

2.3 Masonry Chimneys

A masonry chimney must conform to the following guidelines:

- The chimney flue size should not be less than the cross-sectional area of the stove flue collar.
- The cross-sectional area of the flue of a chimney with no walls exposed to the outside below the roofline shall not be more than three times the cross-sectional area of the stove flue collar.
- The cross-sectional area of the flue of a chimney with one or more walls exposed to the outside below the roofline shall not be more than two times the cross-sectional area of the stove flue collar.
- Larger chimney flues should be relined with a listed or code approved liner.
- The masonry chimney must have a fireclay liner or equivalent, with a minimum thickness of 5/8" (16mm) and must be installed with refractory mortar. There must be at least 1/4" (6,35mm) air space between the flue liner and chimney wall.
- The fireclay flue liner must have a nominal size of 8" X 8", and should not be larger than 8" X 12". If a round fireclay liner is to be used it must have a minimum inside diameter of 6" (157mm) and not larger than 8" (208mm) in diameter.

- If a chimney with larger dimensions is to be used, it should be relined with an appropriate liner that is code approved.
- The masonry wall of the chimney, if brick or modular block, must be a minimum of 4" (106mm) nominal thickness. A mountain or rubble stone wall must be at least 12" (310mm) thick.
- A newly-built chimney must conform to local codes and in their absence must recognize national regulations. When using an existing chimney, it must be inspected by a licensed professional chimney sweep, fire official, or code officer, to ensure that the chimney is in proper working order.
- No other appliance can be vented into the same flue.
- An airtight clean-out door should be located at the base of the chimney.

2.4 Prefabricated Chimneys

A prefabricated metal chimney must be tested and listed for use with solid fuel burning appliances to High Temperature (HT) Chimney Standard UL 103 for the U.S. and High Temperature Standard ULC S-629 for Canada.

The manufacturer's installation instructions must be followed precisely. Always maintain the proper clearance to combustibles as established by the pipe manufacturer. This clearance is usually a minimum of 2" (56mm), although it may vary by manufacturer or for certain chimney components.

2.5 Chimney Height

The minimum chimney height is 15 feet (4.57 m). The chimney must also be at least 3 feet higher than the highest point where it passes through the roof and at least 2 feet higher than the highest part of the roof or structure that is within 10 feet of the chimney, measured horizontally. See figure 3.

Chimneys shorter than 14 feet may not provide adequate draft. This could result in smoke spilling into the room from the stove when loading the stove, or when the door is open. In addition, inadequate draft can cause back puffing, which is a build up of gases inside the firebox.

Other times, chimney height can create excessive draft which can cause high stove temperatures and short burn times. Excessive drafts can be corrected by installing a butterfly damper. If you suspect you have a draft problem, consult your dealer.

2.5 Wall Pass-throughs

When your installation unavoidably requires the chimney connector to pass through a combustible wall to reach the chimney, always consult your local building officials, and be sure any materials to be used have been tested and listed for wall pass-throughs.

In the U.S:

The National Fire Protection Association's publication, NFPA 211, Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances permits four methods for passing through a combustible wall. Before proceeding with any method be sure to consult with your local building officials to discuss any local code requirements.

Common Method:

- When passing through a combustible wall to a masonry chimney this method requires the removal of all combustible materials from at least 12" (310mm) around the chimney connectors proposed location. With a 6" (157mm) round liner the minimum area required would be 31" x 31" (792x792mm) square.
- The space is then filled with at least 12" (310mm) of brick around a fireclay liner. Remember, the liner must be ASTM C35 or equivalent, with a minimum wall thickness of 5/8" (16mm).
- It is important to remember to locate the pass-through at least 18" (457mm) from the ceiling for proper clearance to combustibles.
- It will be necessary to cut wall studs, install headers, and construct a sill frame to maintain the proper dimensions and to support the weight of the brick.
- The bricks must be solid brick with a minimum of 3 1/4" (83mm) thick (4" (106mm) nominal).
- Refractory mortar must be used at the junction of the chimney and the pass-through liner. The pass-through liner must not penetrate the chimney liner beyond the inner surface of the chimney liner. Use extreme care when constructing the hole in the chimney liner, the tiles can shatter easily. See figure 4.

In Canada:

In Canada the standard has been established by the Canadian Standard Association. The installation must conform to CAN/CSA-B365, Installation Code for Solid Fuel Burning Appliances and Equipment. Before proceeding be sure to consult your local building inspector.

Common Method:

This method requires the removal of all combustible materials from at least 18" (457mm) around the chimney connector's proposed location. With a 6" (157mm) round liner the minimum area required would be 43" x 43" square (1092x1092mm).

It is important to remember to locate the pass-through at least 18" (457mm) from the ceiling to maintain the proper clearance to combustibles.

The space that is cleared of combustible materials must then remain empty. Sheet metal panels can then be used to cover the area. However, when using a panel on both sides of the wall each cover must be installed on noncombustible spacers at least 1" (25,4mm) from the wall. If one panel of sheet metal is to be used it may be installed flush to the wall.

See section 5.3.1 and 5.3.2 of CAN/CSA - B365-M91.

Consult your local building inspector, authorized Jøtul Dealer, NFPA 211 in the U.S. or CAN/CSA-B635 in Canada for other approved wall pass-through methods.

3. Connecting to the Chimney

3.1 Masonry Chimney Thimble

When connecting the stove to a masonry chimney through a "thimble" (the opening through the chimney wall to the flue), the thimble must be lined with ceramic tile or metal and be securely cemented in place. See fig. 4.

The chimney connector/stove pipe must slide completely inside the thimble to the inner surface or the flue liner. A slip-connector may be used to permit adjustability and ease maintenance / cleaning access. See fig. 5.

Make sure the connector pipe or thimble sleeve does not protrude into the flue liner, thereby restricting the area the smoke has to flow through. This bottle-neck will have a negative affect on the chimney system.

The chimney connector should be sealed at the thimble with refractory cement and the stove pipe leading to the stove should have a minimum of three screws.

Do not connect this stove to a chimney flue servicing another appliance of any kind.

3.2 Hearthmount Into a Masonry Fireplace

The Jøtul F 500 V3 has a rear exit flue collar height of 28 1/4" (718 mm) when installed with standard legs. Substitution of Short Legs will lower the height to 26" (660 mm).

When installing the Jøtul F 500 V3 into a masonry fireplace, code requires that the fireplace damper plate be removed or securely fixed in the open position. A connector pipe must then extend from the stove's flue exit through the damper area of the fireplace and into the chimney tile liner. See figure 6.

The inside area of the flue liner must not be less than the area of the stove's flue exit, and cannot be more than three times greater than the cross sectional area of the stove's flue exit.

If the chimney liner is too large to accommodate the stove, an approved relining system must be installed to resize the flue.

A new sheet metal damper block-off plate must be installed around the connector pipe at the damper frame and sealed with the proper sealant (usually High-Temp Silicone).

Fireplace installation must also observe the proper clearances to surrounding trim and mantels (addressed in clearance section of this manual). In addition, fireplace installations must also adhere to the floor protection guidelines specified in the following section.

3.3 Prefabricated Chimneys

When installing the Jøtul F 500 V3 to a prefabricated metal chimney always follow the pipe manufacture's instructions and be sure to use the components that are required. This usually includes some type of "smoke pipe adapter" that is secured to the bottom section of the metal chimney and allows the chimney pipe to be secured to it with three sheet metal screws. See figure 7.

4. Clearances to Combustibles

4.1 Floor Protection

Floor protection under the stove must be composed of continuous non-combustible materials for protection from sparks and embers. Install the supplied bottom heatshield. Alcove installations also require a minimum R-value of 1.6 for thermal protection.

Individual sections of floor protection must be mortared together to prevent sparks from falling through to combustible materials. Any carpeting must be removed from under the floor protection.

In the U.S. and Canada

The Jøtul F 500 V3 must be installed on a non-combustible surface extending:

- A minimum of **18" (457mm)** in front of the stove and the left side load door (measured from the legs).
- **8" (200mm)** on the right side and back of the stove (measured from side and back panels).

This will result in a minimum floor protection of

54.25"W X 50.5"D (1378mm x 1283mm). See figure 8.

For a rear vent installation, the floor protection must also extend under the stove pipe a minimum of **2" (50mm)** beyond either side of the pipe.

Alternate hearth protection

A hearth pad measuring **46" wide X 50.5" deep (1168mmx1283mm)** can be used only if the left side door is locked to prevent use. Door Lock Kit #155850 is available for this purpose.

4.2 Clearances to Walls and Ceilings

The following clearances have been tested to UL and ULC standards and are the minimum clearances specifically established for the Jøtul F 500 V3.

The following diagrams give the required clearances you must maintain when installing the Jøtul F 500 V3 near combustible surfaces. See pages 22-23.

A combustible surface is anything that can burn (i.e. sheet rock, wall paper, wood, fabrics etc.). These surfaces are not limited to those that are visible and also include materials that are behind non-combustible materials.

If you are not sure of the combustible nature of a material, consult your local fire officials. Contact your local building officials about restrictions and installation requirements in your area.

Remember: "Fire Resistant" materials are considered combustible; they are difficult to ignite, but will burn. Also "Fire-rated" sheet rock is also considered combustible.

4.3 Using Shields to Reduce Clearances

Pipe shields: When using listed pipe shields to reduce the connector clearance to combustibles, it must start 1" (25,4mm) above the lowest exposed point of the connect pipe and extend vertically a minimum of 25" (635mm) above the top surface of the stove.

Double wall pipe: Listed double wall pipe is an acceptable alternative to connector pipe heatshields.

Wall-Mounted Protection: When reducing clearances through the use of wall mounted protection:

In the U.S. refer to NFPA 211, Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, for acceptable materials, proper sizing and construction guidelines.

In Canada, refer to CAN/CSA-B365, Installation Code for Solid-Fuel Burning Appliances and Equipment, also for acceptable materials, proper sizing and construction guidelines.

Jøtul F 500 V3 Rear Heatshield Kit 154332
No other heat shield may be used.

See pages 17-18 for complete clearance requirements and diagrams.

NOTE:

Accessories approved for clearance reduction have been developed by many manufacturers. Be sure that any accessory you choose has been tested and listed by an independent laboratory and carries the laboratory's testing mark. Follow all of the manufacturer's instructions.

Always contact your local building inspector or fire officials about restriction and requirements in your area. Your local officials have final authority for installation approval.

4.4 Alcove Installation

This appliance may be installed in an alcove provided: (See figures 9 and 10)

1. The stove must be installed with listed double walled pipe.
2. In a protected alcove installation both side walls and rear wall must be protected per NFPA 211 or CAN/CSA-B365. The wall protection must be elevated 1" (24,5mm) from the floor and at least 1" (24,5mm) off the combustible wall to allow for an air-flow.
3. The height of the wall protection including the bottom air space must be 48" (1219mm).
4. **The bottom heatshield is required in all Alcove installations.** See page 15 for installation instructions.
5. Hearth protection material must consist of:
 - a) a UL/ULC listed Type II Thermal Floor Protector or,
 - b) material having a minimum r value of 1.6 (see appendix a).
6. Minimum ceiling height in an unprotected installation, off the top of the stove is 41" (1041 mm). The minimum ceiling height off the top of the stove in a protected ceiling installation is 15" (380mm).

Use of the left side load door is prohibited in alcove installations. Install 155840 Side Door Lock kit available from your dealer.

4.5 Mobile Home Installations

The Jøtul F 500 V3 has been approved for use in mobile homes in the U.S. and Canada, provided:

1. The stove is secured to the floor or the mobile home. Floor mounting kit #750304. The structural integrity of the mobile home must be maintained.
2. All chimney components, including chimney sections, supports, spark arrestor, etc., shall comply with the Standard for Factory-built Chimneys for Residential Type and Building Heating Appliances, UL 103 and/or CAN/ULC-S629 Standard for 650°C Factory-built Chimneys.
3. The chimney shall be attached directly to the stove and extend at least 3 ft. (0.9m) above the roof. Termination must be at least 2 ft. (0.6m) above the highest elevation of any part of the mobile home within 10 ft. (3m).
4. In order to allow for transportation of the mobile home, the chimney termination shall be readily removed at or below an elevation of 13.5 ft. (4.1 m) above ground level and reinstalled without use of special tools or instructions.

5. A spark arrester must be installed at the termination. The net free area of the arrester above the chimney outlet must not be less than four times the net area of the chimney outlet, and the vertical height of the arrester must not be less than one-half the diameter of the chimney flue. Openings shall not permit the passage of a sphere having a diameter larger than 1/2" (12.7 mm), and shall permit the passage of a sphere having a diameter of 3/8" (9.6 mm).
6. Direct connection of the stove to an outside air source is required. Use Outside Air Kit 154333. Do not substitute any other connection method or device. See page 11 for more details. Duct termination must not be installed at a level that is higher than the air inlet located at the bottom of the stove.
7. When the chimney exits the mobile home at a location other than through the roof, and exits at a point 7 ft. (2.1 m) or less above the ground level, a guard or other method of enclosing the chimney, must be provided at the point of exit for a height up to 7 ft. Openings of this chimney guard shall not permit penetration of a 3/4 in. (19.1 mm) diameter rod, or contact with the chimney by a 1/2 inch (12.7 mm) diameter rod inserted through the opening a distance of 4 inches (102 mm).

DO NOT INSTALL THE STOVE IN A BEDROOM OR SLEEPING AREA.

Always consult your local building inspector or fire officials about restrictions and requirements in your area prior to installing the stove.

5. Operation

Please read the following section completely before building a fire in your new Jøtul F 500 V3.

5.1 Combustion Efficiency

The Jøtul F 500 V3 has an EPA test **High Heating Value (HHV) efficiency rate of 78.4%**. There are, however, aspects of efficiency that you should be aware of in order to get the most from your stove. Operation habits and fuel moisture can have a significant effect on efficiency. Poorly seasoned wood having a higher than optimum moisture content, can reduce the amount of energy transferred to the living area as a result of the energy expended to evaporate the excess fuel moisture in order for the wood to burn. Operational habits - such as not building a robust kindling fire to readily ignite the larger fuel pieces - can result in an inefficient, smoldering fire. Additionally, most modern wood heaters' optimum performance and efficiency are at the medium to medium-low burn rates.

The location of the stove can also have a significant effect on heating efficiency, primarily in regard to distribution of the heat. For example, a wood heater centrally located in an open living area, will likely provide better circulation of heat than will a stove located in a room adjacent to the larger living area.

5.2 Minimize Carbon Monoxide Emissions

Testing the F 500 V3 to CSA B415.1-10 resulted in a carbon monoxide emission rate of **.50 grams per minute**. There are properties related to CO generation that you should be aware of. Most means of combustion produce CO, including wood fire. You can greatly reduce CO levels by maintaining a well-established fire and avoiding operation that produces a smoldering, smoky fire. We highly recommend that a CO monitor (detector) be installed in the same room as the stove. The monitor should be located as far away as possible from the stove to avoid alerts when the doors are opened.

5.3 Wood Fuel and Performance

Use dry wood.

The F 500 V3 is designed to burn natural wood only. Higher efficiencies and lower emissions generally result when burning air-dried, seasoned hardwoods, as opposed to softwoods, green or freshly cut hardwoods. Wood that has been air-dried for a period of 6 to 14 months will provide the cleanest, most efficient heat. Wood seasoned more than 2 years will burn too quickly to take advantage of the stove's low end efficiency strength.

A seasoned log will have many check marks (cracks) through the ends and be lighter than an unseasoned log which will show few or no check marks.

We recommend using a moisture meter that incorporates probes to determine the moisture content of your wood. Meters are available at your dealer or local hardware store. For purposes of home heating, your fuel should have a moisture content between 12 - 20% on the meter gauge. Wood with higher moisture content will burn, however, very inefficiently. Most of its heat value will be lost through evaporation, driving water out of the wood. Worse, that moisture will condense as creosote in the relatively cool chimney flue, increasing the potential for a chimney fire and weak draft strength. ***Use of unseasoned wood defeats the purpose of any modern wood-burning stove.***

BURN UNTREATED WOOD ONLY. DO NOT BURN:

- Coal;
- Garbage;
- Synthetic fuel or logs;
- Material containing rubber, including tires;
- Material containing plastics;
- Waste petroleum products, asphalt products, paints, paint thinners or solvents;
- Materials containing asbestos;
- Construction or demolition debris;
- Railroad ties or pressure-treated wood;
- Manure or animal remains;
- Salt water driftwood or other previously salt-water saturated materials;
- Unseasoned wood;
- Colored paper, or
- Paper products, cardboard, plywood, or particle board. *(The prohibition against burning these materials does not include the use of fire starters made from paper, cardboard, saw dust, wax or similar substances for the purpose of starting a fire.)*
- Burning of any of the materials listed above can result in the release of toxic fumes, cause smoke, or render the catalytic combustor permanently damaged and ineffective.

- IT IS AGAINST FEDERAL REGULATIONS TO OPERATE THIS WOOD HEATER IF THE CATALYTIC ELEMENT IS DEACTIVATED OR REMOVED.
- NEVER USE GASOLINE, GASOLINE-TYPE LANTERN FUEL, KEROSENE, CHARCOAL LIGHTER FLUID OR SIMILAR LIQUIDS TO START OR "FRESHEN-UP" THE FIRE. ALWAYS KEEP SUCH LIQUIDS AWAY FROM THE HEATER AT ALL TIMES.
- NOTE: Prevent logs from resting directly on the glass panel. Logs should be spaced off of the glass enough to promote unrestricted air flow within the firebox.

5.4 F 500 V3 Control Functions

The F 500 V3 is designed to support efficient combustion and optimal heat transfer by directing air to the fire through two separate channels; **Primary and Secondary**. See figure 11.

Primary Air is manually regulated by a lever- controlled valve located at the front center of the stove, directly below the door. See fig. 12. The lever position controls the volume of primary air entering the firebox and thereby affects fire intensity, heat output and burn time. Primary air is directed to the main body of the fire through air ports at the front of the stove. Separate manifolds at each side also deliver pre-heated primary air above the front doors and create an 'air-wash' to help keep the viewing glass clean.

Secondary air is automatically regulated to promote combustion of volatile gas that would otherwise be exhausted to the atmosphere unburned. The secondary air inlet is located at the back of the stove where a temperature-sensitive bimetal coil continuously varies the volume of air introduced to fire. This air is preheated as it passes over the back and top of the firebox, directed to the secondary combustion baffle and delivered to the catalytic combustor. The combustor maintains the high temperatures necessary to burn volatile gas that would otherwise pass unburned into the atmosphere. When the combustor is functioning, no smoke will be observed exiting the chimney. This is evidence that the stove is operating in the so-called "sweet-spot" wherein optimum efficiency is realized.

Secondary air is always available to the secondary combustion baffle and the catalytic combustor. The automatic control valve functions to provide the appropriate amount of secondary air relative to maintaining optimal clean combustion.

When first starting or reviving the fire: the primary control lever should be set to the far right position, which permits the maximum amount of air into the stove. The greater the amount of air entering the stove, the hotter and faster the fire will burn.

Moving the lever to the left reduces the airflow into the stove and thereby prolonging the fire at a lower heat output. See figure 12.

Control Settings and Performance

Use the table below as a guide to achieve the best performance from your stove.

Burn Rate	Air Control Setting	Blower Speed
Low	Fully to the Left	Minimum
Med. Low	1/4" to the Right	Minimum
Med. High	3/8" to the Right	Medium
High	Fully to the Right	High

The valve lever should be set at Full Open (Right) for the first five minutes of the Low, Medium Low and Medium High burn rate.

5.5 Using the Combustor Monitor

Determining the primary air setting for the best overall performance for your particular needs and installation will be established over time through trial and error. Each installation has unique physical and environmental characteristics that will affect stove performance. Other variables affecting combustion efficiency are cordwood species and moisture content. Taking those variables into consideration, you should use the integrated Combustor Monitor to maintain the fire in the most efficient manner tailored to your specific needs and installation configuration.

You can readily monitor combustion efficiency by noting the temperature indicated on the stovetop thermometer, shown in **figs. 1c and 13**. Seated within the top plate directly behind the catalytic element, the thermoprobe accurately reports combustion activity. Secondary combustion takes place at temperatures between 500°F (260°C) and 1200°F (649°C).

The primary air valve should remain at the fully open setting, (to the Right), at least until the monitor registers 500°F (260°C). Maintain that temperature for 15-20 minutes before adjusting the primary air lever to Medium Low - Medium High settings. The optimum temperature range for most efficient combustion is between 500°F and 800°F (260°C - 371°C). Chimney draft should be in the .05 - 1.0 w.c. range. The so-called "sweet spot" combustion zone is best maintained at those temperatures.

Visual Monitoring

Evidence of efficient combustion can be observed in three distinct ways:

1. At temperatures over 500°F, look up through the door glass to the steel baffle and catalytic element at the top of the firebox. As exhaust gases ignite, jets of flame can be seen projecting from the baffle ports and the catalyst will glow vividly red.
2. Little or no smoke will be seen flowing from the chimney flue outside of the house.
3. If the stove has been properly operated, brushing the chimney flue will produce mostly fly ash. Little or no creosote accumulation will be evident.

See Section 6.7 for more information regarding combustor performance.

5.6 Stove Break-In Procedure

The Jøtul F 500 V3 is constructed of cast iron plates and sealed with stove furnace cement. Cast iron, while very durable, expands and contracts as it is heated and cooled. This type of construction requires the stove to be "broken-in" gradually so that thermal expansion does not occur too quickly. This process is accomplished by burning a short series of small-to-medium fires as described below.

1. Fully open the primary air valve. Light a small fire of newspaper and kindling. Only allow the stove monitor to reach a temperature of 200°F (93°C). Maintain the fire at that level for approximately 1 hour and allow the stove to cool to room temperature.
2. Light a second fire, allowing the stove to reach a maximum temperature of 400°F (204°C) for 1 hour.
3. Cool the stove to room temperature.
4. Light a third fire and gradually allow the stove to reach and maintain a surface temperature of 500°F (260°C).
5. Cool stove to room temperature. This completes the "break-in" procedure.

NOTE: Keep the stove under 400°F (204°C) surface temperature during any “break-in fire”, with the exception of the last “break-in” fire. If the temperature exceeds 400°F, move the primary air control lever all the way to the left to minimize the air supply. It is normal for the stove top temperature will continue to climb until the fuel burns down somewhat. Once the fire is out and the stove has cooled to room temperature, continue the break-in procedure. **Never attempt to reduce the temperature by removing burning logs from the fire.**

5.7 Starting and Maintaining a Fire

Burn only solid wood directly on the bottom grate of the stove. Do not elevate the fire in any way.

WARNING: THE ASH PAN DOOR MUST ALWAYS BE SECURELY CLOSED WHEN THE STOVE IS IN BURNING. OPERATING THE STOVE WITH THE ASH DOOR OPEN WILL PROMOTE UNEVEN THERMAL EXPANSION AND CAN RESULT IN DAMAGE TO THE STOVE AND VOID YOUR WARRANTY.

Traditional Fire Building

1. Set the primary air control lever in the full open position (*to the right*). Place several sheets of crumpled newspaper placed directly on the grate. On top of the newspaper, place several pieces of small dry kindling (approx. 1" in diameter) with two to three small logs (approx. 3" to 5" in diameter) on top.
2. Light the fire and close the door, slowly building the fire by adding larger and larger logs. *Be sure to follow the break-in procedure before creating a hot fire that could damage the stove.*
3. Once the stove has reached a temperature range of between 500° and 600°, (260°C -316°C), adjust the primary air control lever as necessary to generate the heat output and burn time desired.

You can also use a stove top thermometer to monitor the surface temperature of the stove. The optimum surface temperature range for the most efficient burn is between 400° and 600° (204°C -316°C).

Top-Down Fire Building - See fig. 14.

As an alternative to the traditional “teepee” fire starter, the Top-Down method minimizes start-up smoke and more quickly establishes strong draft through the chimney.

1. With the primary air control lever in the full open position (*to the right*), place two short 1/4-split logs on the firebox floor, perpendicular to the rear wall, about 6 inches apart.
2. Place kindling across the base logs.

3. Place one or two smaller logs on top of the kindling.
4. Place newspaper between the two bottom logs under the kindling. Light the news paper and close the door. Continue to add kindling and small logs as necessary to build the fire. Keep the air control fully open until the fire is well-established.

WARNING: DO NOT OVER-FIRE THIS HEATER. IF ANY PART OF THE STOVE OR CHIMNEY CONNECTOR GLOWS, YOU ARE OVER-FIRING. A HOUSE FIRE OR SERIOUS DAMAGE TO THE STOVE OR CHIMNEY COULD RESULT. ATTEMPTS TO ACHIEVE HEAT OUTPUT RATES THAT EXCEED HEATER DESIGN SPECIFICATIONS CAN RESULT IN PERMANENT DAMAGE.

5.8 Creosote and Soot Formation and the Need for Removal

When wood is burned slowly, it produces tar and other organic vapors which combine with expelled moisture to form creosote. These creosote vapors condense in the relatively cool chimney flue of a slow burning fire. The creosote that accumulates in the flue is highly flammable and is the fuel of chimney fires. To prevent a chimney fire, the creosote needs to be removed by sweeping the chimney and flue connector. The frequency of sweeping will depend on how you operate your stove. An accumulation of 1/4" or more on the sides of the flue or connector is considered hazardous and should be removed.

In the event that creosote in your chimney or flue connector ignites, the resulting fire is often accompanied by a roaring noise and a crackling sound as flakes of burned creosote break loose. If you suspect you are having a chimney fire, immediately close the primary air control and make sure the stove door is closed. Call the fire department and get everyone safely out of the house.

Trying to extinguish the fire in the stove will not help. In fact it can make the matter worse by allowing more oxygen through the door, which then accelerates the fire in the chimney. When the roaring and crackling has stopped, you should resist the temptation to open the door and look at the fire. The fire may have suffocated, but could rekindle when you open the door. After a chimney fire, do not use your stove until the chimney and the flue connector has been cleaned and inspected to ensure that no damage has occurred.

5.9 Adding Fuel

Reload the stove while a bed of hot embers still exists,
Follow this procedure:

- Always wear gloves when tending to the stove.
- Push the air control lever to the full open position (far right).
- Wait a few seconds before opening the door to re-establish draft that will pull exhaust gas out of the stove.
- Use a stove tool or poker to distribute the hot embers equally around the firebox and away from the air inlet ports at the front center of the firebox floor.
- Load the fuel, usually with smaller logs first.
- Close the door and secure the latch tightly.
- Wait 5 – 10 minutes before adjusting the primary air to the desired heat output setting. (If there remains at least a 2" thick ember bed when reloading, it may be possible to close the door and immediately adjust the air control setting).

6. Maintenance

See Appendix A, page 22, for Combustor Maintenance and Replacement instructions.

Regular maintenance will prolong the life of your stove and ensure satisfactory performance.

6.1 Annual Stove Inspection

- Empty stove of all soot and ashes. Only use a vacuum for this job if the vacuum is specifically designed to handle ashes.
- Inspect the stove seams. Use a utility light to inspect the stove inside and out for cracks or leaks. Replace all cracked parts and repair any cement leaks with furnace cement. Always wear safety gloves when handling the ash pan.
- Inspect the Catalytic Combustor. See Section 6.7.

6.2 Ash removal

Ash removal will be required periodically depending on how frequently the stove is used. Conveniently, the Jøtul F 500 V3 is equipped with an ash pan for easy ash removal without the need to open the front door.

The ash pan door is located under the front ashlip of the stove. To open the ash door, rotate the door handle counterclockwise to unlatch the door and clockwise to latch the door. Always use stove gloves when handling the ash pan. Always close the ash door before leaving to dispose of the ashes when the stove is burning.

Ashes should be placed in a metal container equipped with a tight sealing lid. The container should be placed on a noncombustible 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 the closed container until all cinders have thoroughly cooled. Only use a vacuum for this job if the vacuum is specifically designed for ashes.

It is advisable to always keep a one or two inch bed of ashes on the firebox floor to help maintain a hot charcoal bed and insulate the bottom.

WARNING:

DO NOT OPERATE THIS STOVE WITH THE ASH DOOR OPEN.

This condition will lead to overfiring which is dangerous and can damage the stove. Such damage is not covered under warranty. Only empty the ash drawer before refueling, when the fire is low or extinguished. The ash door should be open only long enough to empty the drawer and then securely closed. Inspect the gasket on the ash pan door regularly and replace as necessary.

6.3 Chimney System

The Jøtul F 500 V3 is designed to burn cleanly and efficiently when used according to the guidelines in this manual. In order to maintain proper performance, you should inspect the chimney and chimney connector at the beginning of each heating season and then every other month during the heating season. Clean the chimney whenever creosote and fly ash accumulation exceeds 1/4 inch in any part of the system.

Chimney brushes are available from your local Jøtul dealer or hardware supply store. Your dealer can also refer you to a reputable, professional chimney sweep who will have all the equipment to ensure a complete and proper job. Failure to keep the chimney system free of creosote and build-up could result in a serious chimney fire.

6.4 Enamel Care

- **DO NOT ATTEMPT TO CLEAN HOT ENAMEL SURFACES.** Clean only cold enamel surfaces with a soft damp cloth and polish with a clean dry cloth. Most stains can be removed with a solution of baking soda and vinegar. Let this solution sit on the stain for a minute or two before rubbing it dry with a damp cloth. Organic cleaning commercial cleaning solutions, such as Citra-Solv®, can also be effective.
- **DO NOT USE SOAPY OR ABRASIVE SOLUTIONS.** These can cause stains. Coffee, tea, and fruit juices will also cause stains.
- **AVOID CONTACT WITH METAL OBJECTS.** Trivets, kettles, or pots, can damage the enamel.

6.5 Glass Care

Cleaning

While the air wash and high temperatures of normal operation will combine to keep the glass free of heavy deposits, it will occasionally be necessary to clean carbon and fly ash off the glass. If allowed to remain for an extended period of time, these deposits can eventually cause the glass surface to become etched and cloudy.

- **USE ONLY AMMONIA-FREE, NON-ABRASIVE STOVE GLASS CLEANER**
- **DO NOT ATTEMPT TO CLEAN HOT GLASS.**
- **CLEAN GLASS ONLY AT ROOM TEMPERATURE.**

Glass Replacement / See Fig. 15, pg. 19

1. Remove the doors from the stove and place on a flat surface.
2. Carefully remove all of the glass clips from the inside of the door.
3. Gently remove all pieces of the glass panel and gasket.
4. Remove all remaining gasket remnants with a wire brush.
5. Apply a small bead of gasket/stove cement and the new gasket. Do not overlap the ends of the gasket rope.
6. Important: Gradually tighten the glass clips in an alternating pattern as you would tighten the lugs on an automobile wheel.

6.6 Gaskets

Check door and glass panel gaskets for tightness. To check the seal of the front door, close and latch the door on a dollar bill and slowly try to pull the dollar bill free. If it can be easily removed, the seal is too loose. Check several spots around the door, and repeat the procedure on the ash pan door as well.

Gasket Replacement

1. Use pliers and a putty knife to remove the old gasket from the door.
2. Thoroughly clean the channel with a wire brush.
3. Apply a small bead of cement to the channel.
4. Gently press the new gasket into the cement to seat it in the channel. Close and latch the door and then reopen. Wipe any excess cement squeezed out from around the gasket.

F 500 V3 Gaskets

Description	Size	Length
Top Cover	3/8 in.	3.5 ft.
Top Plate	3/8 in.	7 ft.
Smoke Outlet	1/4 in.	3 ft.
Ash Housing	1/4 in.	4 ft.
Ash Pan Door	3/8 in.	4 ft.
Front Door	3/8 in.	6 ft.
Left Side Door	3/8 in.	4.5 ft.
Glass	3/8 in.	5 ft.

Universal Wood Stove Gasket Kit 157050 is also available from your dealer to replace all the gaskets in the F 500 V3.

7. Accessories

The following accessories, specifically designed for the Jøtul F 500 V3 wood stove, are available from your Jøtul authorized dealer.

Blower Kit - 156431

This thermostatically-controlled, 120 cfm blower mounts unobtrusively to the back of the stove to quietly enhance heat convection to the living area. The kit includes installation and operation instructions.

Outside Air Kit - 154335

Provision for outside air may be required by your local building codes.

The outside air kit includes a 3 inch adapter used to connect an air duct directly to the stove combustion chamber. The following additional materials will be required:

- A. The appropriate length of metallic flex pipe for a conduit of the outside air.
- B. A rain/weather resistant cap for the outside of the house.
- C. A rodent screen - that is no larger than 1/4" (6,4mm) mesh.

Follow the instructions provided with the kit. Please be aware that provision of outside air to support combustion will not necessarily eliminate performance issues associated with negative pressure within the home or chimney system.

Floor Bracket Kit - 750304

Use of the floor bracket kit is required in all mobile home installations to secure the stove to the floor. Installation instructions and diagrams are supplied with each floor bracket kit.

Rear Heatshield - 154332

A stove rear heatshield has been specifically designed for the Jøtul F 500 V3 to reduce clearances off the rear of the stove to combustible materials. Use of the heatshield does not affect the clearance off the sides of the appliance.

See pages 19-20 for specific clearance requirements. Complete installation instructions are supplied with the heatshield. No other type of heatshield may be used on the rear of the Jøtul F 500 V3.

Bottom Heatshield - 154330

A bottom heatshield has been specifically designed for the Jøtul F 500 V3 and is included with your stove. It is required in all alcove installations. Use of the bottom heatshield does not affect the floor protection requirements described on page 7 of this manual. No other type of heatshield may be used on the bottom of the Jøtul F 500 V3.

Stove-top Thermometer - 5002

You can use of a magnetic stove-top thermometer in conjunction with the catalytic combustor monitor to help achieve optimal stove performance.

Side Door Lock Kit - 155850

The side load door must be locked to permit installation of the F 500 V3 in a corner or alcove constructed of combustible materials.

Leg Leveler Kit - 156096

Replacement Door Knob Kit - 155991

Stove Gloves, pair - 157363

Heavy duty, flame retardant, with full gauntlet.

Universal Gasket Kit - 157050

This kit includes all the gasket material required to maintain your wood stove.

Catalyst Combustor Monitor - 158001

The thermometer provides a convenient method to monitor the catalytic combustor temperature and promote effective, efficient stove operation.

8. Illustrations

Fig. 1a

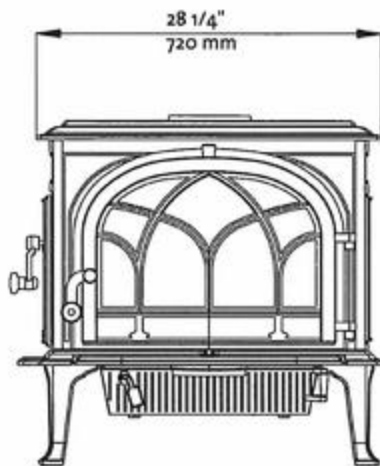


Fig. 1b

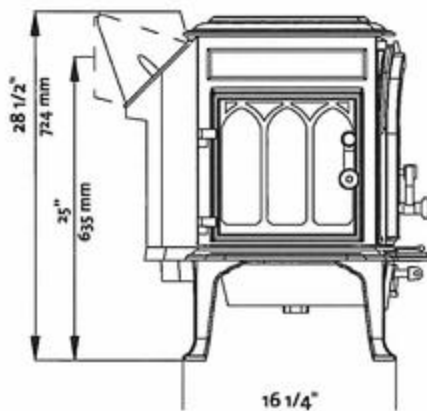


Fig. 1c.

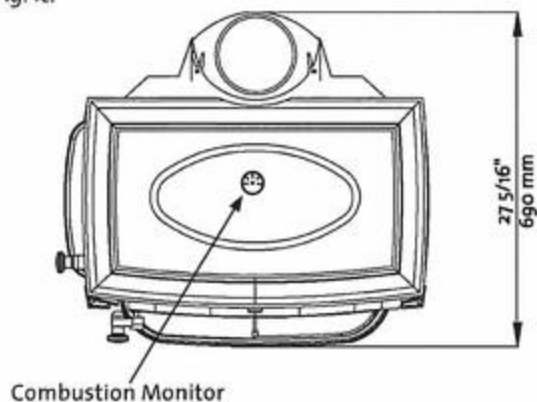


Fig. 2. Chimney connector assembly.

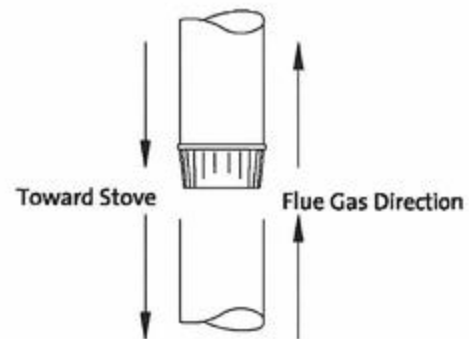


Fig. 3. Chimney height; 3 / 2 / 10 Rule.

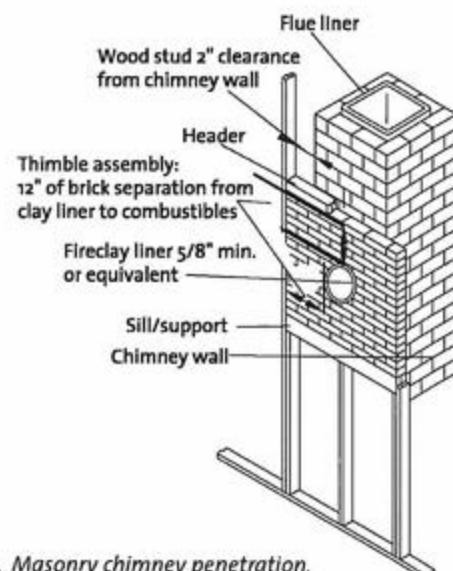
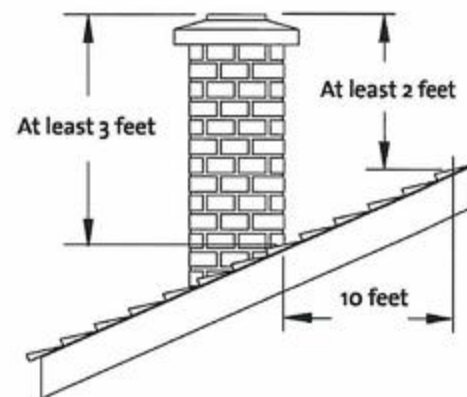


Fig. 4. Masonry chimney penetration.

Fig. 5. Chimney thimble components.

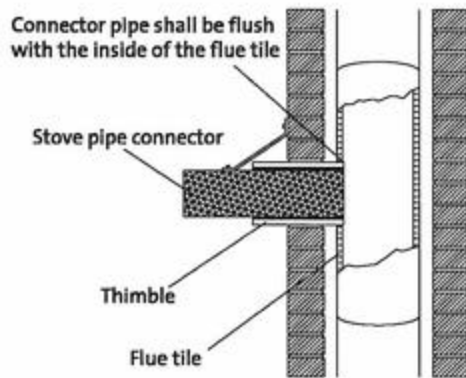


Fig. 6. Fireplace chimney construction.

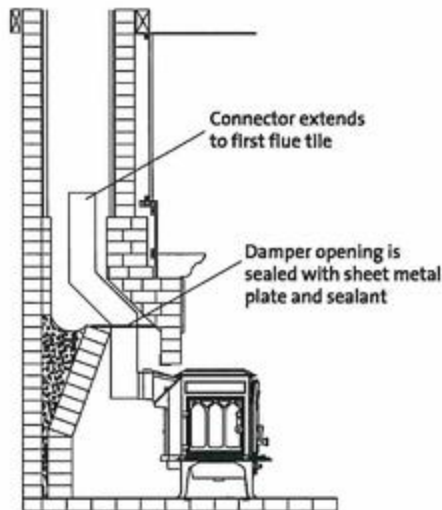


Fig. 7. Prefabricated chimney components.

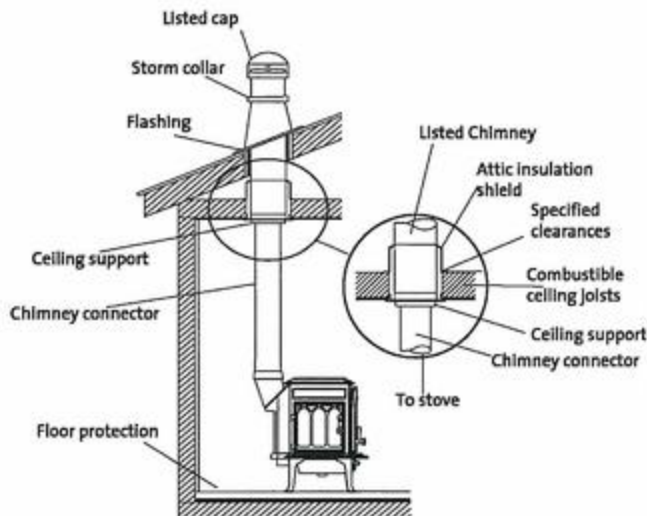


Fig. 8. F 500 V3 Hearth Dimensions.

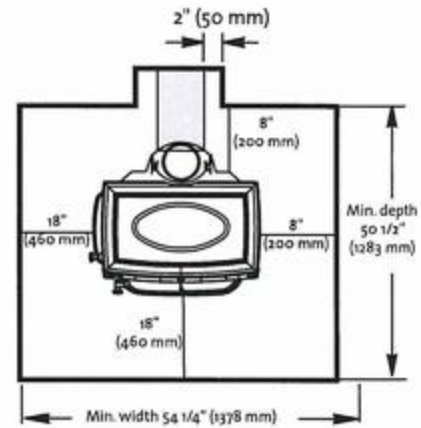
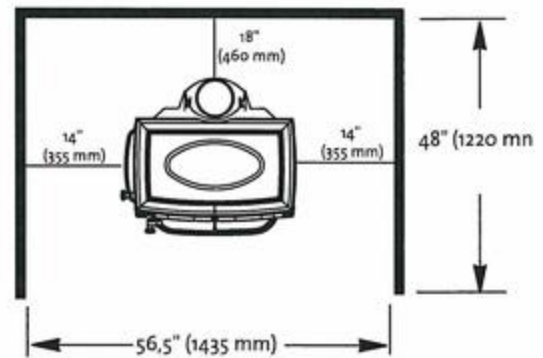
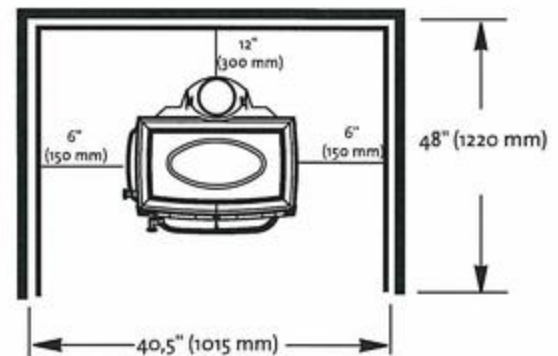


Fig. 9. Alcove unprotected wall clearances.



NOTE: Alcove installations require Side Door Lock Kit 155850.

Fig. 10. Alcove protected wall clearances.



NOTE: Alcove installations require Side Door Lock Kit 155850.

Fig. 11. F 500 V3 Combustion air flow.

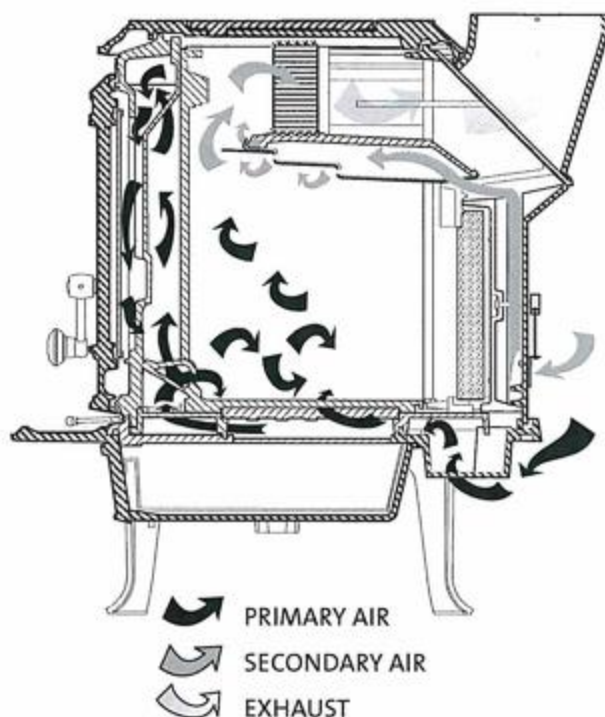


Fig. 12. Primary air lever settings

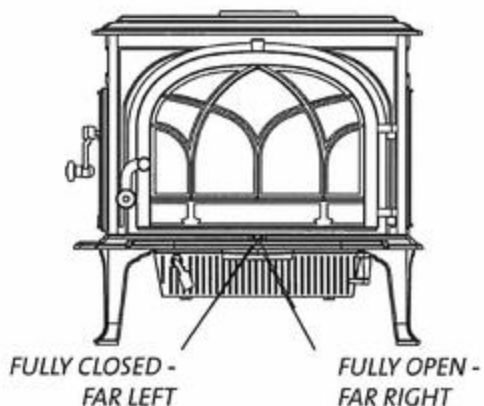


Fig. 13. Catalyst Temperature Monitor



Fig. 14. Top-down fire-starting log tier.

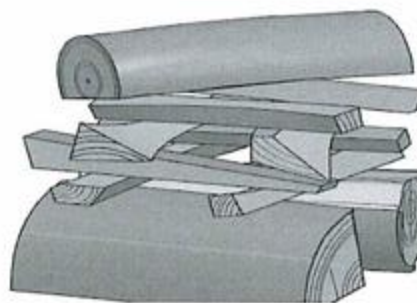


Fig. 15. Door glass components.

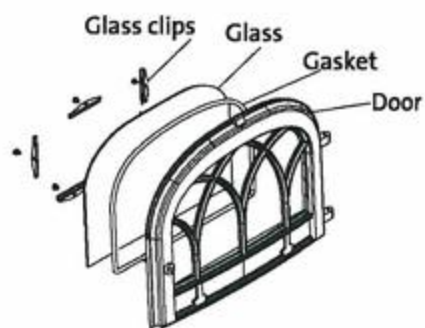


Fig. 16. Bottom heat shield installation.



- 1) Bend the flattened heat shield on the perforations as shown, painted side down.
- 2) Use a 10 mm wrench to remove the two bolts from the bottom of the ash compartment.



- 3) Oriented as shown, use the two bolts to attach the heat shield to the stove bottom.

Jøtul F 500 V3 Woodstove Clearances

These clearance specifications result from safety testing by Intertek Testing Services, Inc. Use the table below together with the diagrams on the facing page to determine the clearances for your particular installation.

Stove clearances	Unprotected surface			Protected surface NFPA 211		
	Parallel installation			Parallel installation		
	<u>Side</u>	<u>Rear</u>	<u>Corner*</u>	<u>Side</u>	<u>Rear</u>	<u>Corner*</u>
Stove- no heatshields	14" A	18" B	13" C	6" D	12" E	9" F
Single wall pipe	355mm	460mm	330mm	150mm	300mm	230mm
Stove with rear heatshield	14" G	10" H	9" I	6" J	10" K	9" L
Single wall pipe	355mm	255mm	230mm	150mm	255mm	230mm
Stove with rear heatshield	14" M	6" N	9" O	6" P	6" Q	6" R
With connector shield	355mm	150mm	230mm	150mm	150mm	150mm
Stove with rear heatshield	14" S	6" T	9" U	6" V	6" W	6" X
With double wall pipe	355mm	150-mm	230mm	150mm	150mm	150mm

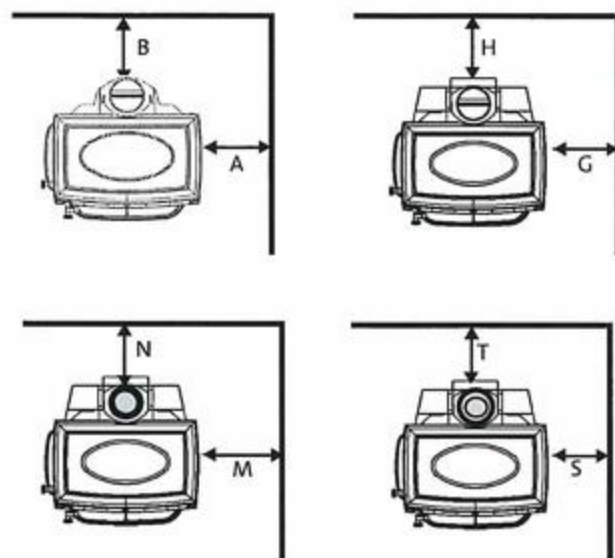
Connector clearances (pipe)	Unprotected surface		Protected surface NFPA 211	
	Vertical installation		Vertical installation	
Single wall pipe	18"	460mm	12"	300mm
Single wall pipe with connector shields	6"	150mm	6"	150mm
Double wall pipe	6"	150mm	6"	150mm

Connector clearances (pipe)	Unprotected surface		Protected surface NFPA 211	
	Horizontal installation		Horizontal installation	
Single wall connector	18"	460mm	12"	300mm
Double wall pipe	6"	150mm	6"	150mm
Mantel and trim clearances	Stove to 1" thick or less, side trim		12"	300mm
	Stove to 1" thick or less, top trim		16"	410mm
	Stove to mantel- maximum mantel depth 12"		30"	765mm

* Use of the left side load door is prohibited in alcove or corner installations. Use Side Door Lock Kit # 155850.

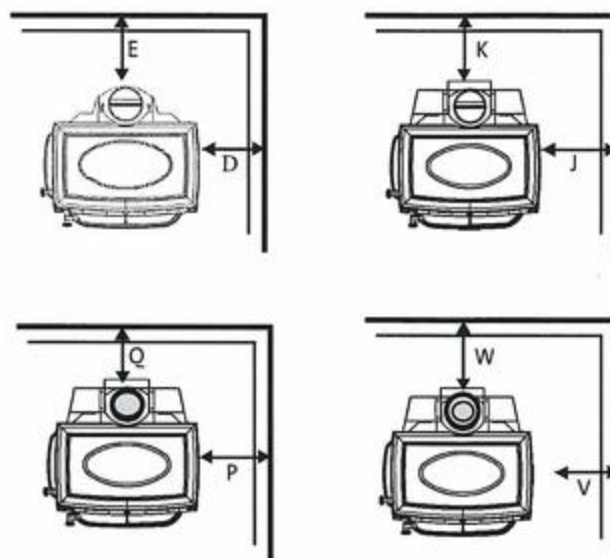
Minimum clearance from Left Side Load Door to combustible surfaces is 36".
The side door must be locked in alcove and corner installations. Use Side Door Lock Kit 155850.

Unprotected Surface Parallel to the Wall



Protected Surface Parallel to the Wall

PER NFPA 211 or
CAN/CSA-B365

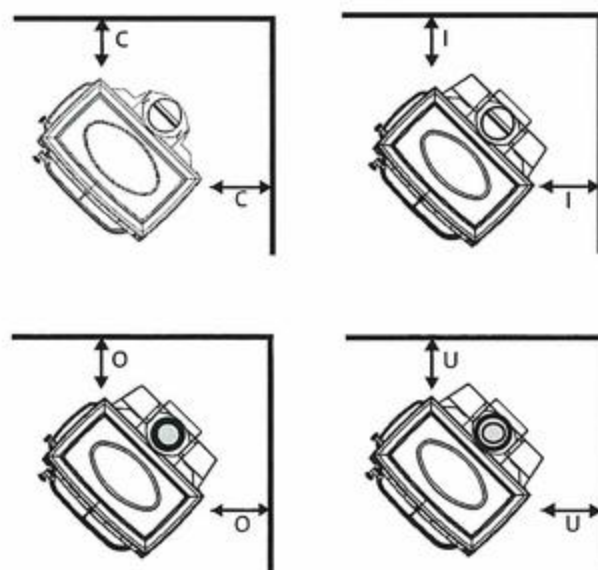


Important:
Connector heatshields and double wall pipe must be a listed product.
Always follow the manufacturer's instructions.

○ = SINGLE WALL PIPE WITH CONNECTOR SHIELDS

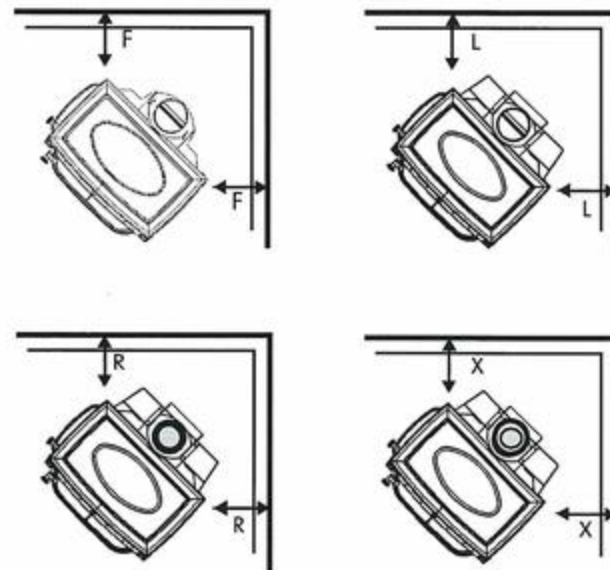
⊙ = DOUBLE WALL PIPE

Unprotected Surface Corner Installation



Protected Surface Corner Installation

PER NFPA 211 or
CAN/CSA-B365



9. Appendix A

Combustion System Maintenance

While catalytic combustor element is extremely durable, you can prolong its service life with routine inspections. The combustor itself is self-cleaning to an extent, however, fly ash will eventually accumulate within the element and upper combustion chamber. If you suspect combustor system performance is lagging, perform the following confirmation test.

1. Burn the fire at medium to high settings for two or three hours at over 500°F to build a full bed of coals.
2. Set primary air at medium to medium low.
3. Confirm that monitor temperatures remain at 500°F or higher. If the monitor temperature falls, the combustor may need to be cleaned or replaced.
4. Repeat this test 2-3 times to confirm that the combustor is **not** functioning properly.

A non-functioning catalytic combustor must be replaced.

Regular Combustor Inspection

The combustor can be visually inspected for damage and fly ash accumulation simply by opening the front door and looking up at the catalyst located above the secondary combustor baffle. Use a flashlight or headlamp to aid inspection.

- Use a soft brush to sweep any fly ash or other loose debris from the combustor cells. Fig. 17.
- A shop vacuum may be used to carefully remove debris from within individual cell bodies. Use caution as the cell material is fragile. Fig. 18.
- Inspect the combustor element for catalyst cell collapse and the insulation panels for surface degradation. Replace damaged components as they are critical to the proper functioning of the stove. Replacement parts are available from your authorized Jøtul dealer.

Fig. 17. Use a soft brush to clean the combustor.

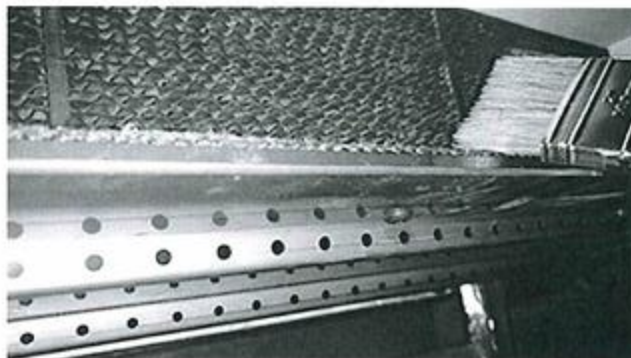
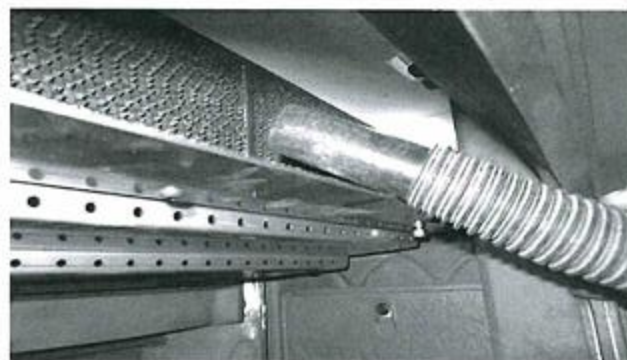


Fig. 18. Vacuum the combustor cells after brushing.



Combustor Replacement

The combustor components are accessed by removal of the top plate which is secured to the front plate by two M6 x 16 bolts, fig. 19.

A single stud engages with a central clevis on the rear plate. See fig. 21.

The only tool required is a 10mm socket and ratchet with extension used to remove the front bolts.

1. Remove the top plate bolts located behind the front plate inside the stove as in fig. 19.
2. Grasping each side, lift the front of the top plate slightly off of the front and side plates. Disengage the rear stud from the back plate by pulling the top forward with a rapid side-to-side shimmy motion. Fig. 20.
3. Use both hands to carefully remove the Insulation Gasket (A) and large Insulation Panel(B) from the firebox. Fig. 21.
4. Simply lift the catalytic combustor to remove it from the compartment channel. Fig. 22.
5. Remove the Left and Right Side Insulation Panels from the combustion chamber. Fig. 23.
6. Reassemble the catalytic combustion components in the reverse order used to remove them.

Fig. 19. Remove both top plate bolts located inside the front door opening.

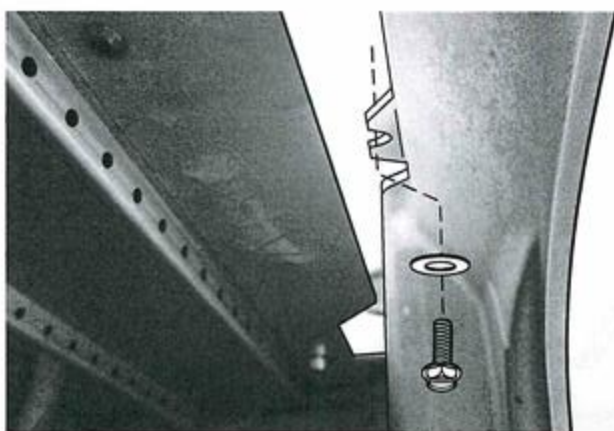


Fig. 20. Pull top plate forward to release stud from back plate.



Fig. 21. Insulation gasket (A) and Insulation panel (B).

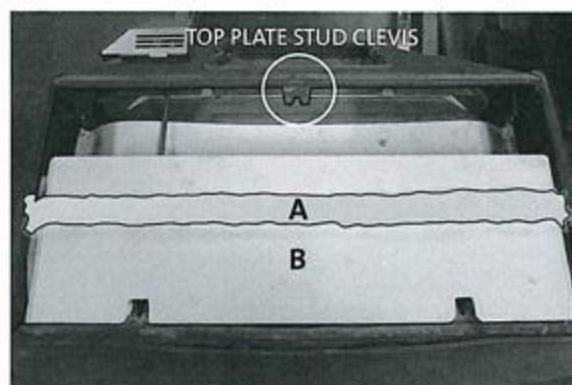


Fig. 22. Lift combustor from the chamber.



Fig. 23. Side insulation panel removal and replacement.



Appendix B

Alternate Floor Protection

All floor protection materials must be non-combustible (ie. metal, brick, stone, mineral fiber boards). Any combustible material may not be used.

The easiest means of determining if a proposed alternate floor material meets requirements listed in this manual is to follow this procedure.

R-value = thermal resistance
k-value = thermal conductivity
C-value = thermal conductance

1. Convert the specification to R-value;
 - a. If R-value is given, no conversion is needed.
 - b. If k-value is given with a required thickness (T) in inches:
 $R = 1/k \times T$.
 - c. If C-value is given: $R = 1/C$.
2. Determine the R-value of the proposed alternate floor protector.
 - a. Use the formula in Step 1 to convert values not expressed as "R".
 - b. For multiple layers, add R-values of each layer to determine overall R-value.
3. If the overall R-value of the system is greater than the R-value of the specified floor protector, the alternate is acceptable.

Example:

The specified floor protector should be 3/4" thick material with a k-factor of 0.84. The proposed alternate is 4" brick with a C-factor of 1.25 over 1/8" mineral board with a k-factor of 0.29.

Step A. Use formula above to convert specifications to R-value. $R = 1/k \times T = 1/.84 \times .75 = .893$

Step B. Calculate R of proposed system.

4" brick of C-1.25, therefore

$R_{\text{brick}} = 1/C = 1/1.25 = 0.80$.

1/8" mineral board of k = 0.29 therefore

$R_{\text{mineral board}} = 1/.29 \times 0.125 = 0.431$

Total R = R brick + R mineral board =
 $0.8 + 0.431 = 1.231$

Step C. Compare proposed system R = 1.231 to specified R of 0.893. Since R is greater than required, the system is acceptable.

Definitions:

Thermal conductance =

$$C = \frac{\text{Btu}}{(\text{hr})(\text{ft}^2)(\text{F})} = \frac{W}{(\text{m}^2)(\text{K})}$$

Thermal conductivity =

$$k = \frac{\text{Btu}}{(\text{hr})(\text{ft})(\text{F})} = \frac{W}{(\text{m})(\text{K})} = \frac{(\text{Btu})}{(\text{hr})(\text{ft})(\text{F})}$$

Thermal resistance =

$$R = \frac{\text{Btu}}{(\text{hr})(\text{ft}^2)(\text{F})} = \frac{(\text{m}^2)(\text{K})}{W} = \frac{(\text{Btu})(\text{inch})}{(\text{hr})(\text{ft}^2)(\text{F})}$$

Alcoves require use of a bottom heat shield and hearth protection having a minimum R-value of 1.6.

10. Jøtul F 500 V3 Oslo Wood-burning Product Warranty

Effective January 1, 2019

This warranty policy applies to wood-burning products identified by Jøtul trade name, as set forth below.

A. LIMITED LIFETIME WARRANTY, parts only:

Jøtul North America Inc. (JØTUL) warrants, to the original retail purchaser, that those baffle and air manifold components of the Jøtul Stove or Fireplace Insert specified above will be free of defects in material and workmanship for the life of the product. This warranty is subject to the terms, exclusions and limitations set forth below.

B. LIMITED FIVE YEAR WARRANTY - Cast Iron and Steel Components:

JØTUL warrants, to the original retail purchaser, that those components of the Jøtul Stove or Fireplace Insert specified above will be free of defects in material and workmanship for a period of five (5) years from the date of purchase. This warranty is subject to the terms, exclusions and limitations set forth below.

C. LIMITED TWO YEAR WARRANTY - Enamel Finish:

JØTUL warrants, to the original retail purchaser, the enamel finish on cast iron components of the Jøtul Stove or Fireplace Insert specified above against peeling or fading for a period of two (2) years from the date of purchase. This warranty is subject to the terms, exclusions and limitations set forth below.

D. LIMITED ONE YEAR WARRANTY - Electrical Components (blowers, thermostatic switches, combustion monitor):

JØTUL warrants, to the original retail purchaser, that those components of the Jøtul Stove or Fireplace Insert specified above will be free of defects in material and workmanship for a period of one (1) year from the date of purchase. This warranty is subject to the terms, exclusions, and limitations set forth below:

JØTUL will repair or replace (including parts & labor), at its option, any of the above components determined by JØTUL to be covered by this warranty. You must, at your own expense, arrange to deliver or ship the component to an authorized Jøtul or Scan dealer and arrange for pickup or delivery of the component after repairs have been made. If, upon inspection, JØTUL determines that the component is covered by this warranty, the repair or replacement will be made as set forth above. This warranty is not transferable and is extended only to, and is solely for the benefit of, the original retail purchaser of the Jøtul Stove or Fireplace Insert. This paragraph sets forth the sole remedy available under this warranty in the event of any defect in the Jøtul or Scan Stove or Fireplace.

The warranty period for any replaced component will be the remaining unexpired portion of the warranty period for the original component.

Please retain your dated sales receipt in your records as proof of purchase.

Exclusions and Limitations

Notice: This warranty is void if installation or service is performed by someone other than an authorized installer or service agency, or if installation is not in conformance with the installation and operating instructions contained in this owner's manual or local and/or national fire and building regulations. A listing of local authorized installers, service agencies and gas suppliers can be obtained from the National Fireplace Institute at <http://www.nficertified.org/>.

This warranty does not cover the following:

1. Repair or replacement of parts that are subject to normal wear and tear during the warranty period or to parts that may require replacement in connection with normal maintenance. These parts include catalytic combustor*, paint, gaskets, burn plates, baffles, air manifolds, firebricks, fire grates, or glass (glass is only warranted against thermal breakage).
** The catalytic combustor is warranted by Applied Ceramics. See next page for warranty information and instructions.*
2. Damage due to incorrect installations not in conformance with the installation instructions contained in this owner's manual or local and/or national fire and building regulations.
3. Damage, including damage to enamel surfaces, caused by improper operation, over-firing, and/or misuse. Improper operation, such as burning the stove with the ash door open, can damage the stove. Over-firing occurs when any part of the stove glows red. Over-firing can also be identified by warped plates, rust-colored cast iron, paint pigment that has turned dusty white, or bubbling, cracking and discoloration of the enamel finish. Misuse includes, without limitation, use that is not in conformance with the operating instructions contained in this owner's manual.
4. Damage due to service performed by an installer or service agency, unless otherwise agreed to in writing by JØTUL.
5. Damage caused by unauthorized modification, use or repair.
6. Costs incurred by travel time and/or loss of service.
7. Labor or other costs associated with the repair of components beyond the warranty period.
8. Damage incurred while the Jøtul or Scan Stove or Fireplace is in transit.

IN NO EVENT SHALL JØTUL, ITS PARENT COMPANY, SHAREHOLDERS, AFFILIATES, OFFICERS, EMPLOYEES, AGENTS OR REPRESENTATIVES BE LIABLE OR RESPONSIBLE TO YOU FOR ANY SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR OTHER SIMILAR DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR DAMAGES TO A STRUCTURE OR ITS CONTENTS, ARISING UNDER ANY THEORY OF LAW WHATSOEVER. ALL IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE, ARE LIMITED IN DURATION TO THE LENGTH OF THIS WRITTEN WARRANTY. EXCEPT AS EXPRESSLY SET FORTH HEREIN, JØTUL MAKES NO ORAL, WRITTEN OR OTHER WARRANTY WITH RESPECT TO JØTUL OR SCAN STOVES OR FIREPLACES.

Some states do not allow the exclusion or limitation of incidental or consequential damages, or limitations on the length of implied warranties. Therefore, the above exclusions or limitations may not apply to you. This warranty gives you specific legal rights, and you may have other rights, which vary from state to state.

JØTUL reserves the right to discontinue, modify or change the materials used to produce the Jøtul Stove or Fireplace. JØTUL shall have the right to replace any defective component with substitute components determined by JØTUL to be of substantially equal quality and price.

The dollar value of JØTUL's liability for breach of this warranty shall be limited exclusively to the cost of furnishing a replacement component. JØTUL shall not in any event be liable for the cost of labor expended by others in connection with any defective component. Any costs or expenses beyond those expressly assumed by JØTUL under the terms of this warranty shall be the sole responsibility of the owner(s) of the Jøtul or Scan Stove or Fireplace.

No dealer, distributor, or other person is authorized to modify, augment, or extend this limited warranty on behalf of JØTUL. **NO MODIFICATION OR CHANGE TO THIS WARRANTY WILL BE EFFECTIVE UNLESS IT IS MADE IN A WRITTEN DOCUMENT MANUALLY SIGNED BY AN AUTHORIZED OFFICER OF JØTUL.**

An authorized installer may have been provided with certain information related particularly to the Jøtul or Scan Stove or Fireplace; however, no authorized installer or other person who may service the appliance is an agent of JØTUL. No inference should be made that JØTUL has tested, certified, or otherwise pronounced any person as qualified to install or service the appliance. JØTUL shall not be liable or otherwise responsible for any error or omission by a person installing or servicing a Jøtul or Stove or Fireplace.

If you believe your Jøtul or Scan Stove or Fireplace is defective, you should contact your nearest authorized Jøtul or Scan dealer, who will process a warranty claim. **IN ORDER TO QUALIFY FOR WARRANTY COVERAGE, JØTUL MUST RECEIVE NOTICE OF A POSSIBLE DEFECT WITHIN SIXTY (60) DAYS OF THE DATE THE DEFECT IS FIRST DISCOVERED, OR REASONABLY COULD HAVE BEEN DISCOVERED.**

*This warranty is given by Jøtul North America, Inc.,
55 Hutcherson Drive, Gorham, Maine 04038 USA*

Catalytic Combustor 158000 Lifetime Limited Warranty

APPLIED CERAMICS warrants to the consumer who purchases a FIRECAT STEEL COMBUSTOR as a component in an E.P.A. certified solid fuel appliance, to replace at no charge to the consumer the FIRECAT STEEL COMBUSTOR that ceases to function within two (2) years from the date of purchase by the original consumer, provided that the following conditions are met:

- 1) A copy of the original bill of sale that includes place and date of purchase must be submitted with the warranty claim.
- 2) The original FIRECAT STEEL COMBUSTOR must be returned to APPLIED CERAMICS.
- 3) the FIRECAT STEEL COMBUSTOR must not have been mechanically abused, nor must the wrong fuels have been used in the appliance.

If after two years the FIRECAT STEEL COMBUSTOR fails to function, the prorated warranty will allow replacement at the following special price schedule:

Year 3	\$130.00
Year 4	\$140.00
Year 5	\$150.00
Year 6	\$160.00

Year 7 and after at current retail price.

Conditions 1, 2, and 3 also apply to the Prorated portion of the warranty. Any E.P.A. certified solid fuel appliance will receive one replacement catalyst for each defective catalyst returned during the three year period. The consumer will be responsible for any removal, any servicing and return of any items required for filing the warranty claim. This warranty is APPLIED CERAMICS exclusive warranty and APPLIED CERAMICS disclaims any other express or implied warranty for the FIRECAT STEEL COMBUSTOR, including any warranty for merchantability fitness for a particular use.

All warranty claims must include \$12.50 for postage and handling within the continental U.S. Alaska and Canada claims must include \$35.00. Please allow 2-3 weeks for delivery. Order online at www.firecatcombustors.com.

CUT

WARRANTY REGISTRATION CARD

Name: _____

Dealer Address: _____

Address: _____

City: _____

Stove Manufacturer: _____

State: _____ Zip: _____

Stove Model _____

Telephone _____

Return within 30 Days of purchase to:

Date of Purchase: _____

Applied Ceramics

Customer Service Department

5555 Pleasantdale Road

Doraville, GA 30340

(770) 448-6888 Main / (678) 735-4937 Direct

Place of Purchase: _____

Jøtul pursues a policy of continuous product development. Products supplied may therefore differ in specification, colour and type of accessories from those illustrated and described in this manual.

For Your Records...

Record the following information to help your dealer determine what you will need should your stove ever require parts or service. The serial number and manufacturing date are indicated on the permanent label located on the back of the stove. You may also wish to attach your sales receipt to this manual for future reference.

Model: Jøtul F 500 V3 Oslo

Serial Number:

Purchase Date:

Dealer:

Phone:

Installed by:

Date:

Jøtul North America Inc.
55 Hutcherson Drive
Gorham, Maine 04038
USA

Jøtul AS
P.O. box 1411
N-1602 Fredrikstad,
Norway

www.jotul.us

39946_R00
October 2018





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PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIR101A05026180111

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	1/11/18	6/27/17	6/2018

FUNCTIONAL CHECKS

SHIFT TEST		LINEARITY		REPEATABILITY		ENVIRONMENTAL CONDITIONS
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:	
250	1	HB44	HB44	100	1	
As-Found:		As-Found:		As-Found:		
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	
As-Left:		As-Left:		As-Left:		<div><input type="checkbox"/> Good <input checked="" type="checkbox"/> Fair <input type="checkbox"/> Poor</div> <div>Temperature: 17.7°C</div>
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	1000.1	1000.1	0.5
700	700.3	700.3	0.5
500	499.8	499.8	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	11/24/17	11/2019	20172265

Permanent Information Concerning this Equipment:
2000lbs platform. Has a custom pan.

Comments/Information Concerning this Calibration
1/18 RH = 58.5

Report prepared/reviewed by:  Date: 1-11-18

Technician: D. Gudeans

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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PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIR10182484A0912013i180613

A2LA ACCREDITED CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Digiweigh	DWP12i 400x.01	82484A0912013i	#050	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.01	QC033	6/13/18	1/11/18	12/2018

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: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	
As-Left:		As-Left:		As-Left:		<div><input type="checkbox"/> Good <input checked="" type="checkbox"/> Fair <input type="checkbox"/> Poor</div> <div>Temperature: 22.2°C</div>
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
400	399.98	399.98	0.058
300	300.00	300.00	0.058
200	200.00	200.00	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	11/24/17	11/2019	20172265
Weight Set	Rice Lake	.001 to 10lb	PW0990	9/23/16	9/2018	20161896

Permanent Information Concerning this Equipment:

6 month calibration cycle. Relative humidity= 56%.

Comments/Information Concerning this Calibration

Report prepared/reviewed by: Jake C

Date: 6/13/18

Technician: J. Colacchio

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.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: XC-60-ED
 Lab ID #: 053
 Serial #: 1902130
 Calibration Date: 6/13/2018
 Calibration Expiration: 12/13/2018
 Barometric Pressure: 29.84 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	047
Serial #:	1101001
Calibration Expiration Date:	3/5/2019
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date:	1/10/2018
γ Factor:	0.995
Allowable Deviation ($\pm 5\%$):	0.04975
Actual Deviation:	0.01
Result:	PASS

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	144.977	146.222	201.016
Standard DGM Temperature ($^{\circ}\text{F}$)	73.2	73.0	72.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.194	5.278	7.307
DGM Temperature ($^{\circ}\text{F}$)	84.0	90.0	94.0
DGM Pressure (in H_2O)	2.10	2.58	1.4
Time (min)	36.0	32.0	60.0
Net Volume for Standard DGM (ft^3)	5.120	5.164	7.099
Net Volume for DGM (ft^3)	5.194	5.278	7.307

Dry Gas Meter γ Factor	0.999	1.001	1.006
γ Factor Deviation From Average	0.999	1.001	1.006

Average Gas Meter γ Factor

1.002

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{\text{std}} \times (\gamma_{\text{std}}) \times (P_{\text{bar}} + P_{\text{std}}/13.6) \times (T_{\text{DGM}} + 460)] / [V_{\text{DGM}} \times (T_{\text{std}} + 460) \times (P_{\text{bar}} + P_{\text{DGM}}/13.6)]$

Standard Reference Meter is calibrated to NIST traceable standards. Uncertainty of measurement is $\pm 0.5\%$.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: XC-60-ED
 Lab ID #: 054
 Serial #: 1902133
 Calibration Date: 6/13/2018
 Calibration Expiration: 12/13/2018
 Barometric Pressure: 29.84 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	047
Serial #:	1101001
Calibration Expiration Date:	3/5/2019
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date	1/11/2018
γ Factor:	1.000
Allowable Deviation ($\pm 5\%$):	0.05
Actual Deviation:	0.00
Result:	PASS

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	158.715	148.505	236.136
Standard DGM Temperature ($^{\circ}\text{F}$)	72.5	73.2	73.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.777	5.426	8.616
DGM Temperature ($^{\circ}\text{F}$)	93.5	94.0	90.0
DGM Pressure (in H_2O)	2.50	2.00	1.5
Time (min)	37.0	38.5	71.5
Net Volume for Standard DGM (ft^3)	5.605	5.244	8.339
Net Volume for DGM (ft^3)	5.777	5.426	8.616

Dry Gas Meter γ Factor	1.000	0.997	0.993
γ Factor Deviation From Average	1.000	0.997	0.993

Average Gas Meter γ Factor

0.997

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{\text{std}} \times (\gamma_{\text{std}}) \times (P_{\text{bar}} + P_{\text{std}}/13.6) \times (T_{\text{DGM}} + 460)] / [V_{\text{DGM}} \times (T_{\text{std}} + 460) \times (P_{\text{bar}} + P_{\text{DGM}}/13.6)]$

Standard Reference Meter is calibrated to NIST traceable standards. Uncertainty of measurement is $\pm 0.5\%$.

Dry Gas Meter Calibration

Meter Manufacturer: Apex
 Model: Apex-AK-600
 Lab ID #: 055
 Serial #: 810016
 Calibration Date: 6/15/2018
 Calibration Expiration: 6/15/2019
 Barometric Pressure: 29.83 in. Hg



Reference Standard DGM	
Manufacturer:	Apex
Model:	SK25DA
Lab ID#:	047
Serial #:	1101001
Calibration Expiration Date:	3/5/2019
Calibration γ Factor:	0.998

Unit Under Test Previous Calibration	
Date:	1/18/2017
γ Factor:	0.997
Allowable Deviation ($\pm 5\%$):	0.04985
Actual Deviation:	0.00
Result:	PASS

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	145.479	148.058	143.802
Standard DGM Temperature ($^{\circ}\text{F}$)	71.0	71.0	71.0
Standard DGM Pressure (in H_2O)	0.00	0.00	0.0
DGM Initial Volume (ft^3)	0.000	0.000	0.000
DGM Final Volume (ft^3)	5.146	5.254	5.114
DGM Temperature ($^{\circ}\text{F}$)	75.0	76.5	77.5
DGM Pressure (in H_2O)	1.80	1.80	1.8
Time (min)			
Net Volume for Standard DGM (ft^3)	5.138	5.229	5.078
Net Volume for DGM (ft^3)	5.146	5.254	5.114

Dry Gas Meter γ Factor	0.999	0.999	0.999
γ Factor Deviation From Average	0.999	0.999	0.999

Average Gas Meter γ Factor

0.999

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{\text{std}} \times (\gamma_{\text{std}}) \times (P_{\text{bar}} + P_{\text{std}}/13.6) \times (T_{\text{DGM}} + 460)] / [V_{\text{DGM}} \times (T_{\text{std}} + 460) \times (P_{\text{bar}} + P_{\text{DGM}}/13.6)]$

Standard Reference Meter is calibrated to NIST traceable standards. Uncertainty of measurement is $\pm 0.5\%$.



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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: 03/21/17
Submitted By: John Steiner
Traceable Number: 20170468

Test Item: 200mg and 100mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Stainless Steel	7.95 g/cm ³	200mg & 100mg	ASTM Class 1

Method and Traceability

The procedure used for this calibration is NIST IR 6969 SOP 4 Double 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:

100g to 1mg Working Standards Were Calibrated: 03/03/17 Due: 03/31/18 Standards ID: 723318
Mass Comparators Used: MET-05 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: 03/21/17

Signature David S. Thompson

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Member: National Conference of Standards Laboratories and Weights & Measures



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Calibration Services
Certificate Number: 1550.01
Laboratory code: 115953

Report of Calibration

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

Test Completed: 03/21/17
Submitted By: John Steiner
Traceable Number: 20170468

Test Item: 200mg and 100mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.967	753.44	49.44

Conventional Mass Value

Nominal Value	As Found grams	As Found Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
200mg SN 1000101395	0.2000061	0.0061	0.0026	0.01
100mg SN 1000126267	0.1000046	0.0046	0.0028	0.01

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

Comments: These weights were new from the manufacturer and were within ASTM Class 1 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 dtompson@qc-services.com

Date: 03/21/17

Signature David S. Thompson



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Calibration Services
Certificate Number: 1550 01
Laboratory code: 115953

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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PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIRI0134307497180613

A2LA ACCREDITED CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Balance	Sartorius	ENTRIS224-1S	34307497	#107	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
g	0.0001	QC012	6/13/18	1/11/18	12/2018

FUNCTIONAL CHECKS

ECCENTRICITY		LINEARITY		STANDARD DEVIATION			ENVIRONMENTAL CONDITIONS
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:		
100	0.0003	50 x 4	0.0002	100	0.0001		<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
As-Found:		As-Found:		1. 100.0000	5. 100.0001	9. 100.0001	Good Fair Poor
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	2. 100.0000	6. 100.0001	10. 100.0001	
As-Left:		As-Left:		3. 100.0000	7. 100.0001	<u>Result</u>	Temperature: 22.8°C
Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	Pass: <input checked="" type="checkbox"/>	Fail: <input type="checkbox"/>	4. 100.0000	8. 100.0001	0.00005	

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
200	199.9980	200.0000	0.00015
100	99.9991	100.0000	0.00015
50	49.9995	50.0001	0.00015
20	19.9998	20.0000	0.00015
1	1.0000	1.0000	0.00015
0.1	0.1000	0.1000	0.00015

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	20 kg to 1mg	2831W	1/3/18	1/2019	20152429

Permanent Information Concerning this Equipment:

6 month calibration cycle. Relative humidity= 47%

Comments/Info Concerning this Calibration:

6/13/18: Adjusted span.

Report prepared/reviewed by: Jake C

Date: 6/13/18

Technician: J. Colacchio

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.

NIST Traceable Calibration Report



Reference Number: 1200788
PO Number: JSTEINERT013118

PFS-TECO
11785 SE Highway 212
Suite 305
Clackamas, OR 97015 United States

Manufacturer: Dwyer Instruments Inc.
Model Number: 471
Description: Air Velocity, Digital Thermo Anemometer
Asset Number: #095
Serial Number: #095
Procedure: DS Universal Speed/Time/Temperature

Calibration Date: 02/14/2018
Calibration Due Date: 02/14/2019
Condition As Found: Limited In Tol See Comments
Condition As Left: Limited See Comments

Remarks:

NIST-traceable calibration performed on the unit referenced above in accordance with customer requirements, published specifications and the lab's standard operating procedures. No adjustments were made to the unit.

This calibration is considered limited due to the requested test range.

Standards Utilized

Asset No.	Manufacturer	Model No.	Description	Cal. Date	Due Date
CP105979	Kanomax	X5602	Air Velocity, Wind Tunnel, Open Jet	01/06/2018	01/31/2019
CP144554	Fluke Corporation	1551A EX	Temperature, Stik Thermometer	01/08/2018	01/31/2019

Calibration Data

FUNCTION TESTED	Nominal Value	As Found	Out of Tol	As Left	Out of Tol	CALIBRATION TOLERANCE
Speed Accuracy Air Velocity	50 ft/min	43		Same		35 to 65 ft/min [EMU 1.3 ft/min][TUR 12:1]
Speed Accuracy Air Velocity	100 ft/min	90		Same		85 to 115 ft/min [EMU 1.5 ft/min][TUR 9.8:1]
Speed Accuracy Air Velocity	150 ft/min	140		Same		135 to 165 ft/min [EMU 1.8 ft/min][TUR 8.3:1]
Speed Accuracy Air Velocity	200 ft/min	192		Same		185 to 215 ft/min [EMU 2.1 ft/min][TUR 7.1:1]
Speed Accuracy Air Velocity	250 ft/min	240		Same		235 to 265 ft/min [EMU 2.4 ft/min][TUR 6.2:1]
Speed Accuracy Air Velocity	300 ft/min	288		Same		285 to 315 ft/min [EMU 2.7 ft/min][TUR 5.6:1]
Speed Accuracy Air Velocity	400 ft/min	395		Same		385 to 415 ft/min [EMU 3.3 ft/min][TUR 4.5:1]
Speed Accuracy Air Velocity	500 ft/min	485		Same		485 to 515 ft/min [EMU 3.9 ft/min][TUR 3.8:1]
Temperature Accuracy	72.0 °F	71.9		Same		70.0 to 74.0 °F [EMU 0.11 °F][TUR 18:1]

Temperature: 23° C
Humidity: 20% RH
Rpt. No.: 1375092

Calibration Performed By:				Quality Reviewer:	
Mathews, Rich	314	Metrologist	847-327-5314	Szplit, Tony	02/14/2018
Name	ID #	Title	Phone	Name	Date

This report may not be reproduced, except in full, without written permission of Innocal. The results stated in this report relate only to the items tested or calibrated. Measurements reported herein are traceable to SI units via national standards maintained by NIST and were performed in compliance with MIL-STD-45662A, ANSI/NCSL Z540-1-1994, 10CFR50, Appendix B, ISO 9002-94, and ISO 17025:2005. Guard Banding, if reported on this certificate, is applied at a Z-factor of 30% for test points with a test uncertainty ratio (TUR) below 4:1. In Tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The estimated measurement uncertainty (EMU), if reported on this certificate, is being reported at a confidence level of 95% or K=2 unless otherwise noted in the remarks section.



Model 1430 Microtector® Electronic Point Gage

Installation and Operating Instructions



Model 1430 Microtector® Portable Electronic Point Gage combines modern, solid-state integrated circuit electronics with a time-proven point gage manometer to provide fast, accurate pressure measurements.

SPECIFICATIONS AND FEATURES:

- Accurate and repeatable to $\pm .00025$ inches water column
- Pressure range: 0 - 2" w.c., positive, negative, or differential pressures
- Non-toxic and inexpensive gage fluid consists of distilled water mixed with a small amount of fluorescein green color concentrate
- Convenient, portable, lightweight and self-contained, the unit requires no external power connections and is operated by a 1.5 volt penlight cell
- A.C. detector current eliminates point plating, fouling and erosion
- Micrometers are manufactured in accordance with ASME B89.1.13-2001, and are traceable to a standard at the National Institute of Standards and Technology
- Three-point mounting, dual leveling adjustment, and circular level vial assure rapid setup
- Durablock® precision-machined acrylic plastic gage body
- Sensitive 0 - 50 microamp D.C. meter acts as a detector and also indicates battery and probe condition
- Heavy 2" thick steel base plate provides steady mounting
- Top-quality glass epoxy circuit board and solid-state, integrated circuit electronics
- Electronic enclosure of tough, molded styrene acrylonitrile provides maximum protection to components yet allows easy access to battery compartment
- Rugged sheet steel cover and carrying case protects the entire unit when not in use
- Accessories included are (2) 3-foot lengths Tygon® tubing, (2) 1/8" pipe thread adapters and 3/4 oz. bottle of fluorescein green color concentrate with wetting agent

Maximum pressure: 100 psig with optional pipe thread connections.

Tygon® is a registered trademark of Saint-Gobain Corporation

DWYER INSTRUMENTS, INC.

P.O. BOX 373

MICHIGAN CITY, INDIANA 46361, U.S.A

Phone: 219/879-8000

Fax: 219/872-9057

www.dwyer-inst.com

e-mail: info@dwyer-inst.com



DocNumber: 000113537

Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Tel: (323) 585-2154 Fax: (714) 542-6689
PGVPID: F22017

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information:

PXPKG TUALATIN OR H
10450 SW TUALATIN SHERWOOD
TUALATIN OR 97062

Praxair Order Number: 70337802
Customer P. O. Number:
Customer Reference Number:

Fill Date: 8/7/2017
Part Number: NI CD17C08E-AS
Lot Number: 70086721903
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure & Volume: 1290 psig 99 cu ft.

Certified Concentration:

Expiration Date:	8/11/2025	NIST Traceable
Cylinder Number:	CC700832	Analytical Uncertainty:
4.33 %	CARBON MONOXIDE	± 0.5 %
16.93 %	CARBON DIOXIDE	± 0.3 %
16.99 %	OXYGEN	± 0.2 %
Balance	NITROGEN	

Certification Information: Certification Date: 8/11/2017 Term: 96 Months Expiration Date: 8/11/2025
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.

CO2 responses have been corrected for O2 IR boardening effect. O2 responses have been corrected for CO2 interference.

Analytical Data:

1. Component: CARBON MONOXIDE (R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

Requested Concentration: 4.25 %
Certified Concentration: 4.33 %
Instrument Used: Horiba VIA-510 S/N UB9UCSYX
Analytical Method: NDIR
Last Multipoint Calibration: 7/23/2017

First Analysis Data: Date: 8/11/2017
Z: 0 R: 5 C: 4.33 Conc: 4.333
R: 4.99 Z: 0 C: 4.33 Conc: 4.333
Z: 0 C: 4.32 R: 5 Conc: 4.323
UOM: % Mean Test Assay: 4.33 %

Reference Standard Type: GMIS
Ref. Std. Cylinder #: CC242633
Ref. Std. Conc: 5.00%
Ref. Std. Traceable to SRM #: 2642a
SRM Sample #: 51-D-23
SRM Cylinder #: FF23106

Second Analysis Data: Date: 0
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 DIOXIDE

Requested Concentration: 17 %
Certified Concentration: 16.93 %
Instrument Used: Horiba VIA-510 S/N 20C194WK
Analytical Method: NDIR
Last Multipoint Calibration: 7/20/2017

First Analysis Data: Date: 8/11/2017
Z: 0 R: 20.08 C: 16.99 Conc: 16.936
R: 20.08 Z: 0 C: 16.99 Conc: 16.936
Z: 0 C: 16.98 R: 20.09 Conc: 16.926
UOM: % Mean Test Assay: 16.933 %

Reference Standard Type: GMIS
Ref. Std. Cylinder #: SA10234
Ref. Std. Conc: 20.02%
Ref. Std. Traceable to SRM #: RGM#CC28
SRM Sample #: N/A
SRM Cylinder #: RGM#CC28033

Second Analysis Data: Date: 0
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 %

Information contained herein has been prepared at your request by qualified experts within Praxair Distribution, Inc. While we believe that the information is accurate within the limits of the analytical methods employed and is complete to the extent of the specific analyses performed, we make no warranty or representation as to the suitability of the use of the information for any purpose. The information is offered with the understanding that any use of the information is at the sole discretion and risk of the user. In no event shall the liability of Praxair Distribution, Inc., arising out of the use of the information contained herein exceed the fee established for providing such information.

Report and Certificate of Calibration

CAL-CERT
CALIBRATION CERTIFICATION



6709 SE Lake Road
Milwaukie, OR 97222
1-800-356-4662
CL-108

www.Cal-Cert.com

"Measure The Difference"

14 Inverness Drive East, Ste B-128
Englewood, CO 80112
1-800-983-7832
CL-157



ACCREDITED
Calibration Laboratory

Report #: 2260-28789-46 Customer PO#:
Customer Name: PFS TECO
Customer Address: 11785 Southeast Highway 212
City: Clackamas State: OR Zip: 97015
Contact: John Steinert
Service Address: 6709 Southeast Lake Road Milwaukie, OR 97222

Calibration Standards

10-RH00192 Comark Thermohygrometer S/N 6217150049 Cal Date 11/17/17 Due Date 11/30/18 Vendor Cal-Cert REPORT # 1573-C-01
10-SR1/00515 SPI Steel Rule S/N 00515 Cal Date 3/21/17 Due Date 3/21/18 Vendor Cal-Cert REPORT# 59499-C-07

Instrument Data

Calibration Date:	January 25, 2018	Reference:	Manufacturer's Spec
Calibration Due Date:	January 25, 2019	Cal-Cert Procedure:	CP-115
Calibration Frequency:	12 Months	Indicating System:	Scaling
Manufacturer:	Dewalt	Temperature:	71 °F
Type:	Tape Measure	Humidity:	29% RH
Model Number:	DWHT33372	Asset #:	#090
Serial #:	#1 TAPE	Service Location:	Cal-Cert Lab
Capacity:	192 Inches	As Found:	Pass
		As Left:	Pass

Instrument Range:	192.000 Inches	Range Resolution:	0.0625 Inches
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Calibration Standard	As Found Reading	Verification Reading #1	Verification Reading #2
0.000	0.000	0.000	0.000
0.063	0.063	0.063	0.063
1.000	1.000	1.000	1.000
12.000	12.000	12.000	12.000
48.000	48.000	48.000	48.000
96.000	96.000	96.000	96.000
192.000	192.000	192.000	192.000

Expanded Uncertainty \pm 0.07217 Inches

Remarks:

We sincerely thank you for your business. Please call us at 1-800-356-4662 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by the International Accreditation Service, Inc. (IAS) under Calibration Laboratory Code CL-108 & CL-157.
IAS is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCCL Z540.3, and meets the requirements of all applicable references and Cal-Cert procedures listed above. Any stated measurement uncertainty includes the uncertainty of the Calibration standards used, combined with the uncertainty of the measurement process using the RSS method with a $k=2$ for an approximate 95% level of confidence. The calibration process meets or exceeds a ratio of 4:1 unless otherwise stated. All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

This report shall not be reproduced except in full, without written approval from Cal-Cert.

Service Engineer: TYSON MORAN

Date: January 25, 2018

Technical Manager: MARSHALL DOYLE

Signature: *McDoyl*

Report and Certificate of Calibration

CAL-CERT
CALIBRATION CERTIFICATION



6709 SE Lake Road
Milwaukie, OR 97222
1-800-356-4662
CL-100

www.Cal-Cert.com

"Measure The Difference"

14 Inverness Drive East, Ste B-128
Englewood, CO 80112
1-800-983-7832
CL-157



ACCREDITED
Calibration Laboratory

Report #: 2260-28781-66 Customer PO#:
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212
City: Clackamas State: OR Zip: 97015
Contact: John Steinert
Service Address: 6709 SE Lake Road, Milwaukie, OR 97222

Calibration Standards

10-RH/00192 Conmark Thermohygrometer S/N 6217150049 Cal Date 11/17/17 Due Date 11/08/18 Vendor CC REPORT # 1573-C-01
1-GIB-000397 Mitutoyo 83 Price Gage Block Set S/N 0509020 Cal Date 9/8/16 Due Date 9/30/18 Vendor American Gage REPORT# 83181-2-154224

Instrument Data

Calibration Date: January 23, 2018 Reference: NAVAIR 17-20MD-07
Calibration Due Date: January 23, 2019 Cal-Cert Procedure: CP-008
Calibration Frequency: 12 Months Indicating System: Digital
Manufacturer: General Temperature: 72 °F
Type: Digital Caliper Humidity: 31% RH
Model Number: 147 Asset #: #092
Serial #: #092 Service Location: Cal-Cert Lab
Capacity: 6 Inches As Found: PASS
Resolution: 0.0005 Inches As Left: PASS

Instrument Range: 6 Inches Range Resolution: 0.0005 Inches

Outside Jaws / Linearity				
Calibration Standard Inches	As Found Inches	As Left Reading 1 Inches	As Left Reading 2 Inches	Tolerance ± Inches
0.0000	0.0000	0.0000	0.0000	0.0000
0.0500	0.0500	0.0500	0.0500	0.0010
0.3000	0.3000	0.3000	0.3005	0.0010
0.6000	0.6000	0.6000	0.6000	0.0010
1.2000	1.2005	1.2005	1.2000	0.0010
2.4000	2.4000	2.4000	2.4005	0.0010
3.5000	3.5000	3.5000	3.5000	0.0010
5.0000	5.0000	5.0000	5.0000	0.0010
6.0000	6.0000	6.0000	6.0000	0.0010

Expanded Uncertainty ± 0.00129 Inches

Verifications (for information only)			
	Target	Measured	Tolerance ±
Resolution Check	0.10050	0.10050	N/A
Depth	1.000	1.00000	N/A
Step	1.000	1.00000	N/A
Inside Jaws	1.000	1.00000	N/A

Inspections

Jaws Parallel	Acceptable
---------------	------------

Remarks:

We sincerely thank you for your business. Please call us at 1-800-356-4662 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by the International Accreditation Service, Inc. (IAS) under Calibration Laboratory Code CL-105 & CL-157.
IAS is recognized under the ILAC mutual recognition agreement (MRA).

This certificate is hereby issued that the above instrument was tested for accuracy with calibrated standards traceable to the National Institute of Standards and Technology (NIST). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC 17025 and ANSI/NCCL Z540.3, and meets the requirements of all applicable references and Cal-Cert procedures listed above.

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All tolerances were derived from the applicable standards and pass/fail determination is based on those tolerances. The customer determined any recommended due dates indicated on the certificate.

This report shall not be reproduced except in full, without written approval from Cal-Cert.

Service Engineer: NICOLAS ILLA
Technical Manager: MARSHALL DOYLE

Date: January 23, 2018
Signature: *Mr Doyle*

Caliper CP-008-01

Revision 13 6/29/2017

J-2000

owner's manual



DELMHORST
INSTRUMENT CO.
WHEN ACCURACY IS THE POINT.™



Calibration complies with ISO/IEC
17025, ANSI/NCSL Z540-1, and 9001



Cert. No.: 4198-9765787

Traceable® Certificate of Calibration for Hand Held Barometer

Customer :PFS TECO Suite 305 ,11785 SE Highway 212 ,Clackamas ,OR-97015 ,U.S.A.

Instrument Identification:

Model: 4198,

S/N: 80531676

Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	09 Oct 2018	1000415948
Digital Thermometer	111879345	09 Apr 2019	4000-9377595

Certificate Information:

Technician: 57

Procedure: CAL-32

Cal Date: 29 Aug 2018

Cal Due Date: 29 Aug 2019

Test Conditions: 62.73%RH 23.92°C 1018mBar

Calibration Data:

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
°C	24.10	24.1	Y	23.51	23.9	Y	22.01	25.01	0.05	>4:1
mb/hPa	551.55	552	Y	551.62	546	Y	544	560	0.62	>4:1
mb/hPa	751.22	744	Y	748.87	746	Y	741	757	0.62	>4:1
mb/hPa	1015.90	1011	Y	1018.22	1017	Y	1010	1026	0.62	>4:1

This certificate indicates Traceability to standards provided by (NIST) National Institute of Standards and Technology and/or a National Standards Laboratory.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio;
Accuracy=±(Max-Min)/2; Min=As Left Nominal(Rounded) - Tolerance; Max= As Left Nominal(Rounded) + Tolerance;

Nicol Rodriguez

Nicol Rodriguez, Quality Manager

Aaron Judice

Aaron Judice, Technical Manager

Note :

Maintaining Accuracy:

In our opinion once calibrated your Hand Held Barometer should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Hand Held Barometer change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 12554 Galveston RD Suite B230 Webster TX USA 77598
Phone 281 482-1714 Fax 281 482-9448 sales@control3.com www.control3.com

Control Company is an ISO/IEC 17025:2005 Calibration Laboratory Accredited by (A2LA) American Association for Laboratory Accreditation, Certificate No. 1750.01.
Control Company is ISO 9001:2008 Quality Certified by DNV GL, Certificate No. CERT-01805-2008-AQ-HOU-RvA.
International Laboratory Accreditation Cooperation (ILAC) - Multilateral Recognition Arrangement (MRA).