
Jøtul North America Inc.

Project # 23-167

Model: F445

Type: Catalytic Wood Fired Heater

August 30, 2023

Revised: October 20, 2023, January 11,
2024

**ASTM E2780 Standard Test Method for
Determining Particulate Matter Emissions
from Wood Heaters
EPA Test Method 28R for Certification
and Auditing of Wood Heaters**

Contact: Mr. Roger Purinton
55 Hutcherson Drive
Gorham, ME 04038
RPurinton@jotulnoamer.com
207-591-6621

Prepared by: Sebastian Button,
Laboratory Supervisor



**11785 SE Highway 212 – Suite 305
Clackamas, OR 97015-9050
(503) 650-0088
WWW.PFSTECHO.COM**

Revision Summary

Date: August 30, 2023– Original Issue

Date: October 20, 2023 – Updated analytical balance calibration sheet in Appendix C, see page 370 of Non-CBI report.

Date: January 11, 2024 – The following updates were made per request from EPA:

- Added commentary to the Run Narrative section addressing negative o-ring weights and reported the “adjusted” emissions rate when negative weights are not treated as zero, see page 9.

Contents

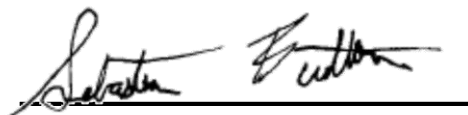
Affidavit	3
Introduction	4
Notes	4
Wood Heater Identification and Testing	5
Test Procedures and Equipment	6
Results	7
Summary Table	7
Test Run Narrative	8
Run 1	8
Run 2	8
Run 3	8
Run 4	8
Run 5	8
Run 6	9
Run 7	9
Test Conditions Summary	9
Appliance Operation and Test Settings	10
Settings & Run Notes	10
Appliance Description	11
Test Fuel Properties	15
Sampling Locations and Descriptions	16
Sampling Methods	17
Analytical Methods Description	17
Calibration, Quality Control and Assurances	17
Appliance Sealing and Storage	17
Sealing Label	17
Sealed Unit	18
List of Appendices	19

Affidavit

PFS-TECO was contracted by Jøtul North America Inc. (Jøtul) to provide testing services for the F445 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 7/5/2023 and ending on 7/12/2023. 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", and ISO 17025:2017 "Requirements for Testing Laboratories." PFS-TECO is also accredited 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.

A handwritten signature in black ink, appearing to read 'Sebastian Button', is written over a horizontal line.

Sebastian Button, Laboratory Supervisor

Introduction

Jøtul contracted with PFS-TECO to perform EPA certification testing on the F445 Wood-Fired Room Heater. All testing was performed at PFS-TECO's Portland Laboratory. All testing was performed by Sebastian Button.

Notes

- Prior to start of testing, 50 hours of conditioning was performed by PFS at a medium burn setting in accordance with ASTM E2780.
- Prior to start of testing, the dilution tunnel was cleaned with a steel brush.
- A separate, independent, third filter train was utilized to determine 1st hour emissions for all test runs.
- A total of 7 test runs were completed. One test run in each of the 4 specified burn rate categories, as well as a fan confirmation test performed at a category 2 burn rate. 2 additional tests were done at a category 2 burn rate, as initial attempts to achieve a low burn rate of less than 1.00 kg/hr were unsuccessful. All runs have been found to be appropriate, no anomalies occurred. See the Run Narrative section for further detail on each run.

Wood Heater Identification and Testing

- Appliance Tested: **F445**
- Serial Number: **PFS Tracking Number 152**
- Manufacturer: **Jøtul**
- Catalyst: **Yes**
- Heat exchange blower: **Optional**
- Type: **Wood Stove**
- Style: **Free Standing Wood Stove**
- Date Received: **Monday, June 26, 2023**
- Testing Period – Start: **Wednesday, July 05, 2023**
Finish: **Wednesday, July 12, 2023**
- Test Location: **PFS TECO**
11785 SE Hwy 212
Clackamas, OR 97015
- Elevation: **~131 Feet above sea level**
- Test Technician(s): **Sebastian Button**
- Observers: **Ames Denis**

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
50	Digiweigh DWP12i Platform Scale
53	APEX XC-60-ED Digital Emissions Sampling Box A
54	APEX XC-60-ED Digital Emissions Sampling Box B
203	APEX XC-50-DIR Digital Emissions Sampling Box C
55	Apex Ambient Air Sample Box
57	California Analytical ZRE CO ₂ /CO/O ₂ IR ANALYZER
94	Moisture meter calibration block
95	Anemometer
97	10 lb audit weight
107	Sartorius Analytical Balance
109A/B	Troemner 100mg/200mg Audit Weights
111	Microtector
115	Delmhorst Wood Moisture Meter
189	Mettler 3'x3' floor scale w/digital weight indicator
202	Digital Barometer
207	Dewalt Tape Measure
208	Digital Calipers
215	Temperature Logger
CC121798	Gas Analyzer Calibration Span Gas
CC139173	Gas Analyzer Calibration Mid Gas

Results

A total of 7 test runs were performed on the F445. Run #7, a fan confirmation test, was not used in any weighted average results calculations. The weighted average emissions rate for the 6 run test series was measured to be **0.49 g/hr** with a Higher Heating Value efficiency of **72%**. The average CO emission rate for the 6 tests was **0.60 g/min**. The Jøtul F445 Wood-Fired Room Heater meets the 2020 cribwood 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	Cat. 2 0.80 - 1.25 kg/hr	Cat. 2 0.80 - 1.25 kg/hr	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)*
Date	7/10/2023	7/5/2023	7/6/2023	7/7/2023	7/11/2023	7/11/2023	7/12/2023
Run Number	4	1	2	3	6	5	7
Emission Rate (g/hr)	0.38	0.37	0.55	0.47	0.33	1.06	0.42
Burn Rate (kg/hr)	0.95	1.19	1.18	1.01	1.51	2.80	1.08
Heat Output (Btu/hr)	13,726	14,887	16,219	13,212	20,384	35,722	14,946
Overall Efficiency (% HHV)	78%	67%	74%	70%	73%	69%	74%
CO Emissions (g/MJ Output)	2.52	0.75	1.85	5.35	0.16	1.57	0.49
CO Emissions (g/kg Dry Fuel)	38.77	10.05	27.14	74.34	2.27	21.31	7.13
CO Emissions (g/min)	0.61	0.20	0.53	1.24	0.06	0.98	0.13
Emissions – 1 st hr (g/hr)	1.14	1.95	1.39	1.60	1.36	1.65	1.38
Weighted particulate emission average of 6 test runs: 0.49 grams per hour.							
Weighted average HHV efficiency of 6 test runs: 72%.							
Average CO Emissions Rate: 0.60 g/min							

*Fan Confirmation test not included in weighted average calculations.

Test Run Narrative

Run 1

Run 1 was performed on 7/5/2023 as a category 2 test, per EPA Method 28R. The total test time was 268 minutes. The particulate emissions rate for the test was 0.37 g/hr, the burn rate was 1.19 kg/hr with an HHV efficiency of 67.4%. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 2

Run 2 was performed on 7/6/2023 as an attempted category 2 test, with a burn rate of <1.00 kg/hr, per EPA Method 28R. The total test time was 269 minutes. The particulate emissions rate for the test was 0.55 g/hr, the burn rate was 1.18 kg/hr with an HHV efficiency of 73.9%. All test results were appropriate and valid. There were no anomalies but the desired burn rate was not achieved, so another attempt was made in subsequent tests.

Run 3

Run 3 was performed on 7/7/2023 as another attempt at a category 2 test, with a burn rate of <1.00 kg/hr, per EPA Method 28R. The total test time was 324 minutes. The particulate emissions rate for the test was 0.47 g/hr, the burn rate was 1.01 kg/hr with an HHV efficiency of 70.1%. All test results were appropriate and valid. There were no anomalies but the desired burn rate was not achieved, so another attempt was made in subsequent tests.

Run 4

Run 4 was performed on 7/10/2023 as another attempt at a category 2 test, with a burn rate of <1.00 kg/hr, per EPA Method 28R. The total test time was 342 minutes. The particulate emissions rate for the test was 0.38 g/hr, the burn rate was 0.95 kg/hr with an HHV efficiency of 77.7%. 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 7/11/2023 as a category 4 test, per EPA Method 28R. The total test time was 119 minutes. The particulate emissions rate for the test was 1.06 g/hr, the burn rate was 2.80 kg/hr with an HHV efficiency of 68.6%. All test results were appropriate and valid. There were no anomalies and all test criteria were met.

Run 6

Run 6 was performed on 7/11/2023 as a category 3 test, per EPA Method 28R. The total test time was 217 minutes. The particulate emissions rate for the test was 0.33 g/hr, the burn rate was 1.51 kg/hr with an HHV efficiency of 72.5%. All test results were appropriate and valid. There were no anomalies and all test criteria were met. One of the sample train O-rings for this test had a negative value relative to its tare weight, which was appropriately treated as zero for the purposes of determining emissions. When leaving the negative value as is, the adjusted rate was determined to be 0.29 g/hr.

Run 7

Run 7 was performed on 7/12/2023 as a category 2 fan confirmation test, per EPA Method 28R. The total test time was 311 minutes. The particulate emissions rate for the test was 0.42 g/hr with a burn rate of 1.08 kg/hr. All test results were appropriate and valid. There were no other anomalies and all test criteria were met. Since the particulate emissions rate is within 1.0 g/hr of the other category 2 tests 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 the ASTM 2780 and ASTM E2515. A summary of facility conditions, fuel burned, and run times is listed below.

Run	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	79	84.3	27.8	31	29.72	12.7	13.94	20.6	268
2	75	77.6	28.7	25.5	29.73	15.98	14.11	21.9	269
3	70	74.8	40.1	35	29.78	13.74	14.41	20.6	324
4	68	72.6	38.7	34.5	29.95	14.01	14.42	21.8	342
5	72	72.8	44.9	40.3	29.96	13.64	14.95	23.1	119
6	75	77.9	34.7	29.6	29.94	13.67	14.49	21.5	217
7	74	77	45.9	30.5	29.90	13.23	14.84	20.8	311

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	Air control open 3/16" from fully closed	Air control open 3/16" from fully closed, fan on low
Run 2	Air control fully closed	Air control fully closed, fan on low
Run 3	Air control fully closed	Air control fully closed, fan on low
Run 4	Air control fully closed	Air control fully closed, fan on low
Run 5	Air control fully open	Air control fully open, fan on high
Run 6	Air control open 3/8" from fully closed	Air control open 3/8" from fully closed, fan on medium
Run 7	Air control open 3/16" from fully closed	Air control open 3/16" from fully closed, fan off (fan confirmation)

Appliance Description

Model(s): F445

Appliance Type: Catalytic Wood-Fired Stove

Total/Usable Firebox Volume: 2.03 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.

Catalytic Combustor: A 21.25" x 4.316", 2.22" thick metal catalyst is located in the flue gas path just prior to the flue collar. The appliance does not utilize any catalytic control bypass, flue gases are always routed through the catalyst. The appliance also features a catalyst temperature monitoring probe on the side of the appliance, the temperature probe tip is located within 1" of the catalyst exit.

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

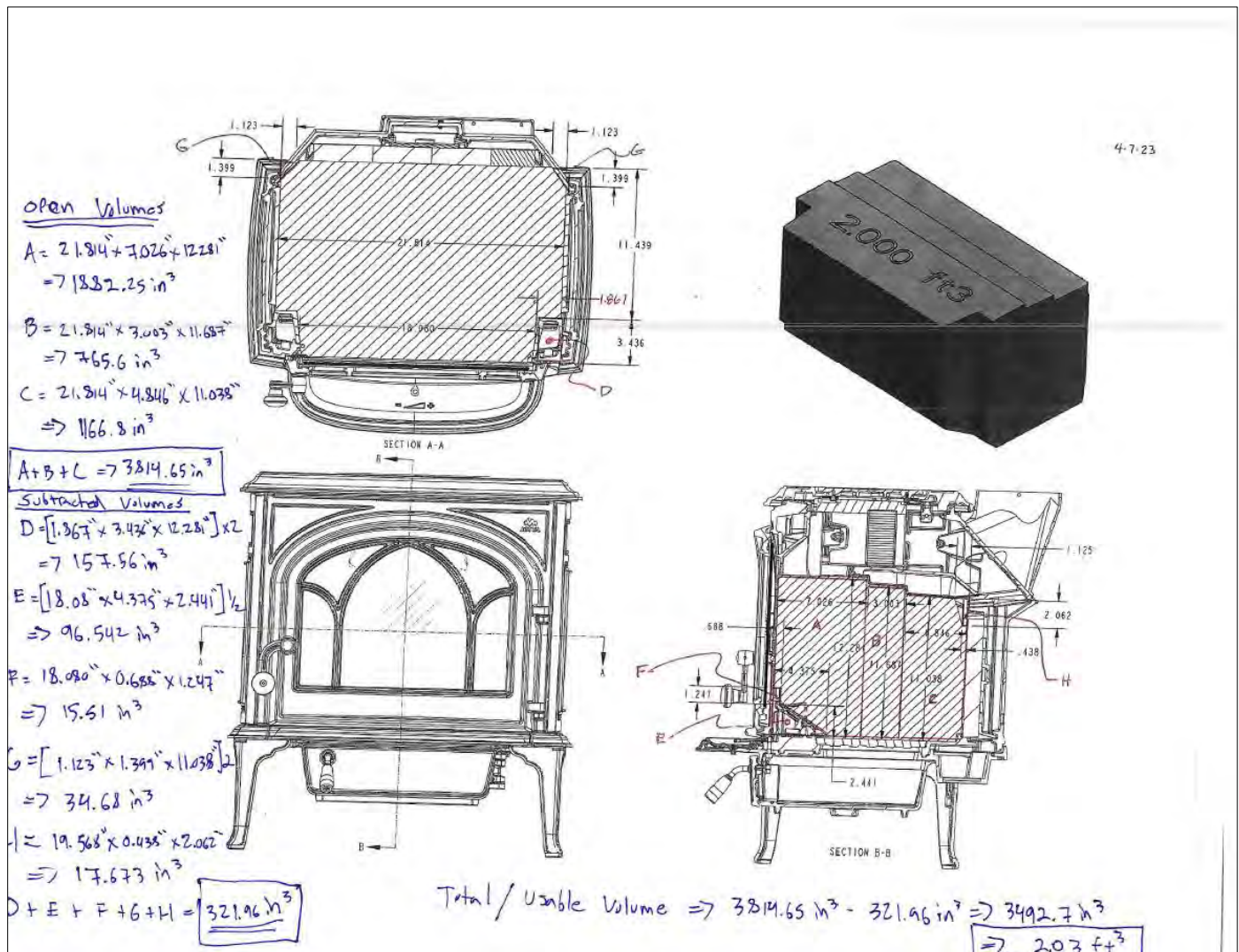
Flue Outlet: 6-inch exhaust outlet located on the top of the appliance.

Fan: An optional variable speed convection fan is mounted to the rear of the appliance.

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

Firebox Volume Dimension

Total Firebox Volume = Usable Firebox Volume



Appliance Front



Appliance Left



Appliance Right



Appliance Rear



Test Fuel Properties

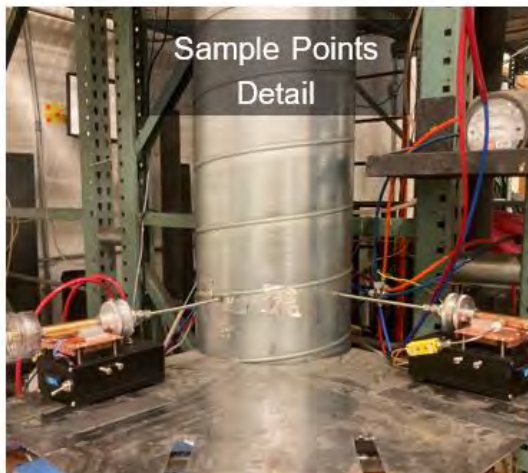
Test fuel used was Douglas Fir dimensional lumber, air-dried to the specified moisture content range. A typical fuel load is pictured below:

Typical Fuel Load



Sampling Locations and Descriptions

Sample ports are located 16.5 feet downstream from any disturbances and 3.5 feet upstream from any disturbances. Flow rate traverse data was collected 8 feet downstream from any disturbances and 4 feet upstream from any disturbances. (See below).



Sampling Methods

ASTM E2515 was used in collecting particulate samples. The dilution tunnel is 12 inches in diameter. All sampling conditions per ASTM E2515 were followed. No alternate procedures were used.

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 and ASTM E2515-11. 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 INACCORDANCE WITH REQUIREMNTS 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, and Sample Analysis

Appendix B – Labels and Manuals

Appendix C –Equipment Calibration Records

Appendix D – Design Drawings (CBI Report Only)

Appendix E – Manufacturer QAP (CBI Report Only)

EPA Method 28R Weighted Average Emissions

Client: Jotul
 Stove Model: F445
 Test Dates: 7/5/23 - 7/12/23
 Job Number: 23-167

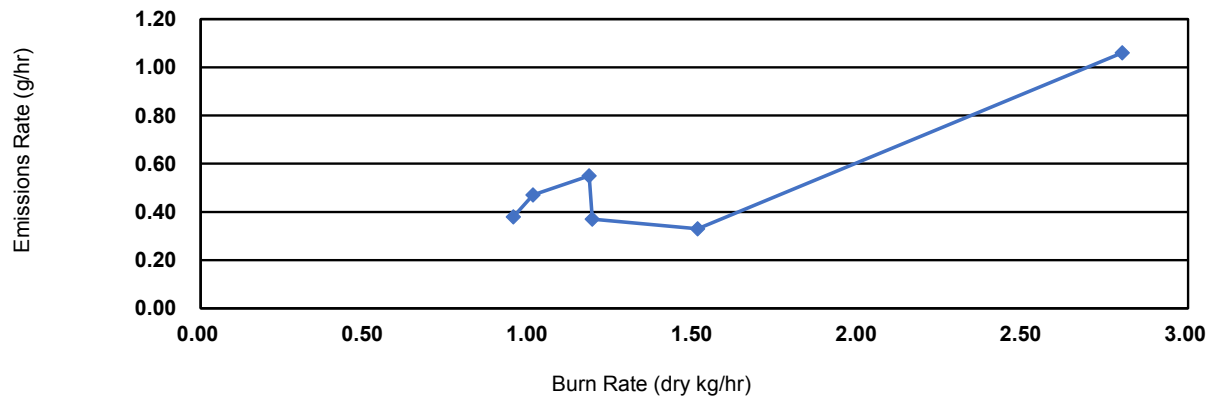
Signature/Date: _____

Weighted Average Particulate Emissions (g/hr):	0.49
Weighted Average HHV Efficiency (%):	72%
Weighted Average LHV Efficiency (%):	78%
Average CO Emissions (g/min):	0.60

Individual Run Summaries

Run Number:	4	Run Number:	3
Burn Rate (dry kg/hr):	0.95	Burn Rate (dry kg/hr):	1.01
Emissions Rate (g/hr):	0.38	Emissions Rate (g/hr):	0.47
HHV Efficiency (%):	77.7%	HHV Efficiency (%):	70.1%
LHV Efficiency (%):	83.9%	LHV Efficiency (%):	75.8%
Weighting Percentage (%):	23.33%	Weighting Percentage (%):	11.99%
Run Number:	2	Run Number:	1
Burn Rate (dry kg/hr):	1.18	Burn Rate (dry kg/hr):	1.19
Emissions Rate (g/hr):	0.55	Emissions Rate (g/hr):	0.37
HHV Efficiency (%):	73.9%	HHV Efficiency (%):	67.4%
LHV Efficiency (%):	79.9%	LHV Efficiency (%):	72.9%
Weighting Percentage (%):	9.24%	Weighting Percentage (%):	13.91%
Run Number:	6	Run Number:	5
Burn Rate (dry kg/hr):	1.51	Burn Rate (dry kg/hr):	2.80
Emissions Rate (g/hr):	0.33	Emissions Rate (g/hr):	1.06
HHV Efficiency (%):	72.5%	HHV Efficiency (%):	68.6%
LHV Efficiency (%):	78.4%	LHV Efficiency (%):	74.1%
Weighting Percentage (%):	26.76%	Weighting Percentage (%):	14.78%

Emission Rate vs Burn Rate Plot



Pre-Conditioning Data

Client: Jotul

Job #: 23-167

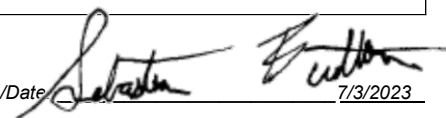
Model: F445

Tracking #: 152

Date(s): 6/26/23 - 6/30/23

Technician: SJB

Elapsed Time (hrs)	Flue (°F)	Catalyst Exit (°F)	Notes: Indicate initial air setting and any changes in in setting during conditioning, as well as weight and average moisture content of all fuel additions.
0	445	1020	Medium air setting, added 9.8 lbs, Avg MC ~21%
1	339	791	
2	408	948	Medium air setting, added 13.2 lbs, Avg MC ~22%
3	373	909	
4	372	859	
5	308	726	
6	267	637	
7	246	602	
8	230	556	
9	210	507	
10	167	396	
11	241	426	Medium air setting, added 15.2 lbs, Avg MC ~19%
12	430	1023	
13	251	692	
14	197	528	Medium air setting, added 12.5 lbs, Avg MC ~22%
15	331	857	
16	337	851	
17	242	623	
18	232	594	
19	349	915	Medium air setting, added 11.5 lbs, Avg MC ~22%
20	353	938	
21	289	722	
22	248	635	
23	245	639	
24	223	571	
25	201	526	
26	184	479	
27	312	536	Medium air setting, added 11.4 lbs, Avg MC ~20%
28	275	780	
29	240	750	
30	200	538	
31	208	598	Medium air setting, added 13.6 lbs, Avg MC ~21%
32	234	699	
33	373	955	
34	272	670	
35	230	598	
36	389	968	Medium air setting, added 13.2 lbs, Avg MC ~20%
37	369	895	
38	302	727	
39	262	646	
40	256	637	
41	242	591	
42	195	475	
43	275	530	Medium air setting, added 14.5 lbs, Avg MC ~23%
44	367	942	
45	281	686	
46	245	612	
47	323	757	Medium air setting, added 10.5 lbs, Avg MC ~20%
48	331	906	
49	304	792	
50	249	634	





June 29, 2023

Mr. Sebastian Button
PFS-TECO
11785 SE Highway 212 – Suite 305
Clackamas, OR 97015

RE: F 445 Air control and blower operation instructions

Dear Mr. Button,

The following is provided as guidance for adjusting the air control of the Jøtul F 445 in order to achieve burn rates in the appropriate categories. The blower speed for each test category is also indicated.

The primary air is operated by a lever type control located at the lower front center of the stove above the ash lip directly below the door.

The secondary air is controlled automatically by way of a bi-metallic coil located in an enclosure at the top left rear of the back plate, as looking from the front of the stove. The bi-metal coil is connected by a cable to a pivot point type air shutter over an opening at the lower rear center of the stove.

Air Control and Blower Setting

Burn Rate		Primary Air Control Handle Position	Blower Speed
Low	(Min, <1.00 dry kg/hr)	Fully to the left	Minimum
Med. Low	(1.00 - 1.25 dry kg/hr)	3/16" to the right	Minimum
Med. High	(1.25 - 1.90 dry kg/hr)	3/8" to the right	Medium
High	(Max dry kg/hr)	Fully to the right	High

Two white marks are visible on the ash lip casting below the air control handle to indicate the air control handle positions for Med Low and Med High settings. The

applicable mark is to be located centrally within the round hole of the air control handle.

Air and blower setting information contained in the operation manual will be presented in a way as to be representative of the information contained above.

Please don't hesitate to contact me if you have any questions.

Sincerely,



Roger W. Purinton
Research & Development Manger
Jotul North America
55 Hutcherson Drive
Gorham, Maine 04038

Email: rpurinton@jotulnoamer.com
Office: 207-591-6621
Mobile: 207-712-0022

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 1 Test Date: 7/5/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): 3/16" open from fully closed
Targeted Burn Category: Medium Low

Preburn Notes

Time	Notes
9:30	Stared kindling fire with ~7 lbs of fuel, air set to fully open, fan off
10:08	With 1.5 lbs of coals left, added preburn fuel load, door closed immediately
10:21	At 12.19 lbs, set air to test setting, turned fan on to low
12:31	@ 3.28lbs leveled coal bed in preparation of fuel loading, left fan on, air control at test setting

Test Notes

Test Burn Start Time: 12:33 Test Fuel Loaded by: 35 seconds
Door Closed: 40 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
12:33	Loaded test fuel, door closed immediately, fan on a low, air set to test setting
17:01	End of test

Test Burn End Time: 17:01

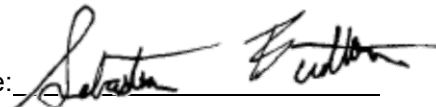
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	10:35	10:40	10:38	17:25	17:20	17:22
CO ₂	0.00	10.12	16.99	0.03	10.03	16.96
CO	0.000	2.512	4.306	0.014	2.517	4.295

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

Technician Signature: 

Date: 7/6/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 1

Tracking #: 152
Test Date: 7/5/2023



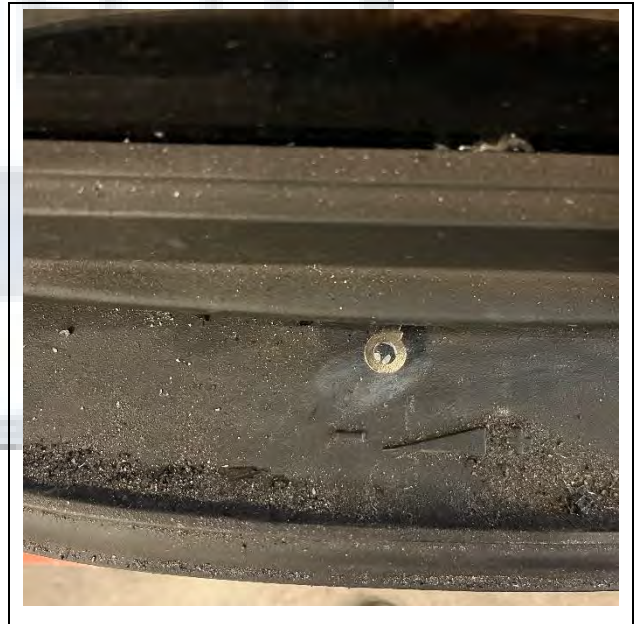
Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: _____

Sebastian E. Sutton

Date: 7/6/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 1 Test Date: 7/5/2023

REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



Technician Signature: _____

Date: 7/6/2023

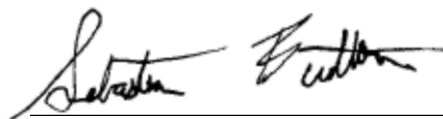
WOOD STOVE TEST DATA PACKET

ASTM E2780/E2515



Run 1 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/5/2023



Technician Signature

7/13/2023
Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 1

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/5/2023

Burn Rate (kg/hr):	1.19
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	34.543	42.711	40.140	9.739
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.7			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	22384.6			
Average Gas Meter Temperature (°F)	82.6	105.5	104.5	88.8
Total Sample Volume (dscf)	34.173	40.222	37.509	9.188
Average Tunnel Temperature (°F)	102.7			
Total Time of Test (min)	268			
Total Particulate Catch (mg)	0.0	0.7	0.6	0.8
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000174	0.0000160	0.0000871
Total PM Emissions (g)	0.00	1.74	1.60	1.95
Particulate Emission Rate (g/hr)	0.00	0.39	0.36	1.95
Emissions Factor (g/kg)	-	0.33	0.30	-
Difference from Average Total Particulate Emissions (g)	-	0.07	0.07	-
Difference from Average Total Particulate Emissions (%)	-	4.2%	4.2%	-
Difference from Average Emissions Factor (g/kg)	-	0.01	0.01	-

Final Average Results	
Total Particulate Emissions (g)	1.67
Particulate Emission Rate (g/hr)	0.37
Emissions Factor (g/kg)	0.32
HHV Efficiency (%)	67.4%
LHV Efficiency (%)	72.9%
CO Emissions (g/min)	0.20

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	87.3	OK
Face Velocity	< 30 ft/min	8.9	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min:78.8/Max:85.1	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	15.9	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/05/23
Run: 1
Control #: 23-167
Test Duration: 268
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	67.4%	72.9%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	67.8%	73.3%

Output Rate (kJ/h)	15,694	14,887	(Btu/h)
Burn Rate (kg/h)	1.17	2.59	(lb/h)
Input (kJ/h)	23,269	22,074	(Btu/h)

Test Load Weight (dry kg)	5.25	11.56	dry lb
MC wet (%)	17.05		
MC dry (%)	20.55		
Particulate (g)	1.67		
CO (g)	53		
Test Duration (h)	4.47		

Emissions	Particulate	CO
g/MJ Output	0.02	0.75
g/kg Dry Fuel	0.32	10.05
g/h	0.37	11.80
g/min	0.01	0.20
lb/MM Btu Output	0.06	1.75

Air/Fuel Ratio (A/F)	42.87
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	20.1		2x4	11.00	19.4
2x4	18.25	18.7		2x4	11.00	18.3
2x4	18.25	23.8				
2x4	18.25	20.4				
2x4	11.00	18.4				
2x4	11.00	21.6				
2x4	11.00	22.8				
2x4	11.00	24.6				
Total Fuel Weight (lbs):		12.7	Average Moisture (%DB):		20.8	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 4.91
 Total 4x4 Crib Weight, with spacers (lbs): 9.03
 Total Wet Fuel Weight, with spacers (lbs): 13.94

Coal Bed Range (20-25%):

Min (lbs): 2.79
 Max (lbs): 3.49

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.12	20.0	20.4	19.5	1.77
2x4	18.25	2.18	20.3	19.7	18.7	1.82
4x4	18.25	4.11	23.6	23.7	21.1	3.35
4x4	18.25	4.03	21.3	19.5	18.8	3.36
Total Dry Weight, no spacers (lbs):						10.30
Total Dry Weight, with spacers (lbs):						11.67

Spacer Moisture Readings (%DB)						
9.4	10.6	8.4				
11.2	7.6	8.7				
9.6	10.8	9.4				
7.8	8.6	7.6				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	27.9	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.87	OK
2x4 Fuel Mix	35 - 65 % of total weight	35%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 1
 Test Start Time: 12:33

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

Total Sampling Time (min): 268
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.73	29.70	29.72
Relative Humidity (%)	27.8	31.0	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:		34.543	ft ³

Sample Train Leak Checks

	Pre-test	Post-test		
Induced Draft Check (in. H ₂ O):	0	(A) 0.000	0.000	cfm @ -5 in. Hg
Smoke Capture Check (%):	100%	(B) 0.001	0.001	cfm @ -5 in. Hg
Date Flue Pipe Last Cleaned:	7/3/2023	(C) 0.001	0.000	cfm @ -5 in. Hg
Test Fuel Scale Audit (lbs)	10.00	(Ambient) 0.000	0.000	cfm @ -5 in. Hg
Platform Scale Audit (lbs)	10.0			

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.014	100
2	0.016	100
3	0.018	100
4	0.018	100
5	0.016	100
6	0.012	100
7	0.014	100
8	0.016	100
9	0.018	100
10	0.020	100
11	0.014	100
12	0.012	100
Center	0.017	100

Dilution Tunnel H₂O: 2.00 percent

Tunnel Diameter: 12 inches

Pitot Tube Cp: 0.99 [unitless]

Dilution Tunnel MW(dry): 29.00 lb/lb-mole

Dilution Tunnel MW(wet): 28.78 lb/lb-mole

Tunnel Area: 0.7854 ft²

V_{strav} : 8.55 ft/sec

V_{scent} : 8.93 ft/sec

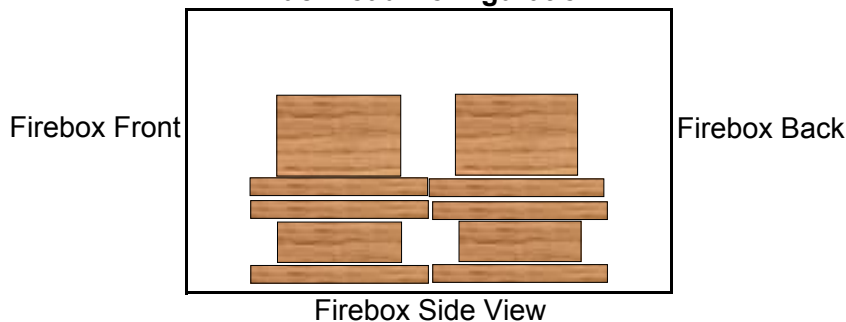
F_p : 0.957 [ratio]

Initial Tunnel Flow: 369.5 scf/min

Static Pressure: -0.091 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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)	20.6

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 1

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/5/2023

Recording Interval (min): 1
Run Time (min): 130

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	12.19	-0.085	347	323	200	249	164	256.6	403	77
1	12.10	-0.081	349	325	202	253	168	259.1	379	77
2	12.01	-0.081	350	324	203	256	170	260.7	365	77
3	11.94	-0.078	349	323	204	259	173	261.4	353	77
4	11.87	-0.077	347	322	205	261	175	262.1	343	77
5	11.79	-0.077	346	320	205	263	177	262.4	338	76
6	11.72	-0.076	344	318	206	265	179	262.5	331	77
7	11.64	-0.077	343	317	206	266	181	262.5	326	77
8	11.57	-0.073	343	315	206	267	183	262.7	320	77
9	11.50	-0.073	342	314	206	267	185	262.7	317	77
10	11.42	-0.072	342	312	205	266	187	262.6	315	77
11	11.35	-0.072	342	311	205	267	189	262.7	313	77
12	11.28	-0.072	342	310	205	266	191	262.5	311	77
13	11.20	-0.071	342	309	204	266	192	262.6	307	77
14	11.13	-0.072	342	307	204	265	194	262.4	305	77
15	11.07	-0.071	342	306	204	264	195	262.2	304	77
16	11.00	-0.071	341	305	203	264	197	262.0	302	77
17	10.92	-0.071	341	304	203	264	198	261.8	302	77
18	10.82	-0.071	341	303	202	262	199	261.3	302	77
19	10.74	-0.069	341	302	201	261	200	261.2	304	77
20	10.65	-0.071	341	301	201	261	201	260.9	302	77
21	10.55	-0.072	342	300	201	260	202	260.7	303	77
22	10.47	-0.072	343	299	200	259	202	260.5	304	76
23	10.36	-0.071	344	298	199	257	203	260.5	304	76
24	10.27	-0.071	346	298	199	258	204	261.0	304	77
25	10.17	-0.071	348	298	199	258	205	261.4	305	77
26	10.07	-0.070	349	297	198	258	205	261.5	304	76
27	9.96	-0.069	351	297	198	258	206	262.0	304	76
28	9.86	-0.072	352	298	198	259	207	262.5	304	77
29	9.74	-0.071	355	298	197	258	207	263.0	305	77
30	9.64	-0.070	357	299	197	260	207	264.0	307	77
31	9.53	-0.073	359	300	198	260	208	265.0	308	77
32	9.43	-0.069	362	302	198	262	208	266.1	309	77
33	9.32	-0.071	363	303	197	262	209	266.8	309	78
34	9.21	-0.072	366	305	198	263	208	268.0	310	77
35	9.12	-0.071	368	307	198	264	208	269.0	310	77
36	9.02	-0.072	369	310	199	264	208	270.0	309	77
37	8.92	-0.072	370	313	199	266	208	271.3	310	77
38	8.82	-0.072	371	316	199	268	208	272.4	309	77
39	8.73	-0.071	372	319	200	269	209	273.6	309	78
40	8.63	-0.072	373	321	201	269	209	274.4	310	78
41	8.53	-0.071	373	324	201	271	208	275.4	311	77
42	8.44	-0.072	374	327	202	272	208	276.6	311	78
43	8.34	-0.070	375	329	203	273	208	277.4	311	77
44	8.24	-0.070	375	332	204	273	208	278.3	310	77

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 1

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/5/2023

Recording Interval (min): 1
Run Time (min): 130

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
45	8.15	-0.070	377	334	204	274	208	279.3	308	77
46	8.06	-0.072	379	336	205	275	207	280.4	309	77
47	7.97	-0.070	381	339	206	275	207	281.5	310	77
48	7.88	-0.071	383	341	207	275	207	282.4	309	77
49	7.78	-0.070	384	343	208	276	206	283.4	309	77
50	7.69	-0.072	385	346	209	276	206	284.3	309	77
51	7.60	-0.072	387	348	210	277	206	285.5	310	77
52	7.50	-0.070	388	351	210	278	205	286.5	311	77
53	7.40	-0.071	391	353	211	278	205	287.6	310	78
54	7.31	-0.071	392	355	213	278	204	288.5	311	77
55	7.22	-0.071	394	357	213	279	204	289.4	311	77
56	7.13	-0.071	394	360	214	280	204	290.3	312	77
57	7.04	-0.072	395	362	216	280	203	290.9	312	77
58	6.96	-0.069	395	364	216	280	203	291.6	311	77
59	6.88	-0.070	395	366	217	280	202	292.1	310	78
60	6.81	-0.070	397	366	218	281	202	292.9	309	77
61	6.72	-0.069	399	367	219	281	202	293.6	306	77
62	6.65	-0.067	401	367	220	281	202	294.1	305	77
63	6.56	-0.072	404	367	221	281	202	294.9	304	78
64	6.49	-0.068	406	367	222	281	202	295.5	304	77
65	6.40	-0.068	408	368	223	281	202	296.2	303	78
66	6.32	-0.069	410	368	224	280	201	296.7	303	78
67	6.24	-0.069	413	369	225	280	201	297.5	303	78
68	6.15	-0.070	415	369	226	280	201	298.1	303	78
69	6.07	-0.071	417	369	227	279	201	298.6	304	78
70	5.97	-0.067	420	370	228	279	201	299.3	305	77
71	5.90	-0.068	423	370	229	278	201	300.1	307	77
72	5.81	-0.070	425	370	230	278	201	300.9	307	77
73	5.73	-0.069	428	370	230	279	202	301.8	307	78
74	5.65	-0.069	431	371	232	278	202	302.5	307	78
75	5.58	-0.069	433	371	232	278	202	303.1	307	78
76	5.51	-0.067	435	370	233	278	202	303.4	307	78
77	5.43	-0.067	436	370	234	279	203	304.4	306	78
78	5.37	-0.069	438	369	235	278	203	304.7	304	78
79	5.31	-0.068	439	370	236	279	204	305.6	303	78
80	5.24	-0.066	440	369	237	279	204	305.9	302	78
81	5.17	-0.068	441	369	238	278	204	306.1	301	78
82	5.10	-0.066	442	369	239	278	205	306.5	301	78
83	5.04	-0.067	442	369	240	278	205	306.6	300	78
84	4.98	-0.069	442	369	241	277	206	306.9	299	78
85	4.91	-0.067	443	369	242	277	206	307.1	299	78
86	4.85	-0.066	444	369	243	277	206	307.7	297	78
87	4.77	-0.067	444	369	244	277	207	308.0	297	78
88	4.72	-0.066	444	369	245	276	207	308.1	296	78
89	4.66	-0.067	444	369	245	276	208	308.4	296	78

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 1

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/5/2023

Recording Interval (min): 1
Run Time (min): 130

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
90	4.61	-0.065	443	370	246	275	209	308.6	296	78
91	4.55	-0.064	443	370	247	275	210	309.0	295	78
92	4.49	-0.066	443	371	248	275	210	309.1	294	78
93	4.44	-0.065	441	372	248	275	211	309.4	294	78
94	4.39	-0.065	440	372	249	274	212	309.4	294	78
95	4.34	-0.065	438	373	250	273	213	309.4	294	79
96	4.28	-0.066	436	374	251	273	214	309.4	293	79
97	4.23	-0.064	435	374	251	272	215	309.6	291	79
98	4.18	-0.064	433	375	252	273	217	309.7	291	79
99	4.13	-0.065	431	375	253	272	218	309.7	290	78
100	4.08	-0.066	430	376	253	272	219	310.0	288	79
101	4.03	-0.062	429	376	254	272	220	310.1	288	79
102	3.98	-0.065	427	376	254	271	222	310.1	288	79
103	3.94	-0.063	425	377	255	271	224	310.3	287	79
104	3.90	-0.063	424	377	255	270	226	310.2	286	79
105	3.86	-0.063	422	377	256	269	227	310.3	285	79
106	3.82	-0.063	420	378	256	269	229	310.4	284	79
107	3.78	-0.063	418	377	256	268	230	309.9	283	79
108	3.75	-0.061	417	377	257	267	232	309.9	281	79
109	3.72	-0.062	414	377	257	268	234	309.9	280	79
110	3.69	-0.062	412	376	258	268	235	309.6	278	79
111	3.66	-0.060	410	376	258	266	237	309.1	277	79
112	3.63	-0.059	407	375	258	266	238	308.9	274	79
113	3.60	-0.059	405	374	259	265	240	308.5	273	79
114	3.57	-0.059	403	373	259	265	241	308.1	271	79
115	3.54	-0.057	401	372	259	263	243	307.5	269	79
116	3.53	-0.055	399	370	259	262	244	306.9	262	79
117	3.51	-0.055	396	369	260	263	246	306.7	257	79
118	3.49	-0.054	394	368	260	262	247	306.3	253	79
119	3.47	-0.057	392	367	260	261	248	305.6	250	79
120	3.47	-0.054	390	365	261	259	249	304.9	247	79
121	3.44	-0.052	388	363	261	257	250	303.7	246	79
122	3.42	-0.052	385	362	261	257	250	303.2	243	79
123	3.40	-0.050	383	361	261	256	251	302.3	242	79
124	3.39	-0.052	381	359	261	254	252	301.4	240	79
125	3.37	-0.052	379	358	262	253	252	300.6	239	79
126	3.35	-0.051	377	357	262	252	253	299.9	238	79
127	3.33	-0.049	374	355	262	251	254	299.1	236	79
128	3.32	-0.050	372	354	262	250	255	298.5	235	79
129	3.30	-0.051	370	353	262	249	256	297.8	234	79
130	3.28	-0.051	368	351	262	248	257	297.0	232	79

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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		0.017	1.39	82	0.8		13.94		107	295	82	79
1	0.138	0.138	0.017	2.05	82	0.9	-	13.90	-0.04	110	293	84	80
2	0.287	0.149	0.018	2.09	82	0.9	-	13.86	-0.04	102	250	84	80
3	0.430	0.143	0.018	2.12	82	0.9	-	13.81	-0.05	100	234	84	80
4	0.581	0.151	0.017	2.14	82	0.9	-	13.77	-0.04	99	230	84	80
5	0.726	0.145	0.018	2.16	82	0.9	-	13.71	-0.06	98	230	84	79
6	0.876	0.150	0.017	2.18	83	0.9	-	13.65	-0.06	98	232	84	79
7	1.023	0.147	0.017	2.20	83	0.9	-	13.62	-0.03	98	234	84	79
8	1.174	0.151	0.017	2.20	83	0.9	-	13.56	-0.06	98	236	85	79
9	1.321	0.147	0.017	2.21	83	0.9	-	13.50	-0.06	98	239	85	80
10	1.473	0.152	0.018	2.22	83	0.9	96	13.44	-0.06	98	241	85	79
11	1.621	0.148	0.017	2.22	83	0.9	-	13.38	-0.06	98	242	85	79
12	1.772	0.151	0.018	2.22	84	0.9	-	13.33	-0.05	98	243	85	79
13	1.921	0.149	0.017	2.24	84	0.9	-	13.25	-0.08	98	244	85	79
14	2.073	0.152	0.017	2.25	84	0.9	-	13.20	-0.05	99	245	85	79
15	2.222	0.149	0.018	2.26	84	0.9	-	13.12	-0.08	99	246	86	79
16	2.375	0.153	0.017	2.25	85	0.9	-	13.05	-0.07	98	249	86	79
17	2.524	0.149	0.016	2.26	85	0.9	-	12.98	-0.07	99	252	85	79
18	2.678	0.154	0.018	2.27	85	0.9	-	12.91	-0.07	99	253	85	79
19	2.827	0.149	0.017	2.27	86	0.9	-	12.82	-0.09	99	256	85	79
20	2.981	0.154	0.017	2.28	86	0.9	98	12.73	-0.09	100	259	85	79
21	3.130	0.149	0.017	2.27	86	0.9	-	12.64	-0.09	100	262	85	79
22	3.285	0.155	0.017	2.29	86	0.9	-	12.56	-0.08	100	266	85	79
23	3.434	0.149	0.017	2.28	87	0.9	-	12.46	-0.10	100	271	85	79
24	3.590	0.156	0.017	2.29	87	0.9	-	12.37	-0.09	100	272	85	79
25	3.740	0.150	0.018	2.30	87	1.0	-	12.28	-0.09	100	277	84	80
26	3.897	0.157	0.017	2.31	88	0.9	-	12.18	-0.10	101	278	84	80
27	4.047	0.150	0.017	2.31	88	1.0	-	12.08	-0.10	101	280	84	80
28	4.203	0.156	0.017	2.32	88	0.9	-	11.98	-0.10	101	283	84	80
29	4.354	0.151	0.017	2.30	89	0.9	-	11.89	-0.09	101	284	84	80
30	4.509	0.155	0.017	2.32	89	0.9	100	11.78	-0.11	101	283	84	80
31	4.662	0.153	0.017	2.32	89	0.9	-	11.69	-0.09	101	283	84	80

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
32	4.816	0.154	0.017	2.33	90	1.0	-	11.59	-0.10	102	285	84	80
33	4.972	0.156	0.017	2.33	90	0.9	-	11.48	-0.11	102	287	84	80
34	5.125	0.153	0.018	2.33	91	0.9	-	11.37	-0.11	102	289	84	80
35	5.281	0.156	0.017	2.33	91	0.9	-	11.26	-0.11	102	289	85	80
36	5.432	0.151	0.018	2.33	91	0.9	-	11.15	-0.11	103	290	85	80
37	5.591	0.159	0.017	2.35	92	0.9	-	11.04	-0.11	103	292	85	80
38	5.744	0.153	0.017	2.34	92	0.9	-	10.92	-0.12	103	293	85	80
39	5.901	0.157	0.017	2.35	92	0.9	-	10.81	-0.11	102	292	85	80
40	6.054	0.153	0.017	2.34	93	0.9	101	10.69	-0.12	103	293	85	80
41	6.210	0.156	0.015	2.34	93	0.9	-	10.57	-0.12	102	298	85	80
42	6.367	0.157	0.017	2.36	94	0.9	-	10.44	-0.13	102	300	85	80
43	6.522	0.155	0.017	2.37	94	0.9	-	10.31	-0.13	103	302	85	80
44	6.679	0.157	0.017	2.36	94	0.9	-	10.17	-0.14	104	303	85	80
45	6.832	0.153	0.016	2.36	94	1.0	-	10.02	-0.15	104	307	85	80
46	6.992	0.160	0.017	2.36	95	1.0	-	9.90	-0.12	103	309	85	80
47	7.146	0.154	0.017	2.37	95	0.9	-	9.77	-0.13	105	308	85	80
48	7.303	0.157	0.017	2.36	95	0.9	-	9.65	-0.12	105	309	85	80
49	7.459	0.156	0.017	2.36	96	0.9	-	9.52	-0.13	105	309	85	81
50	7.616	0.157	0.017	2.37	96	1.0	101	9.39	-0.13	104	309	85	81
51	7.775	0.159	0.017	2.37	96	0.9	-	9.28	-0.11	104	306	85	81
52	7.928	0.153	0.017	2.37	97	0.9	-	9.16	-0.12	105	307	85	81
53	8.088	0.160	0.017	2.37	97	1.0	-	9.03	-0.13	105	307	85	81
54	8.243	0.155	0.016	2.38	97	1.0	-	8.91	-0.12	105	311	85	81
55	8.402	0.159	0.017	2.38	97	0.9	-	8.79	-0.12	104	310	85	81
56	8.558	0.156	0.017	2.38	98	0.9	-	8.70	-0.09	103	310	85	81
57	8.716	0.158	0.018	2.39	98	1.0	-	8.59	-0.11	103	308	85	81
58	8.876	0.160	0.017	2.40	98	1.0	-	8.47	-0.12	104	308	85	81
59	9.029	0.153	0.017	2.38	98	1.0	-	8.36	-0.11	104	309	85	81
60	9.191	0.162	0.017	2.39	99	1.0	102	8.25	-0.11	104	309	85	81
61	9.347	0.156	0.017	2.39	99	1.0	-	8.13	-0.12	105	308	85	81
62	9.505	0.158	0.017	2.40	99	1.0	-	8.02	-0.11	106	308	85	81
63	9.664	0.159	0.017	2.39	100	0.9	-	7.91	-0.11	106	309	85	81

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
64	9.821	0.157	0.017	2.39	100	1.0	-	7.79	-0.12	106	309	85	81
65	9.980	0.159	0.017	2.40	100	0.9	-	7.68	-0.11	106	312	85	81
66	10.136	0.156	0.017	2.40	100	0.9	-	7.56	-0.12	107	312	85	81
67	10.298	0.162	0.018	2.41	101	1.0	-	7.45	-0.11	107	312	85	81
68	10.453	0.155	0.017	2.39	101	1.0	-	7.34	-0.11	107	312	85	81
69	10.612	0.159	0.017	2.40	101	0.9	-	7.22	-0.12	107	314	85	82
70	10.773	0.161	0.017	2.40	101	1.0	102	7.11	-0.11	107	314	85	82
71	10.927	0.154	0.017	2.38	101	1.0	-	7.00	-0.11	106	312	85	82
72	11.089	0.162	0.017	2.37	102	1.0	-	6.88	-0.12	107	311	85	82
73	11.246	0.157	0.017	2.39	102	0.9	-	6.80	-0.08	107	310	85	82
74	11.405	0.159	0.018	2.40	102	0.9	-	6.69	-0.11	107	310	86	81
75	11.565	0.160	0.018	2.39	102	1.0	-	6.60	-0.09	107	309	86	82
76	11.721	0.156	0.017	2.40	102	0.9	-	6.51	-0.09	107	307	86	81
77	11.882	0.161	0.017	2.39	103	0.9	-	6.41	-0.10	107	304	86	82
78	12.039	0.157	0.017	2.36	103	0.9	-	6.33	-0.08	106	303	86	82
79	12.199	0.160	0.017	2.40	103	1.0	-	6.26	-0.07	107	300	86	82
80	12.357	0.158	0.017	2.40	103	1.0	102	6.17	-0.09	107	298	86	81
81	12.516	0.159	0.018	2.37	103	1.0	-	6.10	-0.07	106	296	86	82
82	12.676	0.160	0.017	2.39	104	1.0	-	6.03	-0.07	106	295	86	82
83	12.833	0.157	0.017	2.38	104	0.9	-	5.96	-0.07	106	293	86	82
84	12.996	0.163	0.017	2.39	104	0.9	-	5.90	-0.06	104	293	86	83
85	13.152	0.156	0.018	2.40	104	1.0	-	5.83	-0.07	105	289	86	82
86	13.312	0.160	0.017	2.41	104	0.9	-	5.75	-0.08	106	286	86	82
87	13.473	0.161	0.017	2.42	104	1.0	-	5.70	-0.05	106	285	86	82
88	13.628	0.155	0.018	2.39	105	1.0	-	5.63	-0.07	106	283	86	82
89	13.792	0.164	0.017	2.41	105	1.0	-	5.56	-0.07	105	283	86	82
90	13.948	0.156	0.017	2.42	105	0.9	102	5.51	-0.05	103	282	86	82
91	14.109	0.161	0.018	2.39	105	1.0	-	5.45	-0.06	105	280	86	82
92	14.271	0.162	0.017	2.41	105	0.9	-	5.37	-0.08	105	280	86	82
93	14.426	0.155	0.017	2.39	105	1.0	-	5.32	-0.05	105	280	86	82
94	14.590	0.164	0.017	2.42	106	1.0	-	5.27	-0.05	105	279	86	82
95	14.746	0.156	0.018	2.40	106	1.0	-	5.21	-0.06	105	278	86	82

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
96	14.907	0.161	0.017	2.41	106	1.0	-	5.15	-0.06	106	277	86	82
97	15.070	0.163	0.017	2.41	106	1.0	-	5.10	-0.05	105	276	86	82
98	15.225	0.155	0.017	2.41	106	0.9	-	5.03	-0.07	105	277	86	82
99	15.389	0.164	0.017	2.43	106	1.0	-	4.97	-0.06	105	276	86	82
100	15.546	0.157	0.017	2.43	106	1.0	102	4.92	-0.05	104	275	86	82
101	15.707	0.161	0.017	2.42	106	1.0	-	4.86	-0.06	105	275	86	82
102	15.869	0.162	0.018	2.42	107	1.0	-	4.81	-0.05	104	275	86	82
103	16.025	0.156	0.018	2.41	107	1.0	-	4.75	-0.06	105	275	86	82
104	16.189	0.164	0.017	2.41	107	1.0	-	4.71	-0.04	104	273	86	82
105	16.346	0.157	0.017	2.39	107	1.0	-	4.65	-0.06	104	274	86	82
106	16.508	0.162	0.017	2.38	107	0.9	-	4.60	-0.05	105	273	86	82
107	16.670	0.162	0.017	2.38	107	0.9	-	4.54	-0.06	104	274	86	82
108	16.826	0.156	0.018	2.41	107	1.0	-	4.50	-0.04	104	273	86	82
109	16.990	0.164	0.018	2.42	107	1.0	-	4.44	-0.06	104	271	86	82
110	17.148	0.158	0.018	2.42	107	0.9	100	4.39	-0.05	105	271	86	82
111	17.309	0.161	0.018	2.42	107	0.9	-	4.33	-0.06	105	270	86	83
112	17.470	0.161	0.018	2.40	107	1.0	-	4.28	-0.05	105	268	86	83
113	17.627	0.157	0.018	2.41	108	1.0	-	4.23	-0.05	105	267	86	82
114	17.792	0.165	0.017	2.40	108	1.0	-	4.18	-0.05	105	266	86	82
115	17.949	0.157	0.017	2.39	108	1.0	-	4.13	-0.05	104	265	86	83
116	18.111	0.162	0.018	2.40	108	0.9	-	4.07	-0.06	104	264	86	83
117	18.272	0.161	0.018	2.39	108	1.0	-	4.02	-0.05	104	262	86	82
118	18.430	0.158	0.018	2.39	108	0.9	-	3.98	-0.04	104	262	86	83
119	18.594	0.164	0.017	2.40	108	1.0	-	3.93	-0.05	104	261	86	83
120	18.752	0.158	0.018	2.41	108	1.0	99	3.88	-0.05	104	260	86	83
121	18.913	0.161	0.017	2.42	109	0.9	-	3.82	-0.06	103	261	86	83
122	19.075	0.162	0.017	2.41	109	1.0	-	3.78	-0.04	104	259	86	83
123	19.234	0.159	0.017	2.42	109	0.9	-	3.73	-0.05	105	258	86	83
124	19.396	0.162	0.017	2.41	109	0.9	-	3.68	-0.05	104	258	86	83
125	19.557	0.161	0.017	2.41	109	1.0	-	3.63	-0.05	102	259	86	83
126	19.716	0.159	0.018	2.42	109	1.0	-	3.59	-0.04	103	257	86	83
127	19.879	0.163	0.017	2.40	109	1.0	-	3.54	-0.05	103	257	86	83

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
128	20.038	0.159	0.017	2.41	109	0.9	-	3.49	-0.05	103	257	86	83
129	20.199	0.161	0.017	2.42	109	1.0	-	3.43	-0.06	104	256	86	83
130	20.362	0.163	0.018	2.41	109	1.0	99	3.39	-0.04	103	256	86	83
131	20.520	0.158	0.018	2.42	109	1.0	-	3.34	-0.05	104	255	86	83
132	20.684	0.164	0.018	2.42	109	1.0	-	3.29	-0.05	103	256	86	83
133	20.842	0.158	0.018	2.42	109	1.0	-	3.24	-0.05	103	256	86	83
134	21.004	0.162	0.017	2.41	110	0.9	-	3.20	-0.04	103	256	86	83
135	21.167	0.163	0.018	2.43	110	0.9	-	3.15	-0.05	103	255	86	83
136	21.324	0.157	0.017	2.41	110	1.0	-	3.10	-0.05	103	254	86	84
137	21.489	0.165	0.017	2.39	110	0.9	-	3.06	-0.04	103	254	86	83
138	21.647	0.158	0.017	2.40	110	1.0	-	3.02	-0.04	103	253	86	83
139	21.809	0.162	0.018	2.40	110	1.0	-	2.98	-0.04	104	254	86	83
140	21.972	0.163	0.018	2.41	110	1.0	99	2.94	-0.04	103	256	86	83
141	22.130	0.158	0.017	2.39	110	0.9	-	2.90	-0.04	102	256	86	83
142	22.293	0.163	0.018	2.41	110	1.0	-	2.86	-0.04	103	255	86	83
143	22.454	0.161	0.018	2.42	110	0.9	-	2.82	-0.04	102	254	86	83
144	22.614	0.160	0.018	2.42	110	1.0	-	2.77	-0.05	103	254	86	83
145	22.777	0.163	0.017	2.42	110	0.9	-	2.74	-0.03	104	255	86	83
146	22.936	0.159	0.017	2.41	111	1.0	-	2.69	-0.05	103	254	86	83
147	23.098	0.162	0.017	2.41	111	1.0	-	2.65	-0.04	104	255	86	83
148	23.261	0.163	0.018	2.40	111	1.0	-	2.62	-0.03	104	254	86	83
149	23.419	0.158	0.017	2.41	111	1.0	-	2.57	-0.05	104	254	86	83
150	23.584	0.165	0.017	2.41	111	1.0	100	2.52	-0.05	104	254	86	83
151	23.742	0.158	0.018	2.42	111	1.0	-	2.48	-0.04	103	254	86	83
152	23.905	0.163	0.018	2.40	111	0.9	-	2.45	-0.03	103	255	86	83
153	24.067	0.162	0.017	2.40	111	0.9	-	2.41	-0.04	102	257	86	83
154	24.226	0.159	0.017	2.39	111	1.0	-	2.36	-0.05	103	254	86	83
155	24.390	0.164	0.018	2.43	111	1.0	-	2.32	-0.04	103	255	86	83
156	24.550	0.160	0.018	2.43	111	1.0	-	2.27	-0.05	103	255	86	84
157	24.711	0.161	0.018	2.43	111	1.0	-	2.22	-0.05	104	254	86	83
158	24.874	0.163	0.017	2.41	111	1.0	-	2.18	-0.04	104	254	86	83
159	25.033	0.159	0.018	2.42	111	0.9	-	2.13	-0.05	104	254	86	83

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

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
160	25.195	0.162	0.018	2.42	111	1.0	100	2.09	-0.04	104	254	86	83
161	25.358	0.163	0.017	2.43	111	1.0	-	2.03	-0.06	104	253	86	83
162	25.517	0.159	0.017	2.42	111	1.0	-	2.01	-0.02	105	251	86	83
163	25.682	0.165	0.018	2.41	111	1.0	-	1.97	-0.04	104	251	86	84
164	25.840	0.158	0.018	2.39	111	0.9	-	1.94	-0.03	104	251	86	83
165	26.003	0.163	0.017	2.40	111	0.9	-	1.91	-0.03	104	250	87	83
166	26.166	0.163	0.017	2.40	112	1.0	-	1.87	-0.04	104	249	87	83
167	26.325	0.159	0.018	2.39	112	1.0	-	1.85	-0.02	104	247	87	83
168	26.489	0.164	0.017	2.40	112	1.0	-	1.84	-0.01	104	247	87	83
169	26.649	0.160	0.017	2.39	112	1.0	-	1.79	-0.05	104	246	87	84
170	26.810	0.161	0.017	2.39	112	1.0	100	1.79	0.00	103	245	87	84
171	26.973	0.163	0.018	2.39	112	1.0	-	1.76	-0.03	103	243	87	84
172	27.133	0.160	0.017	2.40	112	1.0	-	1.75	-0.01	102	242	87	84
173	27.295	0.162	0.018	2.40	112	1.0	-	1.73	-0.02	103	240	87	84
174	27.459	0.164	0.018	2.42	112	1.0	-	1.70	-0.03	103	238	87	84
175	27.617	0.158	0.018	2.40	112	1.0	-	1.69	-0.01	104	237	87	84
176	27.782	0.165	0.018	2.39	112	1.0	-	1.66	-0.03	103	235	87	84
177	27.941	0.159	0.018	2.39	112	1.0	-	1.64	-0.02	103	234	87	84
178	28.103	0.162	0.018	2.40	112	1.0	-	1.63	-0.01	102	233	87	84
179	28.266	0.163	0.017	2.41	112	1.0	-	1.61	-0.02	103	232	87	84
180	28.426	0.160	0.018	2.41	112	1.0	100	1.59	-0.02	102	231	87	84
181	28.589	0.163	0.017	2.40	112	1.0	-	1.57	-0.02	102	229	87	84
182	28.751	0.162	0.018	2.39	112	1.0	-	1.55	-0.02	102	228	87	84
183	28.911	0.160	0.017	2.41	112	1.0	-	1.53	-0.02	102	227	87	84
184	29.076	0.165	0.017	2.41	112	1.0	-	1.51	-0.02	102	225	87	84
185	29.235	0.159	0.018	2.41	112	1.0	-	1.49	-0.02	102	226	87	84
186	29.398	0.163	0.017	2.40	113	1.0	-	1.48	-0.01	102	225	87	84
187	29.562	0.164	0.018	2.41	113	0.9	-	1.45	-0.03	102	225	87	84
188	29.720	0.158	0.017	2.41	113	0.9	-	1.43	-0.02	102	224	87	84
189	29.885	0.165	0.017	2.43	113	0.9	-	1.41	-0.02	103	223	87	84
190	30.045	0.160	0.018	2.43	113	1.0	99	1.39	-0.02	103	222	87	84
191	30.208	0.163	0.017	2.43	113	1.0	-	1.37	-0.02	102	223	87	84

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
192	30.371	0.163	0.017	2.43	113	1.0	-	1.37	0.00	101	222	87	84
193	30.532	0.161	0.017	2.44	113	1.0	-	1.29	-0.08	102	220	87	84
194	30.693	0.161	0.018	2.42	113	1.0	-	1.34	0.05	101	221	87	84
195	30.858	0.165	0.017	2.41	113	1.0	-	1.32	-0.02	101	220	87	84
196	31.015	0.157	0.017	2.40	113	1.0	-	1.29	-0.03	101	220	87	84
197	31.182	0.167	0.018	2.42	113	1.0	-	1.28	-0.01	102	218	87	84
198	31.341	0.159	0.017	2.41	113	1.0	-	1.26	-0.02	101	218	87	84
199	31.504	0.163	0.017	2.42	113	1.0	-	1.25	-0.01	101	218	87	84
200	31.668	0.164	0.017	2.42	113	1.0	100	1.23	-0.02	102	217	87	84
201	31.828	0.160	0.017	2.40	113	0.9	-	1.21	-0.02	100	217	87	85
202	31.991	0.163	0.018	2.40	113	1.0	-	1.20	-0.01	101	216	87	84
203	32.155	0.164	0.017	2.41	113	1.0	-	1.16	-0.04	101	215	87	84
204	32.314	0.159	0.018	2.40	113	1.0	-	1.16	0.00	100	215	87	84
205	32.480	0.166	0.017	2.40	113	0.9	-	1.15	-0.01	101	214	87	84
206	32.639	0.159	0.018	2.42	113	0.9	-	1.13	-0.02	101	215	87	85
207	32.803	0.164	0.018	2.42	113	1.0	-	1.11	-0.02	102	214	87	84
208	32.966	0.163	0.018	2.41	113	1.0	-	1.10	-0.01	102	214	87	84
209	33.127	0.161	0.018	2.41	114	1.0	-	1.08	-0.02	102	214	87	84
210	33.290	0.163	0.017	2.42	114	1.0	101	1.06	-0.02	101	215	87	84
211	33.454	0.164	0.018	2.40	114	1.0	-	1.04	-0.02	101	213	87	84
212	33.612	0.158	0.018	2.41	114	1.0	-	1.02	-0.02	102	213	87	84
213	33.779	0.167	0.018	2.40	114	1.0	-	1.01	-0.01	102	213	87	84
214	33.938	0.159	0.017	2.40	114	1.0	-	0.99	-0.02	102	214	87	84
215	34.101	0.163	0.018	2.40	114	1.0	-	0.97	-0.02	102	214	87	84
216	34.265	0.164	0.018	2.40	114	1.0	-	0.95	-0.02	101	214	87	84
217	34.425	0.160	0.018	2.39	114	1.0	-	0.94	-0.01	102	213	87	84
218	34.589	0.164	0.018	2.40	114	0.9	-	0.92	-0.02	102	213	87	84
219	34.753	0.164	0.018	2.39	114	1.0	-	0.90	-0.02	103	213	87	84
220	34.911	0.158	0.018	2.40	114	0.9	100	0.89	-0.01	102	213	87	84
221	35.078	0.167	0.018	2.40	114	1.0	-	0.87	-0.02	101	213	87	84
222	35.237	0.159	0.018	2.40	114	0.9	-	0.85	-0.02	102	213	87	84
223	35.400	0.163	0.018	2.40	114	1.0	-	0.83	-0.02	102	212	87	84

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
224	35.564	0.164	0.018	2.42	114	1.0	-	0.81	-0.02	102	213	87	84
225	35.725	0.161	0.018	2.40	114	0.9	-	0.79	-0.02	101	213	87	84
226	35.888	0.163	0.017	2.42	114	1.0	-	0.77	-0.02	101	213	87	84
227	36.052	0.164	0.018	2.41	114	1.0	-	0.74	-0.03	102	213	87	84
228	36.211	0.159	0.017	2.40	114	0.9	-	0.73	-0.01	101	213	87	84
229	36.377	0.166	0.018	2.41	114	0.9	-	0.72	-0.01	102	213	87	84
230	36.536	0.159	0.017	2.41	114	1.0	100	0.70	-0.02	101	213	87	85
231	36.700	0.164	0.018	2.40	114	1.0	-	0.68	-0.02	101	213	87	85
232	36.863	0.163	0.018	2.41	114	1.0	-	0.66	-0.02	101	212	87	85
233	37.024	0.161	0.017	2.40	114	0.9	-	0.64	-0.02	100	212	87	84
234	37.187	0.163	0.017	2.40	114	1.0	-	0.61	-0.03	100	212	87	84
235	37.352	0.165	0.018	2.40	114	0.9	-	0.60	-0.01	101	211	87	84
236	37.510	0.158	0.017	2.40	114	1.0	-	0.58	-0.02	101	212	87	85
237	37.677	0.167	0.018	2.40	114	1.0	-	0.56	-0.02	101	212	87	85
238	37.836	0.159	0.018	2.40	114	0.9	-	0.54	-0.02	101	212	87	85
239	38.000	0.164	0.018	2.41	114	1.0	-	0.52	-0.02	102	211	87	85
240	38.163	0.163	0.018	2.41	114	1.0	100	0.51	-0.01	100	212	87	85
241	38.324	0.161	0.018	2.42	114	1.0	-	0.49	-0.02	99	212	87	85
242	38.487	0.163	0.017	2.42	114	0.9	-	0.47	-0.02	100	212	87	85
243	38.651	0.164	0.018	2.42	114	1.0	-	0.45	-0.02	101	211	87	85
244	38.810	0.159	0.019	2.42	114	1.0	-	0.43	-0.02	101	211	87	85
245	38.977	0.167	0.018	2.41	114	1.0	-	0.42	-0.01	101	212	87	85
246	39.136	0.159	0.018	2.41	115	1.0	-	0.40	-0.02	101	211	87	85
247	39.299	0.163	0.018	2.40	115	1.0	-	0.38	-0.02	102	211	87	85
248	39.463	0.164	0.018	2.42	115	0.9	-	0.35	-0.03	102	211	87	85
249	39.624	0.161	0.017	2.41	115	1.0	-	0.34	-0.01	102	211	87	84
250	39.787	0.163	0.017	2.41	115	1.0	100	0.32	-0.02	101	211	87	84
251	39.952	0.165	0.018	2.42	115	1.0	-	0.30	-0.02	101	212	87	84
252	40.110	0.158	0.018	2.42	115	1.0	-	0.29	-0.01	102	212	87	85
253	40.277	0.167	0.018	2.47	115	1.0	-	0.27	-0.02	101	212	87	85
254	40.436	0.159	0.018	2.46	115	1.0	-	0.25	-0.02	102	212	87	85
255	40.600	0.164	0.018	2.47	115	1.0	-	0.23	-0.02	102	212	87	85

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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
256	40.763	0.163	0.018	2.46	115	1.0	-	0.21	-0.02	102	212	87	84
257	40.924	0.161	0.018	2.46	115	0.9	-	0.20	-0.01	102	212	87	85
258	41.087	0.163	0.017	2.45	115	0.9	-	0.18	-0.02	101	212	87	85
259	41.252	0.165	0.018	2.44	115	0.9	-	0.16	-0.02	102	211	87	85
260	41.410	0.158	0.018	2.44	115	0.9	100	0.14	-0.02	102	212	87	85
261	41.576	0.166	0.018	2.43	115	1.0	-	0.12	-0.02	101	212	87	85
262	41.736	0.160	0.017	2.44	115	1.0	-	0.11	-0.01	101	212	87	85
263	41.900	0.164	0.018	2.44	115	1.0	-	0.08	-0.03	101	213	87	85
264	42.063	0.163	0.018	2.43	115	0.9	-	0.07	-0.01	102	213	87	84
265	42.224	0.161	0.017	2.44	115	0.9	-	0.05	-0.02	101	213	87	85
266	42.387	0.163	0.018	2.42	115	1.0	-	0.04	-0.01	101	213	87	85
267	42.552	0.165	0.017	2.42	115	1.0	-	0.03	-0.01	100	214	87	85
268	42.711	0.159	0.017	2.43	115	1.0	101	0.00	-0.03	101	214	87	84
Avg/Tot	42.711	0.159	0.017	2.38	105.5	0.9	100			102.7	253.4	86.0	82.6

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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		1.55	82	1.8		83	-0.051	2.41	0.052
1	0.142	0.142	2.12	82	1.7	-	84	-0.049	1.72	0.073
2	0.286	0.144	2.12	82	1.8	-	84	-0.050	1.21	0.085
3	0.432	0.146	2.12	82	1.5	-	84	-0.051	1.40	0.009
4	0.575	0.143	2.13	82	2.0	-	84	-0.054	1.39	0.012
5	0.722	0.147	2.13	82	1.6	-	84	-0.054	1.78	0.013
6	0.865	0.143	2.12	83	1.7	-	84	-0.057	2.05	0.015
7	1.013	0.148	2.12	83	1.6	-	84	-0.054	2.00	0.016
8	1.156	0.143	2.12	83	1.5	-	84	-0.057	1.94	0.012
9	1.304	0.148	2.12	83	1.5	-	84	-0.057	1.91	0.011
10	1.447	0.143	2.12	83	1.8	100	85	-0.057	2.21	0.011
11	1.593	0.146	2.12	83	1.5	-	85	-0.056	2.23	0.011
12	1.737	0.144	2.12	83	1.5	-	85	-0.056	2.02	0.011
13	1.882	0.145	2.12	84	1.9	-	85	-0.056	2.20	0.007
14	2.029	0.147	2.12	84	1.9	-	85	-0.059	2.38	0.009
15	2.173	0.144	2.12	84	1.5	-	85	-0.059	2.35	0.012
16	2.321	0.148	2.12	85	1.7	-	85	-0.059	2.18	0.011
17	2.465	0.144	2.13	85	1.6	-	85	-0.060	2.53	0.008
18	2.613	0.148	2.13	85	1.6	-	84	-0.060	2.69	0.011
19	2.756	0.143	2.13	85	1.9	-	84	-0.060	2.71	0.012
20	2.904	0.148	2.13	86	1.5	100	84	-0.059	2.91	0.010
21	3.047	0.143	2.12	86	1.5	-	84	-0.062	3.04	0.010
22	3.196	0.149	2.13	86	1.6	-	84	-0.063	2.94	0.012
23	3.340	0.144	2.13	86	1.6	-	84	-0.064	3.00	0.007
24	3.488	0.148	2.13	87	1.6	-	84	-0.064	3.06	0.009
25	3.633	0.145	2.13	87	1.4	-	84	-0.064	3.17	0.013
26	3.781	0.148	2.13	88	1.7	-	84	-0.065	3.13	0.009
27	3.926	0.145	2.13	88	2.0	-	84	-0.065	3.33	0.010
28	4.073	0.147	2.13	88	1.5	-	84	-0.067	3.48	0.011
29	4.219	0.146	2.13	89	1.5	-	84	-0.065	3.59	0.008
30	4.366	0.147	2.13	89	1.5	102	84	-0.062	3.51	0.009
31	4.512	0.146	2.13	89	1.5	-	84	-0.065	3.49	0.009

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
32	4.658	0.146	2.12	90	2.0	-	84	-0.064	3.67	0.010
33	4.806	0.148	2.13	90	2.0	-	84	-0.063	3.54	0.008
34	4.952	0.146	2.13	90	1.7	-	84	-0.062	3.44	0.011
35	5.100	0.148	2.13	91	1.6	-	84	-0.065	3.78	0.007
36	5.246	0.146	2.13	91	2.0	-	84	-0.065	3.75	0.006
37	5.395	0.149	2.15	91	1.6	-	84	-0.066	3.70	0.006
38	5.541	0.146	2.14	92	1.6	-	84	-0.067	3.80	0.008
39	5.691	0.150	2.15	92	2.0	-	84	-0.068	3.95	0.011
40	5.835	0.144	2.14	92	2.0	102	84	-0.069	4.00	0.047
41	5.985	0.150	2.14	93	2.0	-	84	-0.069	4.01	0.118
42	6.130	0.145	2.14	93	1.5	-	84	-0.071	4.07	0.177
43	6.280	0.150	2.14	94	1.9	-	84	-0.070	4.28	0.239
44	6.426	0.146	2.14	94	1.8	-	84	-0.070	4.25	0.292
45	6.576	0.150	2.14	94	1.5	-	84	-0.069	4.34	0.327
46	6.721	0.145	2.14	95	1.5	-	84	-0.070	3.97	0.292
47	6.871	0.150	2.15	95	1.6	-	84	-0.070	4.16	0.300
48	7.017	0.146	2.14	95	2.0	-	84	-0.074	3.95	0.327
49	7.168	0.151	2.14	95	1.5	-	84	-0.067	3.83	0.284
50	7.313	0.145	2.14	96	1.6	102	84	-0.072	3.93	0.254
51	7.463	0.150	2.14	96	1.5	-	84	-0.071	4.05	0.243
52	7.609	0.146	2.15	96	1.6	-	84	-0.069	4.10	0.248
53	7.760	0.151	2.14	97	1.9	-	84	-0.069	4.22	0.236
54	7.906	0.146	2.15	97	1.9	-	84	-0.072	3.97	0.223
55	8.056	0.150	2.15	97	1.8	-	84	-0.070	3.90	0.136
56	8.203	0.147	2.14	98	2.0	-	84	-0.070	3.63	0.081
57	8.354	0.151	2.14	98	1.9	-	84	-0.067	3.89	0.069
58	8.500	0.146	2.14	98	1.8	-	84	-0.067	3.92	0.046
59	8.651	0.151	2.14	98	1.6	-	84	-0.069	4.06	0.033
60	8.798	0.147	2.14	99	1.5	102	84	-0.072	3.58	0.025
61	8.948	0.150	2.14	99	1.5	-	84	-0.068	4.20	0.039
62	9.095	0.147	2.14	99	1.9	-	84	-0.067	4.20	0.040
63	9.245	0.150	2.15	99	1.7	-	84	-0.070	4.29	0.034

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
64	9.392	0.147	2.15	99	2.0	-	84	-0.070	4.24	0.040
65	9.543	0.151	2.15	100	1.7	-	84	-0.072	4.21	0.053
66	9.690	0.147	2.14	100	1.6	-	85	-0.072	4.19	0.055
67	9.841	0.151	2.15	100	1.7	-	84	-0.071	4.45	0.075
68	9.987	0.146	2.15	100	1.8	-	85	-0.069	4.22	0.057
69	10.139	0.152	2.15	101	1.7	-	85	-0.071	3.96	0.063
70	10.286	0.147	2.15	101	2.0	102	85	-0.072	3.90	0.060
71	10.437	0.151	2.15	101	2.0	-	85	-0.070	3.79	0.045
72	10.583	0.146	2.15	101	1.6	-	85	-0.072	3.89	0.090
73	10.735	0.152	2.16	101	1.5	-	85	-0.067	3.99	0.035
74	10.882	0.147	2.16	102	1.9	-	85	-0.069	4.00	0.054
75	11.034	0.152	2.15	102	1.6	-	85	-0.069	3.83	0.034
76	11.181	0.147	2.15	102	1.6	-	85	-0.068	3.87	0.011
77	11.332	0.151	2.15	102	1.9	-	85	-0.068	3.56	0.006
78	11.479	0.147	2.16	102	2.0	-	85	-0.066	3.62	0.006
79	11.631	0.152	2.16	103	1.8	-	85	-0.064	3.54	0.006
80	11.778	0.147	2.16	103	1.6	102	85	-0.066	3.46	0.004
81	11.930	0.152	2.15	103	1.6	-	85	-0.064	3.39	0.005
82	12.077	0.147	2.16	103	1.9	-	85	-0.067	3.35	0.007
83	12.228	0.151	2.16	103	1.5	-	85	-0.064	3.17	0.005
84	12.376	0.148	2.16	103	1.9	-	85	-0.067	2.80	0.006
85	12.527	0.151	2.16	103	1.5	-	85	-0.065	2.84	0.006
86	12.675	0.148	2.16	104	1.5	-	85	-0.066	2.97	0.006
87	12.827	0.152	2.16	104	1.7	-	85	-0.063	2.97	0.006
88	12.975	0.148	2.16	104	2.0	-	85	-0.063	3.19	0.005
89	13.126	0.151	2.16	104	1.7	-	85	-0.064	2.93	0.005
90	13.274	0.148	2.16	104	1.7	101	85	-0.065	2.86	0.003
91	13.425	0.151	2.16	104	1.8	-	85	-0.062	3.01	0.004
92	13.573	0.148	2.16	105	1.6	-	85	-0.063	3.12	0.006
93	13.724	0.151	2.16	105	1.8	-	86	-0.057	3.01	0.006
94	13.872	0.148	2.16	105	1.6	-	86	-0.062	2.89	0.008
95	14.024	0.152	2.16	105	1.5	-	86	-0.066	2.77	0.004

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
96	14.172	0.148	2.16	105	1.7	-	86	-0.062	2.68	0.008
97	14.324	0.152	2.17	105	2.0	-	86	-0.062	2.86	0.004
98	14.472	0.148	2.16	105	1.5	-	86	-0.063	2.83	0.005
99	14.623	0.151	2.16	105	1.5	-	86	-0.059	2.84	0.005
100	14.772	0.149	2.16	106	1.9	101	86	-0.059	2.76	0.005
101	14.924	0.152	2.17	106	2.0	-	86	-0.063	2.90	0.004
102	15.074	0.150	2.17	106	1.8	-	86	-0.062	2.76	0.003
103	15.224	0.150	2.16	106	2.0	-	86	-0.063	2.88	0.005
104	15.374	0.150	2.17	106	1.5	-	86	-0.062	2.79	0.004
105	15.525	0.151	2.16	106	1.8	-	86	-0.061	2.81	0.005
106	15.675	0.150	2.16	106	1.7	-	86	-0.059	2.94	0.007
107	15.825	0.150	2.17	106	2.0	-	86	-0.066	2.89	0.005
108	15.976	0.151	2.17	107	1.8	-	86	-0.066	2.90	0.005
109	16.125	0.149	2.17	107	1.5	-	86	-0.064	2.91	0.004
110	16.276	0.151	2.16	107	1.7	100	86	-0.060	2.78	0.003
111	16.425	0.149	2.16	107	1.5	-	86	-0.061	2.74	0.005
112	16.577	0.152	2.17	107	1.5	-	86	-0.062	2.70	0.004
113	16.725	0.148	2.17	107	1.5	-	86	-0.063	2.90	0.002
114	16.877	0.152	2.17	107	1.5	-	86	-0.059	2.82	0.003
115	17.025	0.148	2.16	107	2.0	-	86	-0.061	2.76	0.006
116	17.178	0.153	2.17	107	1.5	-	86	-0.059	2.79	0.002
117	17.327	0.149	2.17	107	1.5	-	86	-0.059	2.84	0.004
118	17.480	0.153	2.17	107	2.0	-	86	-0.059	2.82	0.003
119	17.628	0.148	2.17	108	1.5	-	86	-0.061	2.89	0.002
120	17.781	0.153	2.17	108	1.5	99	86	-0.058	2.81	0.003
121	17.929	0.148	2.17	108	1.8	-	86	-0.057	2.74	0.004
122	18.082	0.153	2.18	108	2.0	-	86	-0.057	2.85	0.004
123	18.230	0.148	2.17	108	1.6	-	86	-0.062	2.84	0.004
124	18.383	0.153	2.18	108	1.8	-	86	-0.060	2.85	0.005
125	18.531	0.148	2.17	108	1.5	-	86	-0.060	2.63	0.002
126	18.683	0.152	2.17	108	1.5	-	86	-0.057	2.91	0.005
127	18.832	0.149	2.17	108	2.0	-	86	-0.060	2.77	0.004

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
128	18.984	0.152	2.17	108	2.0	-	86	-0.058	2.67	0.002
129	19.133	0.149	2.16	108	1.9	-	86	-0.058	2.90	0.004
130	19.285	0.152	2.17	108	1.5	98	86	-0.056	2.90	0.003
131	19.435	0.150	2.16	108	1.6	-	86	-0.058	3.11	0.001
132	19.587	0.152	2.17	108	1.8	-	86	-0.061	2.79	0.002
133	19.737	0.150	2.17	108	1.7	-	86	-0.057	2.80	0.003
134	19.888	0.151	2.16	109	1.9	-	86	-0.056	2.68	0.006
135	20.039	0.151	2.17	109	1.5	-	86	-0.058	2.74	0.003
136	20.189	0.150	2.17	109	1.8	-	86	-0.058	2.70	0.004
137	20.340	0.151	2.17	109	1.5	-	86	-0.059	2.43	0.004
138	20.489	0.149	2.17	109	1.7	-	86	-0.058	2.71	0.005
139	20.642	0.153	2.17	109	1.5	-	86	-0.056	2.68	0.004
140	20.791	0.149	2.17	109	2.0	98	86	-0.058	2.54	0.005
141	20.943	0.152	2.16	109	1.6	-	86	-0.057	2.30	0.006
142	21.092	0.149	2.16	109	1.5	-	86	-0.058	2.47	0.003
143	21.245	0.153	2.17	109	1.8	-	86	-0.056	2.43	0.005
144	21.394	0.149	2.16	109	1.7	-	86	-0.058	2.62	0.004
145	21.547	0.153	2.17	109	1.8	-	86	-0.059	2.58	0.003
146	21.695	0.148	2.16	109	1.7	-	86	-0.055	2.67	0.004
147	21.849	0.154	2.17	109	1.5	-	86	-0.059	2.66	0.003
148	21.997	0.148	2.17	109	1.9	-	86	-0.055	2.71	0.005
149	22.150	0.153	2.18	109	1.6	-	86	-0.059	2.75	0.003
150	22.298	0.148	2.17	110	2.0	100	86	-0.057	2.72	0.002
151	22.451	0.153	2.17	110	1.9	-	86	-0.057	2.66	0.003
152	22.600	0.149	2.17	110	2.0	-	86	-0.059	2.80	0.003
153	22.752	0.152	2.17	110	1.8	-	86	-0.060	2.72	0.003
154	22.902	0.150	2.17	110	1.7	-	86	-0.059	2.80	0.002
155	23.055	0.153	2.17	110	1.5	-	86	-0.055	2.81	0.003
156	23.205	0.150	2.17	110	1.7	-	86	-0.058	2.78	0.002
157	23.356	0.151	2.17	110	1.5	-	86	-0.061	2.92	0.003
158	23.508	0.152	2.17	110	1.9	-	86	-0.058	2.81	0.003
159	23.658	0.150	2.17	110	1.5	-	86	-0.054	2.96	0.003

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
160	23.810	0.152	2.18	110	1.4	100	86	-0.061	3.12	0.003
161	23.959	0.149	2.17	110	1.5	-	86	-0.057	3.08	0.004
162	24.111	0.152	2.17	110	2.0	-	86	-0.057	2.85	0.003
163	24.260	0.149	2.17	110	1.7	-	86	-0.056	2.67	0.003
164	24.413	0.153	2.16	110	1.6	-	86	-0.057	2.53	0.002
165	24.562	0.149	2.16	110	1.9	-	86	-0.055	2.62	0.002
166	24.716	0.154	2.17	110	1.6	-	86	-0.055	2.71	0.004
167	24.864	0.148	2.16	110	1.9	-	86	-0.056	2.31	0.003
168	25.018	0.154	2.17	110	2.0	-	86	-0.054	2.26	0.002
169	25.166	0.148	2.17	110	1.5	-	86	-0.056	2.23	0.003
170	25.320	0.154	2.17	110	1.7	100	86	-0.054	2.08	0.003
171	25.468	0.148	2.18	110	1.5	-	86	-0.055	2.28	0.003
172	25.621	0.153	2.17	111	1.9	-	86	-0.054	2.09	0.001
173	25.770	0.149	2.17	110	2.0	-	86	-0.050	2.32	0.002
174	25.923	0.153	2.17	110	1.9	-	86	-0.054	2.32	0.004
175	26.072	0.149	2.16	111	1.6	-	86	-0.051	2.42	0.002
176	26.224	0.152	2.17	111	1.9	-	86	-0.053	2.35	0.001
177	26.375	0.151	2.17	111	1.9	-	86	-0.055	2.21	0.001
178	26.527	0.152	2.17	111	1.6	-	86	-0.054	2.11	0.003
179	26.678	0.151	2.17	111	1.8	-	86	-0.053	2.38	0.002
180	26.829	0.151	2.17	111	1.5	99	86	-0.048	2.37	0.002
181	26.981	0.152	2.17	111	1.7	-	87	-0.051	2.30	0.001
182	27.130	0.149	2.18	111	2.0	-	87	-0.051	2.35	0.002
183	27.282	0.152	2.17	111	1.6	-	87	-0.050	2.20	0.001
184	27.432	0.150	2.17	111	1.9	-	87	-0.049	2.39	0.002
185	27.584	0.152	2.17	111	1.8	-	87	-0.049	2.47	0.002
186	27.733	0.149	2.17	111	2.0	-	86	-0.049	2.47	0.002
187	27.887	0.154	2.17	111	2.0	-	87	-0.048	2.33	0.003
188	28.036	0.149	2.17	111	1.5	-	87	-0.050	2.36	0.002
189	28.190	0.154	2.17	111	1.7	-	86	-0.051	2.49	0.003
190	28.339	0.149	2.17	111	1.5	98	86	-0.050	2.43	0.002
191	28.493	0.154	2.17	111	1.5	-	87	-0.048	2.37	0.002

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
192	28.641	0.148	2.17	111	2.0	-	87	-0.049	2.29	0.003
193	28.793	0.152	2.16	111	2.0	-	87	-0.044	2.31	0.001
194	28.943	0.150	2.17	111	2.0	-	87	-0.048	2.12	0.003
195	29.095	0.152	2.17	111	1.6	-	87	-0.049	2.30	0.001
196	29.245	0.150	2.16	111	1.9	-	87	-0.047	2.26	0.002
197	29.398	0.153	2.17	111	1.5	-	87	-0.046	2.31	0.003
198	29.548	0.150	2.17	111	1.6	-	87	-0.049	2.28	0.002
199	29.700	0.152	2.17	112	1.5	-	87	-0.047	2.30	0.003
200	29.852	0.152	2.16	112	1.6	99	87	-0.048	2.41	0.002
201	30.003	0.151	2.17	112	2.0	-	87	-0.045	2.19	0.002
202	30.154	0.151	2.18	112	1.9	-	87	-0.052	2.18	0.003
203	30.304	0.150	2.17	112	1.5	-	87	-0.048	2.33	0.001
204	30.457	0.153	2.17	112	2.0	-	87	-0.049	2.29	0.002
205	30.606	0.149	2.17	112	1.8	-	87	-0.049	2.37	0.003
206	30.759	0.153	2.17	112	1.5	-	87	-0.048	2.29	0.001
207	30.909	0.150	2.17	112	1.8	-	87	-0.043	2.38	0.002
208	31.063	0.154	2.17	112	1.5	-	87	-0.047	2.39	0.002
209	31.212	0.149	2.17	112	1.5	-	87	-0.045	2.31	0.001
210	31.365	0.153	2.17	112	1.5	101	87	-0.045	2.42	0.001
211	31.515	0.150	2.17	112	2.0	-	87	-0.044	2.37	0.002
212	31.667	0.152	2.18	112	1.5	-	87	-0.045	2.53	0.002
213	31.816	0.149	2.17	112	2.0	-	87	-0.045	2.58	0.004
214	31.969	0.153	2.17	112	2.0	-	87	-0.046	2.46	0.002
215	32.119	0.150	2.17	112	1.5	-	87	-0.045	2.57	0.002
216	32.271	0.152	2.17	112	1.5	-	87	-0.046	2.55	0.003
217	32.423	0.152	2.17	112	2.0	-	87	-0.047	2.44	0.001
218	32.575	0.152	2.17	112	1.5	-	87	-0.045	2.52	0.003
219	32.726	0.151	2.16	112	2.0	-	87	-0.048	2.64	0.002
220	32.877	0.151	2.17	112	1.5	99	87	-0.048	2.54	0.002
221	33.029	0.152	2.17	112	1.5	-	87	-0.046	2.49	0.002
222	33.179	0.150	2.17	112	1.7	-	87	-0.043	2.53	0.003
223	33.331	0.152	2.17	112	1.5	-	87	-0.046	2.60	0.002

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
224	33.481	0.150	2.17	112	1.5	-	87	-0.045	2.69	0.002
225	33.634	0.153	2.16	112	1.7	-	87	-0.047	2.48	0.002
226	33.784	0.150	2.17	112	1.5	-	87	-0.046	2.63	0.001
227	33.937	0.153	2.17	112	1.7	-	87	-0.048	2.69	0.002
228	34.086	0.149	2.17	112	1.7	-	87	-0.045	2.55	0.002
229	34.240	0.154	2.17	112	1.5	-	87	-0.044	2.67	0.002
230	34.389	0.149	2.17	112	1.7	99	87	-0.047	2.45	0.001
231	34.542	0.153	2.17	112	1.7	-	87	-0.045	2.59	0.003
232	34.691	0.149	2.17	112	2.0	-	87	-0.044	2.47	0.001
233	34.844	0.153	2.17	112	1.8	-	87	-0.042	2.42	0.001
234	34.994	0.150	2.17	113	1.5	-	87	-0.046	2.54	0.004
235	35.146	0.152	2.16	113	1.7	-	87	-0.045	2.60	0.003
236	35.297	0.151	2.17	113	2.0	-	87	-0.045	2.60	0.003
237	35.450	0.153	2.17	113	1.8	-	87	-0.047	2.71	0.002
238	35.601	0.151	2.16	113	1.5	-	87	-0.048	2.54	0.000
239	35.752	0.151	2.17	113	1.5	-	87	-0.046	2.66	0.003
240	35.904	0.152	2.17	113	1.7	99	87	-0.047	2.54	0.002
241	36.054	0.150	2.16	113	1.9	-	87	-0.046	2.34	0.001
242	36.206	0.152	2.17	113	1.8	-	87	-0.042	2.34	0.003
243	36.356	0.150	2.17	113	1.5	-	87	-0.043	2.41	0.002
244	36.508	0.152	2.16	113	1.9	-	87	-0.046	2.58	0.002
245	36.658	0.150	2.16	113	1.5	-	87	-0.048	2.65	0.001
246	36.812	0.154	2.17	113	1.8	-	87	-0.045	2.48	0.004
247	36.961	0.149	2.17	113	1.5	-	87	-0.047	2.53	0.001
248	37.115	0.154	2.16	113	2.0	-	87	-0.045	2.52	0.001
249	37.264	0.149	2.17	113	1.5	-	87	-0.048	2.51	0.002
250	37.417	0.153	2.17	113	1.5	99	87	-0.045	2.56	0.002
251	37.566	0.149	2.17	113	1.9	-	87	-0.044	2.54	0.001
252	37.719	0.153	2.17	113	1.6	-	87	-0.046	2.66	0.002
253	37.868	0.149	2.16	113	1.8	-	87	-0.048	2.44	0.001
254	38.021	0.153	2.16	113	1.6	-	87	-0.044	2.55	0.003
255	38.172	0.151	2.17	113	1.8	-	87	-0.047	2.53	0.002

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

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 (%)
256	38.324	0.152	2.17	113	1.6	-	87	-0.048	2.61	0.002
257	38.475	0.151	2.17	113	1.8	-	87	-0.046	2.51	0.002
258	38.627	0.152	2.17	113	1.8	-	87	-0.046	2.43	0.001
259	38.779	0.152	2.17	113	1.8	-	87	-0.049	2.53	0.003
260	38.928	0.149	2.17	113	1.6	99	87	-0.047	2.46	0.001
261	39.081	0.153	2.17	113	1.8	-	87	-0.050	2.47	0.001
262	39.231	0.150	2.17	113	1.5	-	87	-0.045	2.43	0.001
263	39.383	0.152	2.16	113	1.5	-	87	-0.044	2.45	0.001
264	39.533	0.150	2.17	113	1.8	-	87	-0.047	2.68	0.001
265	39.687	0.154	2.17	113	2.0	-	87	-0.048	2.38	0.001
266	39.836	0.149	2.17	113	1.9	-	87	-0.046	2.31	0.001
267	39.990	0.154	2.17	113	1.7	-	87	-0.046	2.41	0.002
268	40.140	0.150	2.17	113	1.8	100	87	-0.045	2.53	0.002
Avg/Tot	40.140	0.150	2.16	104.5	1.7	100	85.6	-0.057	2.84	0.022

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 1

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/5/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.000		0.70	83	1.7		81
1	0.155	0.155	1.07	83	1.7	-	82
2	0.311	0.156	1.08	83	1.8	-	82
3	0.468	0.157	1.10	83	1.9	-	82
4	0.625	0.157	1.11	83	1.7	-	82
5	0.782	0.157	1.11	83	1.7	-	82
6	0.940	0.158	1.10	83	1.8	-	83
7	1.099	0.159	1.11	83	1.7	-	83
8	1.257	0.158	1.12	83	1.8	-	83
9	1.416	0.159	1.12	84	1.7	-	83
10	1.574	0.158	1.11	84	1.7	98	83
11	1.734	0.160	1.12	84	1.9	-	83
12	1.893	0.159	1.12	84	1.8	-	83
13	2.053	0.160	1.13	84	1.7	-	83
14	2.211	0.158	1.12	84	1.8	-	83
15	2.371	0.160	1.12	85	1.8	-	83
16	2.532	0.161	1.13	85	1.9	-	84
17	2.691	0.159	1.14	85	1.8	-	83
18	2.852	0.161	1.13	86	1.7	-	82
19	3.013	0.161	1.14	86	1.9	-	82
20	3.174	0.161	1.15	86	1.7	99	82
21	3.335	0.161	1.14	86	1.8	-	82
22	3.498	0.163	1.15	87	1.7	-	82
23	3.658	0.160	1.15	87	1.7	-	82
24	3.822	0.164	1.15	87	1.7	-	82
25	3.984	0.162	1.16	88	1.8	-	82
26	4.146	0.162	1.15	88	1.8	-	82
27	4.309	0.163	1.16	88	1.9	-	82
28	4.471	0.162	1.16	88	1.8	-	82
29	4.635	0.164	1.16	88	1.7	-	82
30	4.798	0.163	1.17	88	1.8	101	82
31	4.961	0.163	1.15	89	1.7	-	82

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 1

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/5/2023

Elapsed Time (min)	Particulate Sampling 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)
32	5.125	0.164	1.17	89	1.9	-	82
33	5.287	0.162	1.16	90	1.7	-	82
34	5.452	0.165	1.16	90	1.9	-	82
35	5.615	0.163	1.17	90	1.9	-	82
36	5.779	0.164	1.16	90	1.9	-	82
37	5.944	0.165	1.17	91	1.7	-	82
38	6.107	0.163	1.16	91	1.9	-	82
39	6.272	0.165	1.17	91	1.9	-	82
40	6.436	0.164	1.16	92	1.9	102	82
41	6.601	0.165	1.17	92	1.9	-	82
42	6.765	0.164	1.17	92	1.7	-	82
43	6.930	0.165	1.17	93	1.8	-	82
44	7.094	0.164	1.17	93	1.9	-	82
45	7.260	0.166	1.17	93	1.9	-	82
46	7.423	0.163	1.18	94	1.7	-	82
47	7.589	0.166	1.17	93	1.8	-	82
48	7.754	0.165	1.18	94	1.8	-	82
49	7.919	0.165	1.17	94	1.8	-	82
50	8.084	0.165	1.18	95	1.9	102	83
51	8.250	0.166	1.17	94	1.9	-	83
52	8.415	0.165	1.18	95	1.8	-	83
53	8.581	0.166	1.17	95	1.8	-	83
54	8.745	0.164	1.18	95	1.9	-	83
55	8.912	0.167	1.17	95	1.8	-	83
56	9.077	0.165	1.18	95	1.9	-	83
57	9.243	0.166	1.18	95	1.8	-	83
58	9.408	0.165	1.18	96	1.7	-	83
59	9.575	0.167	1.18	96	1.8	-	83
60	9.739	0.164	1.18	96	1.8	102	83
Avg/Tot	9.739	0.162	1.14	88.8	1.8	101	82.3

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

Stove ΔT: 16

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	365	350	262	246	259	296.5	566.7
1	364	349	263	245	261	296.3	467.0
2	360	347	263	244	262	295.4	451.6
3	357	344	263	242	263	293.9	502.3
4	353	340	263	241	264	292.1	570.2
5	349	336	262	239	264	290.1	619.1
6	345	333	262	238	265	288.5	654.6
7	341	330	261	237	266	286.8	676.3
8	337	326	260	236	266	285.0	688.6
9	333	322	259	234	267	283.0	698.3
10	330	319	259	233	268	281.6	705.1
11	326	316	258	232	268	280.1	710.3
12	323	313	257	231	269	278.6	713.3
13	321	310	255	231	269	277.2	715.7
14	318	307	254	230	269	275.5	722.9
15	316	305	253	229	268	274.1	733.3
16	313	302	252	229	268	272.9	744.9
17	311	300	250	228	267	271.0	757.4
18	309	298	249	228	267	270.1	770.2
19	307	295	247	227	267	268.6	783.2
20	306	294	246	228	267	268.0	797.5
21	306	292	245	227	266	267.1	810.4
22	305	290	243	227	266	266.4	824.1
23	305	289	242	227	266	265.7	835.9
24	305	287	241	229	266	265.5	848.9
25	304	286	239	229	266	265.1	857.3
26	305	285	238	229	266	264.6	854.6
27	305	285	237	230	266	264.4	856.1
28	305	284	236	230	266	264.2	860.6
29	305	284	235	232	266	264.3	859.6
30	305	285	234	233	265	264.4	855.7
31	306	285	233	234	265	264.7	859.6
32	307	286	233	236	265	265.2	863.1
33	308	287	232	237	265	265.7	866.5
34	309	288	232	238	264	266.2	869.0
35	311	290	231	240	264	266.9	874.9
36	312	292	230	241	264	268.0	873.8
37	315	296	230	242	263	269.1	872.8
38	317	299	229	244	263	270.4	873.8
39	320	302	229	246	263	271.9	879.8
40	323	305	229	247	263	273.5	886.4
41	325	307	228	248	261	274.0	892.9
42	329	310	228	250	261	275.6	897.0
43	333	313	228	252	261	277.2	902.6
44	335	315	227	254	261	278.6	905.5
45	337	318	227	254	260	279.2	905.6
46	341	321	227	257	260	280.9	907.6
47	344	323	227	259	260	282.5	909.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

Stove ΔT: 16

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	347	326	226	261	260	283.8	907.7
49	350	327	226	262	259	284.8	906.7
50	353	329	226	264	258	286.1	907.6
51	357	330	226	266	258	287.6	910.1
52	360	331	226	268	258	288.7	910.5
53	363	333	227	269	257	289.7	910.3
54	365	333	227	270	255	290.1	909.7
55	369	335	227	271	255	291.3	911.1
56	372	336	227	273	255	292.7	914.3
57	375	338	227	275	255	294.0	914.5
58	378	339	227	275	254	294.7	915.0
59	380	341	228	277	254	295.9	915.2
60	382	343	228	278	253	297.0	916.7
61	385	345	229	280	253	298.4	917.8
62	386	347	229	281	252	299.2	919.0
63	389	350	229	282	251	300.4	921.4
64	391	352	230	283	251	301.4	923.9
65	393	355	230	285	250	302.5	926.5
66	395	357	230	286	250	303.8	925.5
67	397	359	231	288	250	304.8	925.9
68	399	362	231	288	249	305.8	927.2
69	401	364	231	289	249	306.9	925.6
70	403	366	232	291	249	308.0	925.7
71	405	367	232	292	249	308.9	926.0
72	407	368	233	292	247	309.5	924.3
73	409	370	234	294	247	310.6	921.8
74	412	371	234	294	247	311.4	915.8
75	414	372	235	295	246	312.3	910.3
76	417	373	235	296	246	313.3	903.5
77	418	373	236	296	245	313.6	894.5
78	421	374	236	297	245	314.6	885.3
79	422	375	237	298	245	315.3	876.6
80	422	376	237	298	245	315.6	868.2
81	423	376	238	298	244	315.9	858.7
82	424	377	239	298	244	316.4	848.4
83	424	377	239	298	244	316.5	837.9
84	425	378	239	297	245	316.8	829.2
85	426	378	240	298	245	317.5	820.6
86	427	378	241	298	245	317.8	812.1
87	428	379	241	297	244	317.8	807.0
88	427	379	242	297	245	317.8	804.1
89	426	378	242	295	244	317.1	805.4
90	426	379	243	295	245	317.4	804.6
91	426	379	243	294	245	317.4	802.9
92	425	379	244	293	245	317.0	801.0
93	424	379	244	293	245	317.0	799.6
94	423	378	245	291	245	316.4	799.5
95	422	379	245	291	246	316.4	794.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

Stove ΔT: 16

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	421	378	245	290	246	316.2	789.2
97	420	378	246	290	246	315.9	784.8
98	419	377	246	288	246	315.4	783.7
99	418	377	247	287	246	315.0	783.0
100	417	376	247	286	247	314.4	781.9
101	416	375	247	285	247	313.9	782.5
102	415	374	248	284	247	313.5	783.3
103	414	374	248	283	248	313.2	781.3
104	412	373	248	282	247	312.5	781.3
105	411	372	248	281	248	312.1	783.3
106	410	371	249	280	249	311.7	783.4
107	409	370	249	279	248	310.9	783.6
108	408	370	249	279	249	311.0	781.2
109	407	369	249	278	250	310.6	782.8
110	406	369	250	277	250	310.2	780.2
111	406	368	250	276	251	310.0	772.3
112	405	368	250	276	251	310.0	764.3
113	405	368	251	276	251	310.0	759.7
114	405	367	251	274	251	309.5	759.1
115	404	367	251	274	251	309.4	756.5
116	402	367	251	273	251	308.9	753.4
117	402	367	252	272	252	308.9	751.3
118	401	367	252	272	252	308.7	749.5
119	401	367	252	271	252	308.5	747.2
120	400	368	252	269	252	308.2	745.2
121	398	368	253	269	252	307.7	743.3
122	397	368	253	269	252	307.8	740.9
123	397	369	253	269	252	307.8	738.4
124	396	369	253	267	252	307.4	736.8
125	393	369	253	266	251	306.5	737.2
126	392	370	254	266	251	306.4	736.3
127	392	370	254	264	251	306.2	735.0
128	390	370	254	265	251	305.8	735.3
129	389	370	254	264	251	305.6	733.9
130	388	371	254	263	251	305.5	735.7
131	387	371	255	264	251	305.6	737.9
132	387	372	255	263	252	305.6	739.9
133	386	373	255	262	252	305.5	738.7
134	385	374	255	263	253	305.8	735.3
135	384	374	255	262	253	305.6	736.2
136	383	375	256	262	253	305.6	739.6
137	381	374	256	262	252	305.1	740.0
138	380	374	256	262	253	305.2	739.7
139	379	374	257	262	254	305.0	742.5
140	378	372	257	262	254	304.3	744.0
141	376	370	257	261	253	303.6	744.6
142	377	369	257	261	254	303.5	746.0
143	375	366	258	261	253	302.7	747.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

Stove ΔT: 16

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
144	374	365	258	260	254	302.1	749.5
145	374	363	258	261	254	302.0	751.5
146	373	361	258	260	254	301.5	751.3
147	373	360	259	260	255	301.2	750.5
148	372	359	259	260	255	300.9	752.0
149	371	357	259	260	255	300.5	752.5
150	370	356	260	259	255	299.9	752.1
151	370	355	260	259	256	300.0	750.5
152	370	354	261	258	256	299.6	745.1
153	370	353	261	257	255	299.1	744.1
154	369	352	261	257	256	299.1	741.7
155	369	352	262	257	256	298.9	742.1
156	369	351	262	257	257	299.1	741.4
157	368	351	263	257	257	299.0	735.4
158	368	351	263	256	257	299.0	725.4
159	368	352	264	256	257	299.2	719.0
160	369	352	264	255	257	299.5	710.4
161	370	353	264	255	258	299.8	711.4
162	371	353	265	254	258	300.3	714.6
163	372	354	266	254	258	300.6	715.8
164	372	354	266	253	258	300.7	713.5
165	372	354	266	253	258	300.8	711.5
166	372	355	267	252	259	300.8	708.8
167	371	355	267	253	259	301.0	707.0
168	370	355	268	253	259	300.9	703.5
169	370	354	268	251	259	300.1	696.4
170	369	353	268	251	258	299.8	689.0
171	367	352	269	251	257	299.2	680.1
172	366	351	269	250	257	298.5	673.2
173	365	350	270	250	257	298.4	667.0
174	365	349	269	249	257	297.8	660.6
175	364	348	270	249	258	297.6	656.6
176	363	347	270	249	258	297.2	651.6
177	362	346	270	248	259	296.9	646.7
178	362	345	270	248	259	296.7	641.8
179	361	345	270	247	258	296.1	635.9
180	360	344	270	246	259	295.8	633.2
181	359	343	270	245	260	295.4	627.8
182	359	342	270	243	260	294.8	624.4
183	358	342	270	243	260	294.5	621.3
184	357	341	270	241	261	294.1	617.6
185	356	340	271	240	260	293.5	616.7
186	356	339	271	239	261	293.1	611.4
187	355	339	271	238	261	292.8	612.0
188	355	338	271	238	260	292.5	609.0
189	354	338	271	237	261	292.1	606.4
190	353	337	272	236	261	291.8	605.4
191	353	337	272	235	261	291.5	604.1

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

Stove ΔT: 16

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
192	352	336	272	234	262	291.2	599.6
193	352	336	272	234	262	290.9	598.0
194	351	335	272	233	262	290.8	597.0
195	350	335	272	232	261	290.1	594.4
196	350	334	272	230	262	289.6	594.4
197	349	334	273	230	262	289.6	590.5
198	347	333	273	229	260	288.3	587.5
199	347	333	274	229	261	288.6	587.2
200	346	332	274	228	261	288.2	585.1
201	346	332	274	227	262	287.9	585.3
202	345	331	274	227	262	287.7	583.1
203	343	330	274	225	261	286.7	581.2
204	343	330	274	225	261	286.8	579.7
205	343	330	275	225	261	286.5	578.8
206	342	329	275	224	261	286.2	578.7
207	341	329	275	223	261	286.1	579.0
208	341	329	275	223	261	285.8	577.3
209	340	329	275	222	262	285.5	576.9
210	338	328	276	221	261	284.7	575.6
211	338	328	276	221	262	284.8	575.5
212	337	328	276	221	262	284.6	576.0
213	336	328	276	220	262	284.5	576.6
214	336	328	276	219	262	283.9	577.1
215	335	328	276	219	262	283.8	575.9
216	334	328	276	218	262	283.7	576.4
217	333	328	277	218	262	283.6	577.6
218	333	328	277	218	263	283.6	577.2
219	332	328	277	218	263	283.5	575.2
220	331	328	278	217	263	283.3	575.8
221	330	328	278	217	263	283.2	577.3
222	330	329	278	217	263	283.3	576.7
223	329	328	278	216	263	283.0	577.6
224	329	329	279	216	263	283.0	576.5
225	328	329	279	215	262	282.7	576.6
226	327	329	280	215	262	282.4	578.2
227	326	329	280	215	261	282.0	578.1
228	326	329	281	215	262	282.5	578.9
229	325	329	281	215	262	282.5	576.9
230	325	329	282	214	262	282.5	575.6
231	324	330	282	215	263	282.7	576.9
232	324	330	283	215	263	282.8	576.9
233	323	330	283	214	263	282.5	576.8
234	323	330	284	213	263	282.7	574.6
235	323	330	285	214	263	282.9	575.1
236	322	330	285	213	263	282.7	575.7
237	322	330	286	213	264	283.0	577.6
238	322	330	286	213	264	283.0	579.7
239	321	330	287	213	264	283.0	580.5

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 1

Technician: SJB

Date: 7/5/2023

Stove ΔT: 16

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
240	321	330	287	213	264	283.0	581.0
241	320	330	288	213	264	283.0	579.0
242	320	330	288	213	264	283.1	579.8
243	319	330	289	213	264	283.2	580.0
244	319	330	289	213	265	283.2	579.2
245	319	330	290	213	265	283.2	580.6
246	319	330	290	213	265	283.2	579.2
247	318	330	290	213	265	283.3	577.8
248	318	330	290	213	265	283.3	577.6
249	317	330	291	213	265	283.1	578.0
250	316	330	291	212	264	282.7	577.6
251	316	330	291	212	264	282.7	578.7
252	316	330	292	212	265	282.8	579.1
253	315	330	292	212	265	282.8	578.4
254	315	330	292	212	265	282.7	577.9
255	314	330	293	212	265	282.7	577.9
256	314	330	293	212	265	282.4	577.4
257	313	329	293	212	265	282.3	577.3
258	313	329	293	211	265	282.3	580.9
259	313	330	293	212	265	282.4	578.0
260	312	330	293	211	265	282.1	579.9
261	312	329	294	211	264	281.9	581.0
262	311	329	294	210	263	281.4	580.8
263	310	329	294	210	263	281.3	580.5
264	310	329	294	210	263	281.2	581.4
265	309	329	294	210	263	280.9	584.2
266	308	329	294	210	262	280.6	585.9
267	308	329	294	210	263	280.8	586.2
268	308	329	294	210	262	280.6	586.4
Average	359.1	342.1	258.5	248.9	257.7	293.3	720.7

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Model: F445

Run #: 1

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/5/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G596	242.9	243.1	0.2
	B	G597	242.2	242.5	0.3
	C - 1st Hour	G598	240.9	241.1	0.2
	Amb	G599	242.0	242.0	0.0
Probes	A	5A	116757.1	116757.3	0.2
	B	5B	116875.4	116875.4	0.0
	C - 1st Hour	5C	115855.1	115855.6	0.5
O-rings	A	5A	3536.8	3537.1	0.3
	B	5B	3532.6	3532.9	0.3
	C - 1st Hour	5C	3376.9	3377.0	0.1

Placed in Dessicator on:

7/5 - 17:15

Balance Audit (mg):

100.0

100.0

Filters	A	243.1	7/10 9:00	243.1	7/11 9:00				
	B	242.5	7/10 9:00	242.5	7/11 9:00				
	C - 1st Hour	241.1	7/10 9:00	241.1	7/11 9:00				
	Amb	242.0	7/10 9:00	242.0	7/11 9:00				
Probes	A	116757.2	7/10 9:00	116757.3	7/11 9:00				
	B	116875.3	7/10 9:00	116875.4	7/11 9:00				
	C - 1st Hour	115855.4	7/10 9:00	115855.6	7/11 9:00				
O-Rings	A	3537.2	7/10 9:00	3537.1	7/11 9:00				
	B	3532.8	7/10 9:00	3532.9	7/11 9:00				
	C - 1st Hour	3377.0	7/10 9:00	3377.0	7/11 9:00				

Train A Aggregate, mg: 0.7

Train B Aggregate, mg: 0.6

Train C Aggregate, mg: 0.8

Ambient, mg: 0.0

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 2 Test Date: 7/6/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Fully Closed
Targeted Burn Category: Low

Preburn Notes

Time	Notes
7:18	Stared kindling fire with ~7 lbs of fuel, air set to fully open, fan off
7:41	With 1.5 lbs of coals left, added preburn fuel load, door closed immediately
7:44	Turned air down to halfway open
8:00	Turned air down to medium low setting
8:29	At 13.05 lbs turned air down to test setting, fan turned on low
10:29	At 6.03 lbs, stirred remaining fuel to ensure uniform charcoalization
11:40	@ 3.16lbs leveled coal bed in preparation of fuel loading, left fan on, air control at test setting

Test Notes

Test Burn Start Time: 11:42 Test Fuel Loaded by: 35 seconds
Door Closed: 40 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
11:42	Loaded test fuel, door closed immediately, fan on a low, air set to test setting
16:11	End of test

Test Burn End Time: 16:11

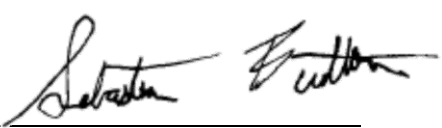
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	7:34	7:39	7:37	16:30	16:25	16:27
CO ₂	0.00	10.16	17.05	0.03	10.15	17.08
CO	0.000	2.522	4.304	0.015	2.514	4.312

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

Technician Signature:  Date: 7/7/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 2

Tracking #: 152
Test Date: 7/6/2023



Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: _____

Sebastian E. Sullivan

Date: 7/7/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 2 Test Date: 7/6/2023

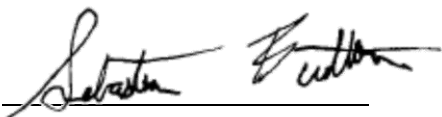
REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



Technician Signature:  Date: 7/7/2023

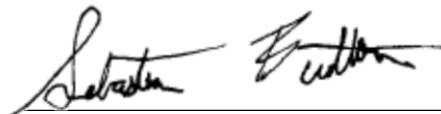
WOOD STOVE TEST DATA PACKET

ASTM E2780/E2515



Run 2 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/6/2023



Technician Signature

7/13/2023

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

Burn Rate (kg/hr):	1.18
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	31.306	42.595	40.005	9.751
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.2			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	21448.4			
Average Gas Meter Temperature (°F)	76.5	100.2	99.2	85.5
Total Sample Volume (dscf)	31.334	40.514	37.753	9.260
Average Tunnel Temperature (°F)	97.3			
Total Time of Test (min)	269			
Total Particulate Catch (mg)	0.0	1.1	0.9	0.6
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000272	0.0000238	0.0000648
Total PM Emissions (g)	0.00	2.61	2.29	1.39
Particulate Emission Rate (g/hr)	0.00	0.58	0.51	1.39
Emissions Factor (g/kg)	-	0.49	0.43	-
Difference from Average Total Particulate Emissions (g)	-	0.16	0.16	-
Difference from Average Total Particulate Emissions (%)	-	6.5%	6.5%	-
Difference from Average Emissions Factor (g/kg)	-	0.03	0.03	-

Final Average Results	
Total Particulate Emissions (g)	2.45
Particulate Emission Rate (g/hr)	0.55
Emissions Factor (g/kg)	0.46
HHV Efficiency (%)	73.9%
LHV Efficiency (%)	79.9%
CO Emissions (g/min)	0.53

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	85.0	OK
Face Velocity	< 30 ft/min	8.9	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min:74.8/Max:77.8	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	11.6	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/06/23
Run: 2
Control #: 23-167
Test Duration: 269
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	73.9%	79.9%
Combustion Efficiency	98.7%	98.7%
Heat Transfer Efficiency	74.9%	80.9%

Output Rate (kJ/h)	17,098	16,219	(Btu/h)
Burn Rate (kg/h)	1.17	2.57	(lb/h)
Input (kJ/h)	23,131	21,943	(Btu/h)

Test Load Weight (dry kg)	5.24	11.54	dry lb
MC wet (%)	17.94		
MC dry (%)	21.86		
Particulate (g)	2.45		
CO (g)	142		
Test Duration (h)	4.48		

Emissions	Particulate	CO
g/MJ Output	0.03	1.85
g/kg Dry Fuel	0.47	27.14
g/h	0.55	31.70
g/min	0.01	0.53
lb/MM Btu Output	0.07	4.31

Air/Fuel Ratio (A/F)	22.95
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	23.5		2x4	11.00	20.7
2x4	18.25	20.8		2x4	11.00	22.4
2x4	18.25	19.7				
2x4	18.25	18.6				
2x4	18.25	17.6				
2x4	11.00	24.8				
2x4	11.00	19.8				
2x4	11.00	20.3				
Total Fuel Weight (lbs):		15.98	Average Moisture (%DB):		20.8	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 5.18
 Total 4x4 Crib Weight, with spacers (lbs): 8.93
 Total Wet Fuel Weight, with spacers (lbs): 14.11

Coal Bed Range (20-25%):

Min (lbs): 2.82
 Max (lbs): 3.53

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.15	21.9	22.0	23.1	1.76
2x4	18.25	2.16	20.3	20.8	22.4	1.78
4x4	18.25	4.09	20.5	20.9	24.7	3.35
4x4	18.25	4.39	23.6	22.1	20.0	3.60
Total Dry Weight, no spacers (lbs):						10.49
Total Dry Weight, with spacers (lbs):						11.69

Spacer Moisture Readings (%DB)						
11.4	12.5	9.0				
7.4	11.1	12.6				
8.3	7.6	9.7				
8.7	8.8	11.2				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	28.4	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	6.95	OK
2x4 Fuel Mix	35 - 65 % of total weight	37%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 2
 Test Start Time: 11:42

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

Total Sampling Time (min): 269
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.77	29.69	29.73
Relative Humidity (%)	28.7	25.5	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:		31.306	ft ³

Sample Train Leak Checks

	Pre-test	Post-test		
Induced Draft Check (in. H ₂ O):	0	(A) 0.001	0.001	cfm @ -5 in. Hg
Smoke Capture Check (%):	100%	(B) 0.000	0.001	cfm @ -5 in. Hg
Date Flue Pipe Last Cleaned:	7/3/2023	(C) 0.001	0.001	cfm @ -5 in. Hg
Test Fuel Scale Audit (lbs)	10.00	(Ambient) 0.001	0.000	cfm @ -5 in. Hg
Platform Scale Audit (lbs)	10.0			

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.014	90
2	0.014	90
3	0.016	90
4	0.018	90
5	0.014	90
6	0.008	90
7	0.012	90
8	0.016	90
9	0.018	90
10	0.018	90
11	0.014	90
12	0.014	90
Center	0.017	90

Dilution Tunnel H₂O: 2.00 percent

Tunnel Diameter: 12 inches

Pitot Tube Cp: 0.99 [unitless]

Dilution Tunnel MW(dry): 29.00 lb/lb-mole

Dilution Tunnel MW(wet): 28.78 lb/lb-mole

Tunnel Area: 0.7854 ft²

V_{strav}: 8.17 ft/sec

V_{scnt}: 8.84 ft/sec

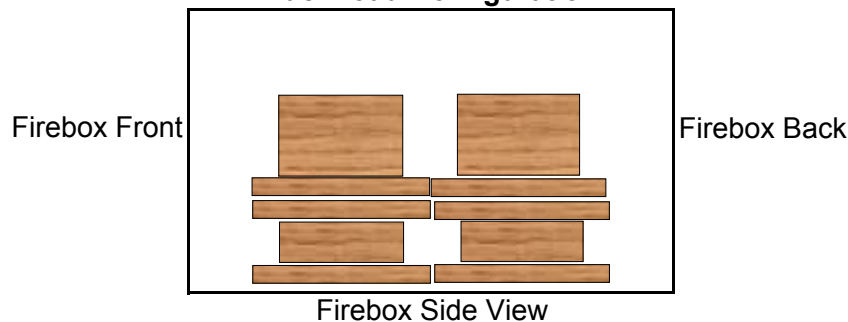
F_p: 0.924 [ratio]

Initial Tunnel Flow: 360.2 scf/min

Static Pressure: -0.090 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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)	21.9

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

Recording Interval (min): 1
Run Time (min): 191

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	13.05	-0.062	334	242	186	239	190	238.1	257	73
1	12.97	-0.064	335	243	187	239	190	238.6	255	73
2	12.90	-0.063	335	245	187	240	190	239.4	252	73
3	12.83	-0.065	336	246	187	241	189	239.9	250	73
4	12.77	-0.062	337	247	187	241	189	240.2	247	73
5	12.70	-0.063	337	249	187	242	189	240.7	245	73
6	12.63	-0.063	337	251	187	242	189	241.1	244	73
7	12.56	-0.062	337	252	187	242	189	241.2	241	73
8	12.50	-0.062	337	254	187	242	188	241.5	241	73
9	12.43	-0.061	337	256	187	242	188	241.8	239	73
10	12.37	-0.061	336	257	187	242	187	242.0	239	73
11	12.31	-0.060	337	258	187	242	187	242.1	238	73
12	12.24	-0.060	337	259	187	241	187	242.1	236	73
13	12.18	-0.060	337	260	187	241	186	242.4	235	73
14	12.12	-0.060	337	261	188	241	186	242.5	234	73
15	12.06	-0.058	337	262	188	240	185	242.6	234	73
16	12.00	-0.059	337	263	189	240	185	242.8	233	73
17	11.94	-0.058	337	264	189	240	184	242.9	232	73
18	11.87	-0.059	338	265	189	240	183	242.9	232	73
19	11.80	-0.060	337	266	190	240	182	243.0	231	73
20	11.75	-0.058	338	267	190	240	182	243.2	231	73
21	11.68	-0.059	338	267	190	239	181	243.3	231	73
22	11.63	-0.059	338	268	191	239	181	243.3	231	73
23	11.56	-0.058	338	269	191	239	180	243.4	231	73
24	11.51	-0.060	339	269	192	239	180	243.7	231	73
25	11.44	-0.058	340	269	192	240	179	243.9	231	73
26	11.39	-0.058	340	270	192	239	179	244.0	231	73
27	11.32	-0.058	340	270	193	240	178	244.2	231	73
28	11.25	-0.058	342	271	193	239	178	244.3	231	73
29	11.19	-0.057	342	271	193	240	177	244.6	230	74
30	11.14	-0.059	343	271	194	240	177	244.9	230	74
31	11.09	-0.060	344	271	194	239	176	245.0	230	74
32	11.03	-0.058	345	272	195	240	176	245.3	230	74
33	10.97	-0.059	345	272	195	240	175	245.5	230	74
34	10.92	-0.059	346	272	196	241	175	245.8	229	74
35	10.86	-0.058	347	272	196	240	175	246.0	230	73
36	10.80	-0.059	348	272	197	241	174	246.3	229	73
37	10.75	-0.059	349	272	197	240	174	246.5	229	73
38	10.69	-0.057	350	273	198	241	173	246.9	229	73
39	10.62	-0.059	351	273	198	241	173	247.2	230	73
40	10.57	-0.057	351	273	199	241	172	247.4	230	73
41	10.50	-0.058	352	274	199	241	171	247.5	230	73
42	10.45	-0.058	353	274	200	241	171	247.7	230	73
43	10.40	-0.058	354	275	200	242	170	248.1	231	73
44	10.32	-0.059	354	275	201	242	170	248.3	230	73

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

Recording Interval (min): 1

Run Time (min): 191

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
45	10.27	-0.061	355	275	201	241	170	248.4	232	74
46	10.20	-0.057	355	276	202	242	170	248.9	232	74
47	10.14	-0.061	356	276	202	242	169	249.1	232	74
48	10.08	-0.059	357	277	203	242	169	249.5	232	73
49	10.02	-0.060	357	278	203	241	169	249.6	233	74
50	9.96	-0.058	358	279	203	241	169	249.8	234	74
51	9.90	-0.058	358	279	204	241	168	250.3	233	74
52	9.83	-0.059	359	280	204	240	168	250.3	235	73
53	9.77	-0.061	360	281	205	241	168	250.8	235	74
54	9.70	-0.059	360	281	205	241	168	251.0	235	74
55	9.64	-0.059	362	282	205	241	168	251.3	235	74
56	9.59	-0.058	362	283	206	240	168	251.6	235	74
57	9.53	-0.060	362	283	206	240	167	251.9	235	74
58	9.47	-0.058	363	284	207	240	167	252.2	235	74
59	9.41	-0.057	363	285	207	240	167	252.5	235	74
60	9.33	-0.061	364	286	208	240	166	252.7	236	74
61	9.28	-0.058	365	287	208	240	166	253.0	235	74
62	9.21	-0.058	365	287	209	240	166	253.3	236	74
63	9.16	-0.060	366	288	209	240	166	253.7	235	74
64	9.09	-0.059	367	289	210	240	165	254.1	235	74
65	9.05	-0.060	368	290	210	240	165	254.3	235	74
66	8.98	-0.059	369	290	210	240	165	254.9	235	74
67	8.93	-0.060	370	291	211	240	165	255.3	235	74
68	8.87	-0.058	371	291	211	240	165	255.5	235	74
69	8.81	-0.058	371	292	212	240	165	255.9	235	74
70	8.75	-0.058	373	292	212	240	165	256.3	234	75
71	8.69	-0.059	373	293	213	240	165	256.6	235	75
72	8.64	-0.059	374	293	213	240	165	256.9	235	75
73	8.58	-0.058	375	293	214	240	165	257.3	235	74
74	8.52	-0.059	376	293	214	240	165	257.5	235	74
75	8.47	-0.059	376	294	214	239	165	257.6	235	74
76	8.41	-0.060	377	294	215	239	165	257.8	235	74
77	8.35	-0.059	377	294	215	239	165	258.0	235	74
78	8.30	-0.059	378	294	216	239	165	258.6	236	75
79	8.25	-0.058	378	295	216	239	165	258.8	236	75
80	8.19	-0.058	379	295	217	239	165	258.9	237	75
81	8.13	-0.059	379	295	217	239	165	259.0	234	75
82	8.08	-0.059	379	295	217	239	165	259.1	234	75
83	8.03	-0.057	379	296	218	238	165	259.2	235	75
84	7.98	-0.059	378	296	218	238	166	259.2	235	75
85	7.92	-0.058	378	297	219	238	166	259.5	235	75
86	7.87	-0.058	378	297	219	238	166	259.4	236	75
87	7.82	-0.058	377	298	220	238	166	259.6	236	74
88	7.76	-0.060	378	298	220	237	166	259.7	236	75
89	7.72	-0.057	377	298	221	238	166	259.9	236	74

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

 Recording Interval (min): 1
 Run Time (min): 191

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
90	7.66	-0.058	377	298	221	237	166	259.9	235	74
91	7.62	-0.058	378	297	221	237	167	260.0	235	74
92	7.56	-0.059	379	297	222	237	167	260.2	235	74
93	7.51	-0.057	380	297	222	237	166	260.5	235	75
94	7.47	-0.057	381	297	223	237	166	260.7	235	74
95	7.42	-0.058	381	297	223	236	167	260.8	236	75
96	7.37	-0.060	381	297	224	236	167	260.9	235	74
97	7.33	-0.058	381	296	224	236	167	260.8	235	74
98	7.29	-0.058	381	296	224	236	167	260.8	234	75
99	7.24	-0.058	380	297	225	236	167	260.8	233	75
100	7.20	-0.057	379	297	225	235	167	260.7	234	75
101	7.15	-0.058	378	297	225	235	167	260.5	234	75
102	7.10	-0.058	377	297	225	235	168	260.4	234	75
103	7.06	-0.058	376	298	226	235	168	260.3	233	75
104	7.01	-0.057	374	298	226	234	168	260.2	233	75
105	6.96	-0.058	373	299	226	234	168	260.2	233	75
106	6.92	-0.056	371	301	227	234	168	260.0	231	75
107	6.87	-0.056	369	303	227	234	169	260.2	232	75
108	6.82	-0.056	368	304	227	234	169	260.5	231	75
109	6.77	-0.056	366	306	228	234	169	260.5	231	75
110	6.72	-0.057	365	307	228	234	170	260.5	232	75
111	6.67	-0.057	363	308	228	234	170	260.6	232	75
112	6.62	-0.057	362	310	228	234	170	260.7	232	75
113	6.57	-0.056	361	311	229	234	171	260.9	233	75
114	6.52	-0.057	359	312	229	234	171	261.0	232	75
115	6.47	-0.057	359	314	229	234	171	261.2	233	75
116	6.41	-0.057	357	315	229	234	172	261.4	234	75
117	6.36	-0.056	356	316	229	234	172	261.6	234	75
118	6.31	-0.058	356	317	229	235	173	261.8	234	75
119	6.26	-0.057	355	318	229	235	173	262.1	233	75
120	6.21	-0.057	355	320	229	235	173	262.2	234	75
121	6.03	-0.064	354	321	230	235	174	262.7	314	75
122	5.89	-0.064	354	323	230	236	175	263.5	277	75
123	5.79	-0.065	356	324	230	236	176	264.3	266	75
124	5.68	-0.068	358	326	230	236	177	265.2	263	75
125	5.58	-0.069	360	327	230	236	177	265.9	263	75
126	5.48	-0.066	362	327	230	237	177	266.6	264	75
127	5.39	-0.063	363	327	230	239	178	267.3	265	75
128	5.31	-0.066	366	327	230	240	179	268.1	264	75
129	5.23	-0.068	368	326	230	241	179	268.9	263	75
130	5.15	-0.065	371	326	230	243	180	269.9	262	75
131	5.07	-0.065	373	326	230	245	181	271.0	261	75
132	5.01	-0.063	376	326	231	246	181	271.9	260	75
133	4.94	-0.064	378	326	231	248	182	272.9	259	76
134	4.89	-0.064	380	326	231	250	183	273.8	259	76

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

Recording Interval (min): 1
Run Time (min): 191

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
135	4.83	-0.063	381	326	231	252	184	274.5	257	75
136	4.78	-0.063	381	325	232	254	185	275.4	255	76
137	4.72	-0.062	382	325	232	255	186	276.0	253	76
138	4.67	-0.064	383	325	232	256	187	276.7	252	76
139	4.62	-0.061	385	325	232	258	188	277.5	251	75
140	4.56	-0.061	387	324	233	259	189	278.3	250	76
141	4.51	-0.062	388	324	233	260	190	279.0	249	75
142	4.47	-0.059	389	324	233	260	192	279.7	247	75
143	4.42	-0.058	390	324	233	261	193	280.4	247	75
144	4.38	-0.060	392	324	234	262	194	281.3	246	75
145	4.34	-0.059	394	324	234	263	196	282.1	246	75
146	4.29	-0.057	395	324	234	263	197	282.6	245	75
147	4.26	-0.061	397	323	235	262	199	283.1	242	75
148	4.24	-0.057	397	323	235	262	200	283.4	241	75
149	4.19	-0.058	397	323	235	262	201	283.7	240	75
150	4.16	-0.057	397	322	235	263	203	284.0	238	75
151	4.13	-0.057	396	322	236	262	204	284.0	237	75
152	4.09	-0.056	395	322	236	262	206	284.1	236	75
153	4.07	-0.055	394	321	237	262	207	284.2	235	75
154	4.02	-0.057	393	321	237	261	209	284.1	234	75
155	4.00	-0.055	392	321	237	261	211	284.2	234	75
156	3.96	-0.056	391	320	238	260	212	284.3	233	75
157	3.93	-0.052	390	320	238	259	214	284.3	232	75
158	3.89	-0.056	389	320	239	259	216	284.4	231	76
159	3.86	-0.055	388	320	239	258	218	284.5	230	76
160	3.83	-0.055	387	319	240	257	219	284.4	229	75
161	3.80	-0.053	386	319	240	256	221	284.6	229	76
162	3.76	-0.055	386	319	241	256	223	284.8	228	76
163	3.74	-0.054	385	319	241	255	225	284.9	227	76
164	3.72	-0.053	384	318	242	253	226	284.7	225	76
165	3.69	-0.053	383	318	242	252	228	284.6	223	75
166	3.66	-0.053	382	318	243	251	230	284.6	223	75
167	3.63	-0.051	381	317	243	250	231	284.6	221	75
168	3.61	-0.050	381	317	244	249	233	284.7	220	75
169	3.59	-0.050	380	317	244	248	235	284.7	219	75
170	3.56	-0.051	379	317	245	247	236	284.6	217	75
171	3.54	-0.052	378	316	246	246	238	284.7	216	75
172	3.52	-0.049	377	316	246	244	239	284.5	215	75
173	3.50	-0.050	377	316	247	244	241	284.8	214	75
174	3.47	-0.048	376	316	247	243	243	284.8	213	76
175	3.46	-0.048	375	315	248	242	244	284.8	212	76
176	3.44	-0.049	374	315	249	240	246	284.7	210	76
177	3.41	-0.048	374	314	249	240	247	284.7	209	76
178	3.40	-0.048	373	314	250	238	248	284.6	208	76
179	3.38	-0.047	372	314	250	237	250	284.4	207	76

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

Run Time (min):	191
-----------------	-----

[illegible]

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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		0.017	1.26	80	0.8		14.06		97	254	78	75
1	0.142	0.142	0.017	2.00	80	0.9	-	14.05	-0.01	100	266	78	75
2	0.283	0.141	0.017	2.04	80	0.9	-	14.02	-0.03	94	237	78	75
3	0.429	0.146	0.017	2.05	80	0.9	-	13.99	-0.03	92	231	78	75
4	0.572	0.143	0.017	2.07	80	0.8	-	13.95	-0.04	92	232	78	76
5	0.717	0.145	0.017	2.09	80	0.8	-	13.93	-0.02	92	234	78	76
6	0.864	0.147	0.017	2.12	80	0.9	-	13.89	-0.04	92	236	78	75
7	1.010	0.146	0.017	2.13	80	0.9	-	13.86	-0.03	92	237	78	76
8	1.159	0.149	0.016	2.16	80	0.9	-	13.82	-0.04	91	239	78	75
9	1.306	0.147	0.017	2.18	80	0.8	-	13.77	-0.05	91	240	78	76
10	1.456	0.150	0.017	2.18	80	0.9	95	13.72	-0.05	91	244	79	75
11	1.603	0.147	0.017	2.19	81	0.9	-	13.66	-0.06	91	248	79	75
12	1.754	0.151	0.017	2.21	81	0.9	-	13.62	-0.04	91	250	79	75
13	1.901	0.147	0.017	2.21	81	0.9	-	13.57	-0.05	92	250	79	75
14	2.053	0.152	0.017	2.22	81	0.8	-	13.53	-0.04	92	249	79	75
15	2.201	0.148	0.017	2.23	81	0.9	-	13.47	-0.06	92	251	79	75
16	2.353	0.152	0.017	2.24	82	0.8	-	13.41	-0.06	92	252	79	75
17	2.501	0.148	0.017	2.24	82	0.9	-	13.36	-0.05	92	255	79	75
18	2.655	0.154	0.017	2.25	82	0.9	-	13.30	-0.06	92	257	79	75
19	2.804	0.149	0.017	2.26	82	0.9	-	13.24	-0.06	92	258	79	75
20	2.956	0.152	0.017	2.26	83	0.9	97	13.19	-0.05	92	260	79	75
21	3.105	0.149	0.017	2.26	83	0.9	-	13.12	-0.07	92	262	79	75
22	3.258	0.153	0.017	2.26	83	0.9	-	13.06	-0.06	92	263	79	75
23	3.408	0.150	0.017	2.27	83	0.9	-	12.99	-0.07	93	265	79	75
24	3.561	0.153	0.017	2.27	84	0.9	-	12.93	-0.06	92	267	80	75
25	3.713	0.152	0.016	2.28	84	0.9	-	12.86	-0.07	93	269	80	75
26	3.865	0.152	0.018	2.28	84	0.9	-	12.79	-0.07	93	271	80	75
27	4.019	0.154	0.017	2.29	85	0.9	-	12.73	-0.06	93	273	80	75
28	4.171	0.152	0.017	2.30	85	0.9	-	12.66	-0.07	93	275	80	75
29	4.325	0.154	0.017	2.30	86	0.9	-	12.58	-0.08	93	276	80	75
30	4.476	0.151	0.017	2.31	86	0.9	98	12.51	-0.07	93	278	80	75
31	4.631	0.155	0.016	2.31	86	0.9	-	12.43	-0.08	93	281	80	75

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

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
32	4.781	0.150	0.017	2.31	86	0.9	-	12.37	-0.06	93	283	80	75
33	4.938	0.157	0.017	2.31	87	0.9	-	12.28	-0.09	93	286	80	75
34	5.087	0.149	0.017	2.30	87	0.9	-	12.21	-0.07	94	289	80	75
35	5.245	0.158	0.017	2.32	87	0.9	-	12.12	-0.09	94	293	80	75
36	5.397	0.152	0.017	2.32	88	0.9	-	12.03	-0.09	94	299	80	75
37	5.553	0.156	0.017	2.32	88	0.9	-	11.93	-0.10	94	304	80	75
38	5.704	0.151	0.017	2.33	88	0.9	-	11.84	-0.09	94	307	80	75
39	5.860	0.156	0.017	2.33	89	0.9	-	11.75	-0.09	94	310	80	75
40	6.014	0.154	0.017	2.33	89	0.9	99	11.65	-0.10	94	313	80	75
41	6.169	0.155	0.017	2.34	89	0.9	-	11.55	-0.10	94	316	80	75
42	6.325	0.156	0.016	2.34	90	0.9	-	11.46	-0.09	95	319	80	75
43	6.477	0.152	0.017	2.34	90	0.9	-	11.34	-0.12	96	320	80	75
44	6.635	0.158	0.017	2.35	90	0.9	-	11.24	-0.10	95	323	80	75
45	6.786	0.151	0.017	2.33	90	0.9	-	11.14	-0.10	96	325	80	75
46	6.945	0.159	0.017	2.36	91	0.9	-	11.04	-0.10	96	327	80	75
47	7.098	0.153	0.017	2.34	91	0.9	-	10.93	-0.11	96	328	80	75
48	7.255	0.157	0.017	2.36	91	0.9	-	10.84	-0.09	96	331	80	75
49	7.409	0.154	0.017	2.35	92	0.9	-	10.73	-0.11	97	332	81	75
50	7.565	0.156	0.017	2.35	92	0.9	99	10.61	-0.12	97	333	81	75
51	7.723	0.158	0.017	2.36	92	0.9	-	10.51	-0.10	97	334	81	75
52	7.876	0.153	0.017	2.37	92	0.9	-	10.38	-0.13	97	336	81	75
53	8.035	0.159	0.017	2.36	93	0.9	-	10.27	-0.11	98	338	81	75
54	8.187	0.152	0.017	2.36	93	0.9	-	10.15	-0.12	98	341	81	75
55	8.347	0.160	0.017	2.36	93	0.9	-	10.02	-0.13	99	342	81	75
56	8.501	0.154	0.017	2.37	94	0.9	-	9.90	-0.12	98	344	81	76
57	8.658	0.157	0.017	2.37	94	0.9	-	9.78	-0.12	98	345	81	76
58	8.815	0.157	0.017	2.37	94	0.9	-	9.65	-0.13	98	348	81	76
59	8.971	0.156	0.017	2.37	94	0.9	-	9.52	-0.13	98	348	81	76
60	9.129	0.158	0.017	2.37	95	0.9	100	9.39	-0.13	99	349	81	76
61	9.282	0.153	0.017	2.38	95	0.9	-	9.26	-0.13	99	350	81	76
62	9.443	0.161	0.016	2.37	95	0.9	-	9.15	-0.11	100	351	81	76
63	9.597	0.154	0.017	2.38	95	0.9	-	9.02	-0.13	100	354	81	76

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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
64	9.755	0.158	0.017	2.38	95	0.9	-	8.88	-0.14	100	354	81	76
65	9.911	0.156	0.017	2.38	96	0.9	-	8.76	-0.12	100	356	81	76
66	10.069	0.158	0.017	2.38	96	0.9	-	8.62	-0.14	100	357	81	76
67	10.228	0.159	0.017	2.39	96	0.9	-	8.50	-0.12	100	357	81	76
68	10.381	0.153	0.017	2.38	96	0.9	-	8.36	-0.14	100	358	82	76
69	10.543	0.162	0.017	2.38	97	0.9	-	8.23	-0.13	100	360	82	76
70	10.698	0.155	0.017	2.38	97	1.0	100	8.10	-0.13	101	360	82	76
71	10.856	0.158	0.017	2.38	97	0.9	-	7.97	-0.13	101	361	82	76
72	11.014	0.158	0.017	2.38	97	0.9	-	7.85	-0.12	102	361	82	76
73	11.171	0.157	0.017	2.39	97	0.9	-	7.72	-0.13	102	361	82	76
74	11.330	0.159	0.016	2.39	97	0.9	-	7.60	-0.12	102	364	82	76
75	11.484	0.154	0.017	2.40	98	0.9	-	7.47	-0.13	102	363	82	76
76	11.646	0.162	0.016	2.39	98	0.9	-	7.34	-0.13	102	363	82	76
77	11.801	0.155	0.017	2.40	98	0.9	-	7.23	-0.11	102	363	82	76
78	11.959	0.158	0.016	2.39	98	0.9	-	7.11	-0.12	102	361	82	76
79	12.120	0.161	0.017	2.40	98	0.9	-	7.00	-0.11	102	362	82	76
80	12.274	0.154	0.016	2.40	99	0.9	102	6.89	-0.11	102	360	82	76
81	12.435	0.161	0.017	2.39	99	0.9	-	6.78	-0.11	102	359	82	76
82	12.592	0.157	0.017	2.40	99	0.9	-	6.67	-0.11	102	359	82	76
83	12.751	0.159	0.016	2.40	99	0.9	-	6.55	-0.12	102	361	82	76
84	12.909	0.158	0.017	2.40	99	1.0	-	6.44	-0.11	103	362	82	76
85	13.068	0.159	0.017	2.40	99	0.9	-	6.32	-0.12	103	363	82	77
86	13.227	0.159	0.017	2.41	99	1.0	-	6.20	-0.12	102	362	82	77
87	13.383	0.156	0.017	2.41	100	0.9	-	6.09	-0.11	103	362	82	77
88	13.545	0.162	0.017	2.41	100	1.0	-	5.98	-0.11	103	361	82	77
89	13.701	0.156	0.017	2.43	100	1.0	-	5.87	-0.11	103	361	82	77
90	13.861	0.160	0.017	2.40	100	1.0	102	5.76	-0.11	103	362	83	77
91	14.022	0.161	0.017	2.42	100	0.9	-	5.65	-0.11	103	361	83	77
92	14.177	0.155	0.017	2.42	100	1.0	-	5.55	-0.10	103	360	83	76
93	14.339	0.162	0.017	2.42	100	1.0	-	5.46	-0.09	103	360	83	77
94	14.496	0.157	0.017	2.42	101	0.9	-	5.36	-0.10	103	357	83	76
95	14.655	0.159	0.017	2.40	101	0.9	-	5.27	-0.09	103	355	83	76

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: <u>Jotul</u>	Job #: <u>23-167</u>
Model: <u>F445</u>	Tracking #: <u>152</u>
Run #: <u>2</u>	Technician: <u>SJB</u>
	Date: <u>7/6/2023</u>

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
96	14.816	0.161	0.017	2.39	101	0.9	-	5.19	-0.08	103	353	83	76
97	14.972	0.156	0.017	2.41	101	0.9	-	5.11	-0.08	102	350	83	76
98	15.133	0.161	0.017	2.41	101	0.9	-	5.04	-0.07	102	348	83	76
99	15.291	0.158	0.017	2.41	101	0.9	-	4.95	-0.09	102	346	83	76
100	15.451	0.160	0.017	2.41	101	0.9	101	4.89	-0.06	102	343	83	77
101	15.611	0.160	0.017	2.40	101	0.9	-	4.82	-0.07	102	340	83	76
102	15.769	0.158	0.017	2.40	101	1.0	-	4.74	-0.08	102	337	83	77
103	15.930	0.161	0.017	2.38	102	0.9	-	4.68	-0.06	102	335	83	77
104	16.087	0.157	0.017	2.39	102	1.0	-	4.60	-0.08	102	333	83	77
105	16.248	0.161	0.017	2.41	102	0.9	-	4.54	-0.06	101	330	83	77
106	16.406	0.158	0.017	2.41	102	0.9	-	4.48	-0.06	102	328	83	77
107	16.566	0.160	0.017	2.42	102	0.9	-	4.43	-0.05	101	325	83	77
108	16.722	0.156	0.017	2.42	102	0.9	-	4.36	-0.07	101	325	83	77
109	16.884	0.162	0.017	2.41	102	0.9	-	4.30	-0.06	100	326	83	77
110	17.047	0.163	0.017	2.42	102	0.9	101	4.23	-0.07	102	328	83	77
111	17.204	0.157	0.017	2.42	102	0.9	-	4.16	-0.07	102	328	83	77
112	17.364	0.160	0.017	2.41	102	0.9	-	4.10	-0.06	101	330	83	77
113	17.525	0.161	0.017	2.41	102	0.9	-	4.04	-0.06	101	329	83	77
114	17.682	0.157	0.018	2.40	103	0.9	-	3.97	-0.07	101	331	83	77
115	17.845	0.163	0.018	2.38	103	1.0	-	3.90	-0.07	100	331	83	77
116	18.002	0.157	0.017	2.39	103	1.0	-	3.84	-0.06	101	331	83	77
117	18.163	0.161	0.017	2.41	103	0.9	-	3.78	-0.06	101	330	83	77
118	18.324	0.161	0.018	2.41	103	0.9	-	3.72	-0.06	100	330	83	77
119	18.481	0.157	0.017	2.43	103	0.9	-	3.66	-0.06	101	329	83	77
120	18.644	0.163	0.017	2.43	103	1.0	101	3.59	-0.07	101	329	83	77
121	18.801	0.157	0.017	2.41	103	1.0	-	3.53	-0.06	101	327	83	77
122	18.962	0.161	0.017	2.41	103	0.9	-	3.46	-0.07	101	326	83	77
123	19.123	0.161	0.017	2.41	103	0.9	-	3.39	-0.07	101	325	83	77
124	19.281	0.158	0.017	2.41	103	0.9	-	3.34	-0.05	100	325	83	77
125	19.443	0.162	0.017	2.40	103	0.9	-	3.28	-0.06	101	323	83	77
126	19.601	0.158	0.017	2.39	104	1.0	-	3.22	-0.06	101	323	83	77
127	19.762	0.161	0.017	2.39	104	0.9	-	3.16	-0.06	100	324	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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
128	19.923	0.161	0.017	2.40	104	0.9	-	3.12	-0.04	101	324	83	77
129	20.081	0.158	0.016	2.41	104	0.9	-	3.07	-0.05	101	323	83	77
130	20.244	0.163	0.017	2.42	104	0.9	101	3.01	-0.06	100	322	83	77
131	20.401	0.157	0.017	2.42	104	0.9	-	2.95	-0.06	101	322	83	77
132	20.562	0.161	0.017	2.43	104	0.9	-	2.90	-0.05	101	321	83	77
133	20.724	0.162	0.017	2.42	104	0.9	-	2.85	-0.05	100	321	83	77
134	20.881	0.157	0.017	2.42	104	0.9	-	2.79	-0.06	100	321	84	77
135	21.044	0.163	0.017	2.43	104	0.9	-	2.74	-0.05	100	320	83	77
136	21.202	0.158	0.017	2.43	104	0.9	-	2.69	-0.05	100	319	83	77
137	21.363	0.161	0.017	2.43	104	0.9	-	2.64	-0.05	100	319	83	77
138	21.525	0.162	0.017	2.44	104	0.9	-	2.59	-0.05	100	318	83	77
139	21.683	0.158	0.017	2.44	104	1.0	-	2.54	-0.05	100	318	83	77
140	21.845	0.162	0.017	2.44	104	0.9	101	2.48	-0.06	100	318	83	77
141	22.004	0.159	0.018	2.45	105	1.0	-	2.42	-0.06	100	318	83	77
142	22.165	0.161	0.017	2.45	105	1.0	-	2.37	-0.05	100	319	83	77
143	22.326	0.161	0.017	2.42	105	0.9	-	2.31	-0.06	100	320	83	77
144	22.484	0.158	0.017	2.43	105	1.0	-	2.27	-0.04	100	320	83	77
145	22.646	0.162	0.017	2.41	105	1.0	-	2.21	-0.06	100	321	83	77
146	22.807	0.161	0.017	2.41	105	1.0	-	2.17	-0.04	100	320	83	77
147	22.965	0.158	0.017	2.44	105	0.9	-	2.13	-0.04	100	319	83	77
148	23.127	0.162	0.017	2.43	105	0.9	-	2.10	-0.03	100	316	83	77
149	23.286	0.159	0.017	2.43	105	0.9	-	2.06	-0.04	100	312	83	77
150	23.448	0.162	0.017	2.41	105	0.9	101	2.04	-0.02	100	309	83	77
151	23.609	0.161	0.017	2.43	105	1.0	-	2.01	-0.03	100	306	83	77
152	23.767	0.158	0.017	2.43	105	0.9	-	1.99	-0.02	100	302	83	77
153	23.930	0.163	0.018	2.42	105	1.0	-	1.96	-0.03	99	300	84	77
154	24.089	0.159	0.017	2.43	105	1.0	-	1.94	-0.02	99	296	84	77
155	24.249	0.160	0.017	2.43	105	0.9	-	1.92	-0.02	99	292	84	77
156	24.412	0.163	0.017	2.41	105	1.0	-	1.89	-0.03	99	290	84	77
157	24.569	0.157	0.017	2.43	105	0.9	-	1.88	-0.01	99	287	84	77
158	24.733	0.164	0.017	2.42	105	0.9	-	1.86	-0.02	99	285	84	77
159	24.890	0.157	0.018	2.42	105	1.0	-	1.83	-0.03	99	284	84	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

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
160	25.052	0.162	0.017	2.43	105	0.9	100	1.81	-0.02	98	280	84	77
161	25.215	0.163	0.017	2.44	105	0.9	-	1.79	-0.02	98	277	84	77
162	25.369	0.154	0.017	2.42	105	0.9	-	1.77	-0.02	98	275	84	77
163	25.536	0.167	0.017	2.42	105	1.0	-	1.75	-0.02	97	273	83	77
164	25.693	0.157	0.017	2.43	106	0.9	-	1.72	-0.03	98	271	83	77
165	25.855	0.162	0.017	2.42	106	0.9	-	1.70	-0.02	97	270	84	77
166	26.017	0.162	0.017	2.43	106	0.9	-	1.68	-0.02	97	267	84	77
167	26.174	0.157	0.017	2.43	106	1.0	-	1.66	-0.02	97	265	83	77
168	26.339	0.165	0.017	2.43	106	0.9	-	1.64	-0.02	97	264	83	77
169	26.497	0.158	0.017	2.44	106	0.9	-	1.62	-0.02	97	263	83	77
170	26.658	0.161	0.017	2.42	106	1.0	100	1.60	-0.02	97	261	83	77
171	26.820	0.162	0.017	2.45	106	0.9	-	1.58	-0.02	97	259	83	77
172	26.979	0.159	0.017	2.43	106	0.9	-	1.56	-0.02	97	258	83	77
173	27.141	0.162	0.017	2.43	106	1.0	-	1.54	-0.02	97	257	83	77
174	27.302	0.161	0.017	2.43	106	0.9	-	1.53	-0.01	97	255	83	77
175	27.462	0.160	0.017	2.44	106	1.0	-	1.51	-0.02	97	255	83	77
176	27.624	0.162	0.017	2.44	106	1.0	-	1.50	-0.01	97	253	83	77
177	27.783	0.159	0.017	2.45	106	0.9	-	1.47	-0.03	96	253	83	77
178	27.944	0.161	0.017	2.43	106	0.9	-	1.45	-0.02	96	252	83	77
179	28.106	0.162	0.017	2.44	106	0.9	-	1.44	-0.01	96	252	83	77
180	28.264	0.158	0.017	2.44	106	0.9	100	1.43	-0.01	96	251	83	77
181	28.428	0.164	0.017	2.46	106	1.0	-	1.41	-0.02	96	250	83	77
182	28.586	0.158	0.017	2.44	106	1.0	-	1.38	-0.03	96	249	83	77
183	28.747	0.161	0.017	2.44	106	0.9	-	1.37	-0.01	96	248	83	77
184	28.910	0.163	0.017	2.44	106	1.0	-	1.35	-0.02	96	248	83	77
185	29.067	0.157	0.017	2.45	106	1.0	-	1.34	-0.01	96	246	83	77
186	29.232	0.165	0.016	2.44	106	0.9	-	1.32	-0.02	96	245	83	77
187	29.389	0.157	0.017	2.44	106	0.9	-	1.30	-0.02	96	245	83	77
188	29.552	0.163	0.017	2.44	106	0.9	-	1.29	-0.01	96	245	83	77
189	29.714	0.162	0.017	2.46	106	1.0	-	1.27	-0.02	96	246	84	77
190	29.871	0.157	0.017	2.45	106	1.0	100	1.25	-0.02	96	244	84	77
191	30.036	0.165	0.017	2.45	106	1.0	-	1.23	-0.02	96	243	84	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

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
192	30.194	0.158	0.017	2.44	106	0.9	-	1.21	-0.02	96	244	83	77
193	30.356	0.162	0.017	2.41	107	1.0	-	1.20	-0.01	96	243	83	77
194	30.518	0.162	0.017	2.43	106	0.9	-	1.18	-0.02	96	244	83	77
195	30.677	0.159	0.017	2.41	106	0.9	-	1.17	-0.01	96	243	83	77
196	30.839	0.162	0.017	2.42	107	0.9	-	1.15	-0.02	95	242	83	77
197	31.000	0.161	0.017	2.42	107	0.9	-	1.13	-0.02	95	241	83	77
198	31.159	0.159	0.017	2.43	107	0.9	-	1.12	-0.01	95	241	83	77
199	31.322	0.163	0.017	2.41	107	0.9	-	1.10	-0.02	96	241	83	77
200	31.481	0.159	0.017	2.41	107	1.0	100	1.08	-0.02	96	241	83	77
201	31.643	0.162	0.017	2.42	107	0.9	-	1.07	-0.01	96	240	83	77
202	31.805	0.162	0.017	2.43	107	0.9	-	1.04	-0.03	95	240	83	77
203	31.963	0.158	0.018	2.42	107	1.0	-	1.03	-0.01	95	240	83	77
204	32.127	0.164	0.017	2.40	107	0.9	-	1.02	-0.01	95	240	83	77
205	32.285	0.158	0.016	2.41	107	0.9	-	1.00	-0.02	96	240	83	77
206	32.447	0.162	0.017	2.41	107	0.9	-	0.97	-0.03	96	239	83	77
207	32.610	0.163	0.016	2.41	107	0.9	-	0.97	0.00	95	239	83	77
208	32.767	0.157	0.017	2.40	107	1.0	-	0.95	-0.02	96	239	83	77
209	32.932	0.165	0.017	2.40	107	0.9	-	0.93	-0.02	96	239	84	77
210	33.090	0.158	0.016	2.41	107	1.0	102	0.92	-0.01	96	239	84	77
211	33.252	0.162	0.017	2.39	107	0.9	-	0.90	-0.02	96	239	84	77
212	33.414	0.162	0.017	2.40	107	1.0	-	0.88	-0.02	96	239	84	77
213	33.572	0.158	0.017	2.39	107	0.9	-	0.86	-0.02	96	238	84	77
214	33.736	0.164	0.017	2.39	107	0.9	-	0.85	-0.01	96	238	84	77
215	33.895	0.159	0.017	2.40	107	0.9	-	0.84	-0.01	96	238	84	77
216	34.056	0.161	0.017	2.40	107	1.0	-	0.82	-0.02	96	238	84	77
217	34.218	0.162	0.017	2.38	107	0.9	-	0.80	-0.02	96	238	84	77
218	34.377	0.159	0.017	2.38	107	1.0	-	0.79	-0.01	96	238	84	77
219	34.540	0.163	0.017	2.38	107	0.9	-	0.77	-0.02	96	238	84	77
220	34.702	0.162	0.017	2.39	107	0.9	102	0.75	-0.02	96	238	84	77
221	34.859	0.157	0.017	2.38	107	0.9	-	0.74	-0.01	96	238	84	77
222	35.024	0.165	0.017	2.39	107	0.9	-	0.72	-0.02	96	238	84	77
223	35.182	0.158	0.017	2.39	107	0.9	-	0.70	-0.02	96	238	84	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

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
224	35.344	0.162	0.017	2.38	107	1.0	-	0.68	-0.02	96	237	84	77
225	35.507	0.163	0.017	2.39	107	1.0	-	0.67	-0.01	96	237	84	77
226	35.664	0.157	0.017	2.39	107	0.9	-	0.66	-0.01	95	237	84	77
227	35.829	0.165	0.017	2.38	107	0.9	-	0.64	-0.02	95	237	84	77
228	35.987	0.158	0.017	2.40	107	0.9	-	0.62	-0.02	96	237	84	77
229	36.149	0.162	0.017	2.40	107	0.9	-	0.60	-0.02	95	237	84	78
230	36.311	0.162	0.017	2.40	107	1.0	100	0.59	-0.01	96	237	84	78
231	36.470	0.159	0.017	2.40	107	0.9	-	0.57	-0.02	96	237	84	77
232	36.633	0.163	0.017	2.40	107	0.9	-	0.55	-0.02	96	237	84	77
233	36.792	0.159	0.017	2.40	107	0.9	-	0.54	-0.01	96	237	84	77
234	36.954	0.162	0.017	2.41	107	0.9	-	0.53	-0.01	96	236	84	77
235	37.116	0.162	0.017	2.41	107	0.9	-	0.52	-0.01	96	236	84	77
236	37.272	0.156	0.017	2.42	107	0.9	-	0.50	-0.02	96	236	84	77
237	37.438	0.166	0.017	2.44	107	0.9	-	0.48	-0.02	96	236	84	78
238	37.599	0.161	0.016	2.43	107	0.9	-	0.47	-0.01	96	235	84	77
239	37.757	0.158	0.017	2.43	107	0.9	-	0.46	-0.01	96	236	84	77
240	37.922	0.165	0.017	2.44	107	0.9	100	0.44	-0.02	96	236	84	77
241	38.080	0.158	0.017	2.45	107	0.9	-	0.43	-0.01	96	235	84	77
242	38.242	0.162	0.017	2.44	107	0.9	-	0.41	-0.02	96	235	84	77
243	38.406	0.164	0.017	2.44	107	1.0	-	0.40	-0.01	96	236	84	78
244	38.562	0.156	0.017	2.43	108	1.0	-	0.38	-0.02	96	236	84	77
245	38.728	0.166	0.017	2.43	107	1.0	-	0.37	-0.01	96	236	84	77
246	38.886	0.158	0.017	2.45	108	1.0	-	0.35	-0.02	96	236	84	78
247	39.048	0.162	0.017	2.43	107	1.0	-	0.34	-0.01	96	236	84	78
248	39.210	0.162	0.017	2.45	107	0.9	-	0.33	-0.01	96	235	84	78
249	39.369	0.159	0.017	2.44	107	1.0	-	0.31	-0.02	96	234	84	78
250	39.532	0.163	0.017	2.44	107	0.9	100	0.30	-0.01	95	234	84	78
251	39.692	0.160	0.017	2.45	107	1.0	-	0.28	-0.02	96	235	84	78
252	39.853	0.161	0.017	2.45	108	1.0	-	0.26	-0.02	95	235	84	78
253	40.015	0.162	0.017	2.44	108	0.9	-	0.25	-0.01	96	235	84	78
254	40.175	0.160	0.017	2.43	108	0.9	-	0.23	-0.02	95	235	84	77
255	40.337	0.162	0.017	2.43	107	0.9	-	0.22	-0.01	95	234	84	78

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul Job #: 23-167
 Model: F445 Tracking #: 152
 Run #: 2 Technician: SJB
 Date: 7/6/2023

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
256	40.499	0.162	0.017	2.43	107	0.9	-	0.21	-0.01	95	234	84	78
257	40.657	0.158	0.017	2.43	108	1.0	-	0.19	-0.02	95	234	84	78
258	40.823	0.166	0.017	2.44	108	1.0	-	0.18	-0.01	95	234	84	78
259	40.980	0.157	0.017	2.44	108	1.0	-	0.16	-0.02	95	235	84	78
260	41.143	0.163	0.017	2.43	108	0.9	100	0.15	-0.01	95	234	84	78
261	41.306	0.163	0.017	2.45	108	1.0	-	0.13	-0.02	95	234	84	78
262	41.463	0.157	0.017	2.45	108	0.9	-	0.12	-0.01	95	233	84	78
263	41.628	0.165	0.017	2.43	108	0.9	-	0.11	-0.01	95	232	84	77
264	41.787	0.159	0.017	2.42	108	0.9	-	0.08	-0.03	95	232	84	77
265	41.949	0.162	0.017	2.42	108	0.9	-	0.07	-0.01	95	231	84	77
266	42.111	0.162	0.017	2.42	108	0.9	-	0.06	-0.01	95	231	84	78
267	42.271	0.160	0.017	2.42	108	0.9	-	0.04	-0.02	95	230	84	77
268	42.433	0.162	0.017	2.43	108	1.0	-	0.03	-0.01	95	231	84	77
269	42.595	0.162	0.017	2.43	108	0.9	100	0.00	-0.03	95	231	84	78
Avg/Tot	42.595	0.158	0.017	2.38	100.2	0.9	100			97.3	286.7	82.4	76.5

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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		1.39	80	1.6		79	-0.041	1.68	0.113
1	0.138	0.138	2.05	80	1.8	-	79	-0.041	2.09	0.120
2	0.277	0.139	2.06	80	1.9	-	80	-0.048	2.59	0.400
3	0.422	0.145	2.06	80	1.9	-	80	-0.050	2.35	0.033
4	0.565	0.143	2.08	80	1.7	-	80	-0.049	2.21	0.030
5	0.708	0.143	2.08	80	1.9	-	80	-0.051	2.24	0.032
6	0.850	0.142	2.08	81	1.9	-	80	-0.049	2.27	0.023
7	0.993	0.143	2.08	81	1.9	-	80	-0.050	2.40	0.032
8	1.138	0.145	2.08	81	1.8	-	80	-0.053	2.49	0.034
9	1.279	0.141	2.08	81	1.9	-	80	-0.051	3.17	0.038
10	1.425	0.146	2.09	81	2.0	99	80	-0.053	3.72	0.034
11	1.566	0.141	2.08	81	1.5	-	80	-0.054	3.72	0.032
12	1.711	0.145	2.08	81	1.5	-	80	-0.056	3.43	0.036
13	1.855	0.144	2.09	81	1.8	-	80	-0.054	3.23	0.035
14	1.999	0.144	2.09	82	1.7	-	80	-0.053	3.25	0.033
15	2.142	0.143	2.09	82	1.5	-	80	-0.053	3.61	0.035
16	2.285	0.143	2.09	82	2.0	-	80	-0.054	4.17	0.036
17	2.431	0.146	2.09	82	1.9	-	80	-0.055	4.21	0.033
18	2.574	0.143	2.10	82	1.4	-	80	-0.055	4.08	0.029
19	2.720	0.146	2.10	82	1.8	-	80	-0.055	4.14	0.034
20	2.862	0.142	2.10	83	2.0	99	81	-0.055	4.18	0.035
21	3.008	0.146	2.10	83	1.4	-	81	-0.058	4.35	0.039
22	3.150	0.142	2.10	83	1.4	-	81	-0.056	4.41	0.036
23	3.297	0.147	2.10	84	2.0	-	81	-0.056	4.49	0.034
24	3.441	0.144	2.11	84	1.8	-	81	-0.057	4.56	0.035
25	3.587	0.146	2.10	84	1.6	-	81	-0.058	4.59	0.043
26	3.731	0.144	2.11	85	1.6	-	81	-0.058	4.76	0.037
27	3.875	0.144	2.11	85	1.7	-	81	-0.058	4.76	0.039
28	4.020	0.145	2.10	85	1.7	-	81	-0.057	4.83	0.041
29	4.164	0.144	2.11	86	2.0	-	81	-0.059	4.99	0.041
30	4.312	0.148	2.12	86	2.0	100	81	-0.060	5.04	0.039
31	4.456	0.144	2.12	87	1.6	-	81	-0.057	5.18	0.044

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
32	4.603	0.147	2.11	87	1.7	-	81	-0.059	5.35	0.035
33	4.746	0.143	2.11	87	1.9	-	81	-0.061	5.54	0.039
34	4.894	0.148	2.12	87	2.0	-	81	-0.061	5.94	0.040
35	5.036	0.142	2.11	88	1.4	-	81	-0.061	6.35	0.046
36	5.185	0.149	2.11	88	1.9	-	81	-0.065	6.34	0.045
37	5.328	0.143	2.11	88	1.9	-	81	-0.062	6.69	0.040
38	5.476	0.148	2.12	89	1.9	-	81	-0.066	6.81	0.034
39	5.621	0.145	2.12	89	1.7	-	81	-0.066	6.74	0.039
40	5.768	0.147	2.11	89	1.9	100	81	-0.065	6.69	0.033
41	5.913	0.145	2.12	90	2.0	-	82	-0.065	6.94	0.030
42	6.059	0.146	2.12	90	2.0	-	82	-0.066	6.98	0.034
43	6.205	0.146	2.11	90	1.9	-	82	-0.069	6.95	0.027
44	6.350	0.145	2.11	91	2.0	-	82	-0.071	7.19	0.026
45	6.497	0.147	2.11	91	1.5	-	82	-0.066	7.09	0.023
46	6.642	0.145	2.11	91	1.5	-	82	-0.064	7.01	0.030
47	6.790	0.148	2.13	91	2.0	-	82	-0.067	7.06	0.031
48	6.935	0.145	2.13	92	2.0	-	82	-0.067	7.21	0.027
49	7.084	0.149	2.14	92	2.0	-	82	-0.069	7.23	0.029
50	7.228	0.144	2.13	92	1.9	99	82	-0.070	7.29	0.042
51	7.378	0.150	2.14	92	1.9	-	82	-0.067	7.20	0.073
52	7.523	0.145	2.14	92	1.5	-	82	-0.070	7.47	0.108
53	7.672	0.149	2.14	92	1.6	-	82	-0.071	7.55	0.211
54	7.817	0.145	2.14	93	1.9	-	82	-0.070	7.64	0.292
55	7.966	0.149	2.14	93	1.5	-	82	-0.072	7.74	0.335
56	8.111	0.145	2.14	94	1.9	-	82	-0.074	7.88	0.341
57	8.261	0.150	2.14	94	2.0	-	82	-0.072	7.78	0.393
58	8.406	0.145	2.14	94	2.0	-	82	-0.072	7.83	0.458
59	8.556	0.150	2.15	95	1.5	-	82	-0.073	7.79	0.501
60	8.702	0.146	2.15	95	1.9	100	83	-0.072	7.70	0.483
61	8.852	0.150	2.16	95	2.0	-	83	-0.072	7.84	0.450
62	8.998	0.146	2.16	96	1.5	-	83	-0.073	7.76	0.472
63	9.147	0.149	2.16	96	1.6	-	83	-0.074	7.73	0.538

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
64	9.293	0.146	2.15	96	1.8	-	83	-0.075	7.86	0.605
65	9.443	0.150	2.16	96	2.0	-	83	-0.077	7.73	0.642
66	9.590	0.147	2.16	96	1.9	-	83	-0.074	7.73	0.660
67	9.739	0.149	2.16	96	1.5	-	83	-0.077	7.73	0.673
68	9.886	0.147	2.17	96	1.5	-	83	-0.076	7.74	0.676
69	10.036	0.150	2.17	96	1.8	-	83	-0.072	7.87	0.713
70	10.183	0.147	2.16	97	2.0	100	83	-0.075	7.86	0.673
71	10.332	0.149	2.17	97	1.5	-	83	-0.076	7.81	0.668
72	10.480	0.148	2.17	97	1.5	-	83	-0.073	7.78	0.584
73	10.629	0.149	2.17	97	1.8	-	83	-0.075	7.71	0.553
74	10.776	0.147	2.16	97	1.6	-	83	-0.074	7.63	0.521
75	10.926	0.150	2.17	97	1.6	-	83	-0.076	7.74	0.545
76	11.073	0.147	2.16	97	1.5	-	83	-0.076	7.80	0.579
77	11.222	0.149	2.16	97	1.5	-	83	-0.072	7.74	0.552
78	11.370	0.148	2.16	98	1.5	-	83	-0.075	7.63	0.473
79	11.519	0.149	2.16	98	1.9	-	83	-0.073	7.53	0.334
80	11.667	0.148	2.16	98	1.8	102	83	-0.074	7.47	0.298
81	11.816	0.149	2.16	98	1.5	-	83	-0.073	7.38	0.231
82	11.964	0.148	2.17	99	2.0	-	84	-0.073	7.58	0.223
83	12.113	0.149	2.17	99	1.4	-	84	-0.072	7.62	0.287
84	12.262	0.149	2.16	99	2.0	-	84	-0.074	7.62	0.292
85	12.411	0.149	2.17	99	1.6	-	84	-0.075	7.71	0.353
86	12.559	0.148	2.17	100	1.7	-	84	-0.074	7.62	0.343
87	12.709	0.150	2.17	100	1.7	-	84	-0.074	7.57	0.322
88	12.857	0.148	2.17	100	1.5	-	84	-0.071	7.56	0.342
89	13.007	0.150	2.17	100	2.0	-	84	-0.074	7.32	0.421
90	13.155	0.148	2.18	100	1.6	102	84	-0.073	7.45	0.418
91	13.305	0.150	2.17	100	1.6	-	84	-0.071	7.32	0.374
92	13.453	0.148	2.17	100	2.0	-	84	-0.073	7.25	0.350
93	13.603	0.150	2.17	100	2.0	-	84	-0.073	7.21	0.197
94	13.751	0.148	2.17	100	1.6	-	84	-0.072	7.12	0.111
95	13.901	0.150	2.17	100	1.5	-	84	-0.073	6.97	0.065

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
96	14.049	0.148	2.17	100	1.6	-	84	-0.070	6.70	0.031
97	14.199	0.150	2.17	100	1.5	-	84	-0.072	6.61	0.023
98	14.347	0.148	2.17	100	1.8	-	84	-0.072	6.28	0.022
99	14.497	0.150	2.17	100	1.9	-	84	-0.071	6.28	0.023
100	14.645	0.148	2.17	101	1.4	100	84	-0.069	6.16	0.021
101	14.795	0.150	2.17	101	2.0	-	84	-0.071	6.17	0.021
102	14.943	0.148	2.18	101	1.6	-	84	-0.069	6.11	0.022
103	15.094	0.151	2.17	101	1.9	-	84	-0.067	5.98	0.023
104	15.241	0.147	2.17	101	1.8	-	84	-0.067	5.82	0.023
105	15.392	0.151	2.17	101	1.6	-	84	-0.068	5.69	0.022
106	15.540	0.148	2.17	101	1.7	-	84	-0.066	5.43	0.023
107	15.691	0.151	2.18	101	1.6	-	84	-0.067	5.62	0.022
108	15.835	0.144	2.18	101	2.0	-	85	-0.068	5.62	0.022
109	15.990	0.155	2.18	101	1.9	-	84	-0.069	5.55	0.030
110	16.138	0.148	2.18	101	1.5	100	84	-0.068	5.70	0.031
111	16.289	0.151	2.17	101	1.6	-	84	-0.067	5.74	0.033
112	16.436	0.147	2.17	102	2.0	-	85	-0.067	5.72	0.032
113	16.588	0.152	2.17	102	2.0	-	85	-0.069	5.66	0.030
114	16.735	0.147	2.17	102	1.5	-	85	-0.068	5.90	0.030
115	16.887	0.152	2.17	102	2.0	-	85	-0.071	5.76	0.033
116	17.034	0.147	2.17	102	1.4	-	85	-0.067	5.70	0.031
117	17.186	0.152	2.18	102	1.5	-	85	-0.067	5.87	0.033
118	17.334	0.148	2.17	102	1.8	-	85	-0.069	5.94	0.031
119	17.486	0.152	2.17	103	1.5	-	85	-0.068	5.89	0.028
120	17.633	0.147	2.17	103	1.7	100	85	-0.067	6.08	0.025
121	17.785	0.152	2.18	103	1.8	-	85	-0.067	6.11	0.026
122	17.932	0.147	2.18	103	1.5	-	85	-0.068	6.37	0.023
123	18.084	0.152	2.17	103	1.7	-	85	-0.067	6.38	0.022
124	18.232	0.148	2.17	103	1.5	-	85	-0.064	6.16	0.023
125	18.384	0.152	2.17	103	2.0	-	85	-0.065	6.11	0.027
126	18.531	0.147	2.17	103	1.8	-	85	-0.065	6.25	0.028
127	18.683	0.152	2.18	103	1.6	-	85	-0.067	5.76	0.028

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
128	18.831	0.148	2.18	103	2.0	-	85	-0.066	5.55	0.028
129	18.983	0.152	2.18	103	1.4	-	85	-0.069	5.65	0.023
130	19.130	0.147	2.18	103	2.0	100	85	-0.068	5.77	0.029
131	19.281	0.151	2.18	103	1.9	-	85	-0.068	5.90	0.029
132	19.429	0.148	2.18	103	1.5	-	85	-0.067	5.77	0.030
133	19.580	0.151	2.18	103	1.7	-	85	-0.064	5.80	0.028
134	19.728	0.148	2.18	103	1.9	-	85	-0.068	5.90	0.033
135	19.880	0.152	2.18	103	1.5	-	85	-0.065	5.75	0.026
136	20.028	0.148	2.18	103	1.5	-	85	-0.066	5.66	0.031
137	20.179	0.151	2.18	103	1.8	-	85	-0.068	5.69	0.027
138	20.328	0.149	2.17	103	1.8	-	85	-0.065	5.51	0.032
139	20.479	0.151	2.17	103	1.5	-	85	-0.063	5.75	0.033
140	20.627	0.148	2.17	104	1.8	100	85	-0.065	5.73	0.027
141	20.779	0.152	2.18	104	1.5	-	85	-0.064	5.94	0.033
142	20.928	0.149	2.18	104	1.7	-	85	-0.066	5.98	0.034
143	21.079	0.151	2.18	104	1.9	-	85	-0.066	6.12	0.029
144	21.229	0.150	2.17	104	1.9	-	85	-0.064	6.01	0.032
145	21.379	0.150	2.18	104	1.5	-	85	-0.067	5.92	0.037
146	21.529	0.150	2.17	104	2.0	-	85	-0.068	5.64	0.031
147	21.678	0.149	2.17	104	1.7	-	85	-0.065	5.43	0.030
148	21.829	0.151	2.18	104	1.5	-	85	-0.062	5.11	0.027
149	21.978	0.149	2.18	104	1.9	-	85	-0.062	5.08	0.028
150	22.129	0.151	2.18	104	1.8	100	85	-0.064	4.82	0.027
151	22.278	0.149	2.18	104	1.9	-	85	-0.063	4.84	0.019
152	22.429	0.151	2.18	104	2.0	-	85	-0.065	4.59	0.028
153	22.577	0.148	2.18	104	1.9	-	85	-0.061	4.48	0.025
154	22.728	0.151	2.18	104	2.0	-	85	-0.060	4.64	0.025
155	22.877	0.149	2.18	104	1.5	-	85	-0.059	4.54	0.024
156	23.029	0.152	2.18	104	2.0	-	85	-0.059	4.57	0.024
157	23.177	0.148	2.18	104	2.0	-	85	-0.059	4.50	0.023
158	23.328	0.151	2.17	104	1.4	-	85	-0.057	4.51	0.027
159	23.476	0.148	2.17	104	1.6	-	85	-0.059	4.44	0.026

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
160	23.628	0.152	2.18	104	1.6	100	85	-0.054	4.38	0.024
161	23.777	0.149	2.18	104	1.8	-	85	-0.058	4.34	0.023
162	23.926	0.149	2.18	104	1.9	-	85	-0.060	4.39	0.024
163	24.077	0.151	2.18	104	1.8	-	85	-0.054	4.42	0.027
164	24.230	0.153	2.18	104	1.8	-	85	-0.053	4.29	0.022
165	24.377	0.147	2.18	104	1.5	-	85	-0.053	4.30	0.020
166	24.529	0.152	2.17	105	1.5	-	85	-0.055	4.43	0.019
167	24.677	0.148	2.18	104	1.9	-	85	-0.056	4.47	0.019
168	24.830	0.153	2.18	105	1.8	-	85	-0.056	4.39	0.023
169	24.978	0.148	2.18	105	1.4	-	85	-0.051	4.37	0.022
170	25.130	0.152	2.18	105	2.0	100	85	-0.051	4.34	0.020
171	25.278	0.148	2.18	105	1.5	-	85	-0.054	4.36	0.028
172	25.429	0.151	2.18	104	1.5	-	85	-0.054	4.39	0.021
173	25.578	0.149	2.18	104	2.0	-	85	-0.052	4.43	0.023
174	25.730	0.152	2.18	104	1.6	-	85	-0.053	4.43	0.021
175	25.878	0.148	2.18	104	2.0	-	85	-0.051	4.53	0.021
176	26.030	0.152	2.18	104	1.5	-	85	-0.053	4.45	0.023
177	26.178	0.148	2.17	105	1.6	-	85	-0.049	4.59	0.022
178	26.330	0.152	2.18	104	1.9	-	85	-0.054	4.30	0.023
179	26.480	0.150	2.18	105	1.7	-	84	-0.053	4.39	0.019
180	26.630	0.150	2.18	105	2.0	100	84	-0.050	4.38	0.025
181	26.781	0.151	2.18	105	1.5	-	85	-0.051	4.41	0.022
182	26.931	0.150	2.18	105	2.0	-	84	-0.051	4.42	0.021
183	27.081	0.150	2.18	104	1.6	-	84	-0.052	4.44	0.024
184	27.231	0.150	2.17	104	1.4	-	84	-0.051	4.47	0.021
185	27.382	0.151	2.18	105	1.6	-	84	-0.049	4.31	0.024
186	27.532	0.150	2.18	105	1.6	-	84	-0.049	4.42	0.021
187	27.683	0.151	2.18	105	2.0	-	84	-0.053	4.37	0.022
188	27.831	0.148	2.18	105	1.6	-	84	-0.049	4.31	0.026
189	27.982	0.151	2.18	105	1.6	-	84	-0.052	4.35	0.027
190	28.131	0.149	2.18	105	1.9	100	84	-0.050	4.39	0.030
191	28.283	0.152	2.18	105	1.8	-	84	-0.050	4.31	0.023

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
192	28.431	0.148	2.18	105	1.6	-	84	-0.050	4.52	0.022
193	28.583	0.152	2.17	105	2.0	-	84	-0.052	4.41	0.024
194	28.731	0.148	2.17	105	1.6	-	84	-0.049	4.33	0.026
195	28.883	0.152	2.18	105	1.5	-	84	-0.050	4.45	0.026
196	29.032	0.149	2.17	105	2.0	-	84	-0.050	4.47	0.023
197	29.185	0.153	2.18	105	1.8	-	84	-0.049	4.38	0.021
198	29.333	0.148	2.18	105	1.9	-	84	-0.047	4.44	0.024
199	29.485	0.152	2.18	105	1.9	-	84	-0.049	4.27	0.026
200	29.633	0.148	2.17	105	1.6	100	84	-0.050	4.31	0.031
201	29.785	0.152	2.18	105	1.6	-	84	-0.047	4.42	0.020
202	29.934	0.149	2.18	105	1.9	-	84	-0.051	4.37	0.024
203	30.086	0.152	2.18	105	1.6	-	84	-0.047	4.32	0.023
204	30.234	0.148	2.19	105	2.0	-	84	-0.047	4.30	0.027
205	30.386	0.152	2.18	105	1.5	-	84	-0.049	4.35	0.028
206	30.534	0.148	2.18	105	1.5	-	84	-0.050	4.45	0.022
207	30.686	0.152	2.18	105	1.5	-	84	-0.048	4.39	0.022
208	30.835	0.149	2.18	105	2.0	-	84	-0.046	4.41	0.024
209	30.986	0.151	2.18	105	1.6	-	84	-0.048	4.26	0.021
210	31.135	0.149	2.17	105	1.4	101	84	-0.048	4.41	0.023
211	31.286	0.151	2.18	105	1.9	-	84	-0.047	4.38	0.021
212	31.436	0.150	2.18	105	1.9	-	84	-0.047	4.37	0.020
213	31.587	0.151	2.17	105	1.6	-	84	-0.048	4.29	0.022
214	31.737	0.150	2.18	105	1.9	-	84	-0.046	4.40	0.027
215	31.888	0.151	2.18	105	1.8	-	84	-0.052	4.38	0.025
216	32.038	0.150	2.17	105	1.6	-	84	-0.048	4.29	0.024
217	32.188	0.150	2.18	105	1.9	-	84	-0.046	4.35	0.026
218	32.339	0.151	2.18	105	2.0	-	84	-0.049	4.35	0.022
219	32.488	0.149	2.18	105	1.5	-	84	-0.046	4.36	0.025
220	32.639	0.151	2.18	105	1.5	101	84	-0.045	4.47	0.024
221	32.788	0.149	2.18	105	1.5	-	84	-0.047	4.30	0.023
222	32.939	0.151	2.17	105	1.8	-	84	-0.046	4.29	0.023
223	33.088	0.149	2.18	105	1.7	-	84	-0.048	4.41	0.025

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
224	33.240	0.152	2.18	105	1.5	-	84	-0.049	4.44	0.019
225	33.388	0.148	2.18	105	1.6	-	84	-0.045	4.30	0.024
226	33.540	0.152	2.17	105	1.6	-	84	-0.047	4.10	0.023
227	33.688	0.148	2.18	105	1.5	-	84	-0.049	4.25	0.022
228	33.841	0.153	2.18	105	1.8	-	84	-0.048	4.15	0.024
229	33.990	0.149	2.17	105	1.5	-	84	-0.049	4.10	0.022
230	34.142	0.152	2.17	105	1.5	100	84	-0.050	4.13	0.026
231	34.290	0.148	2.18	105	1.9	-	84	-0.047	4.11	0.022
232	34.443	0.153	2.18	105	1.5	-	84	-0.050	4.12	0.026
233	34.591	0.148	2.17	105	1.8	-	84	-0.045	3.90	0.021
234	34.744	0.153	2.18	105	1.5	-	84	-0.046	4.03	0.020
235	34.892	0.148	2.18	105	1.5	-	84	-0.050	4.04	0.025
236	35.042	0.150	2.18	105	1.5	-	84	-0.048	3.96	0.027
237	35.192	0.150	2.18	105	1.9	-	84	-0.047	3.93	0.025
238	35.343	0.151	2.18	105	1.6	-	84	-0.047	3.97	0.028
239	35.492	0.149	2.18	105	1.9	-	84	-0.047	4.09	0.029
240	35.644	0.152	2.18	105	1.9	100	84	-0.049	3.98	0.023
241	35.793	0.149	2.18	105	1.9	-	84	-0.048	3.98	0.026
242	35.944	0.151	2.17	105	1.6	-	84	-0.048	4.04	0.022
243	36.093	0.149	2.17	105	1.5	-	84	-0.045	4.00	0.025
244	36.245	0.152	2.18	105	1.4	-	85	-0.050	4.02	0.030
245	36.395	0.150	2.18	105	2.0	-	84	-0.048	4.00	0.025
246	36.546	0.151	2.17	105	1.8	-	85	-0.045	4.23	0.030
247	36.696	0.150	2.17	105	1.5	-	84	-0.047	3.88	0.028
248	36.846	0.150	2.17	105	1.6	-	85	-0.044	3.96	0.028
249	36.997	0.151	2.17	105	1.5	-	85	-0.045	4.06	0.025
250	37.147	0.150	2.18	105	1.9	100	85	-0.045	3.96	0.027
251	37.298	0.151	2.18	105	1.6	-	85	-0.042	3.99	0.028
252	37.447	0.149	2.18	105	1.5	-	85	-0.048	3.85	0.027
253	37.598	0.151	2.18	105	1.7	-	85	-0.045	4.03	0.026
254	37.747	0.149	2.18	105	1.6	-	85	-0.048	4.04	0.021
255	37.899	0.152	2.18	105	1.9	-	85	-0.049	3.90	0.026

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

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 (%)
256	38.048	0.149	2.18	106	2.0	-	85	-0.048	3.97	0.027
257	38.200	0.152	2.18	106	1.7	-	85	-0.047	3.78	0.024
258	38.348	0.148	2.17	106	1.6	-	85	-0.046	3.81	0.026
259	38.501	0.153	2.18	105	1.6	-	85	-0.049	3.82	0.030
260	38.649	0.148	2.18	105	2.0	100	85	-0.049	3.76	0.027
261	38.802	0.153	2.18	105	1.5	-	85	-0.048	3.81	0.031
262	38.950	0.148	2.18	105	1.5	-	85	-0.047	3.94	0.025
263	39.103	0.153	2.18	105	1.7	-	85	-0.049	3.97	0.026
264	39.251	0.148	2.17	106	1.5	-	85	-0.046	4.10	0.024
265	39.404	0.153	2.18	105	2.0	-	85	-0.047	4.19	0.026
266	39.552	0.148	2.18	105	2.0	-	85	-0.048	3.96	0.029
267	39.704	0.152	2.19	105	1.7	-	85	-0.049	4.16	0.027
268	39.852	0.148	2.18	105	1.9	-	85	-0.044	4.02	0.023
269	40.005	0.153	2.18	106	1.6	100	85	-0.047	4.14	0.025
Avg/Tot	40.005	0.149	2.16	99.2	1.7	100	83.5	-0.059	5.24	0.094

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.000		0.66	81	1.7		78
1	0.154	0.154	1.08	80	1.8	-	78
2	0.311	0.157	1.09	80	1.8	-	79
3	0.468	0.157	1.10	80	1.7	-	79
4	0.625	0.157	1.11	80	1.8	-	79
5	0.782	0.157	1.11	80	1.7	-	79
6	0.940	0.158	1.11	81	1.8	-	79
7	1.099	0.159	1.12	81	1.8	-	79
8	1.258	0.159	1.13	81	1.8	-	79
9	1.417	0.159	1.13	81	1.7	-	79
10	1.576	0.159	1.12	81	1.9	97	79
11	1.736	0.160	1.13	81	1.9	-	79
12	1.895	0.159	1.13	81	1.9	-	79
13	2.054	0.159	1.13	82	1.8	-	79
14	2.214	0.160	1.12	82	1.7	-	79
15	2.375	0.161	1.14	82	1.7	-	79
16	2.535	0.160	1.14	82	1.8	-	80
17	2.694	0.159	1.13	82	1.8	-	79
18	2.855	0.161	1.14	82	1.7	-	79
19	3.016	0.161	1.15	83	1.9	-	79
20	3.176	0.160	1.15	83	1.9	98	79
21	3.338	0.162	1.15	84	1.7	-	79
22	3.500	0.162	1.16	84	1.7	-	80
23	3.661	0.161	1.15	84	1.7	-	80
24	3.824	0.163	1.16	85	1.9	-	80
25	3.986	0.162	1.16	84	1.8	-	80
26	4.148	0.162	1.16	84	1.9	-	80
27	4.312	0.164	1.17	84	1.9	-	80
28	4.474	0.162	1.16	85	1.9	-	80
29	4.638	0.164	1.17	85	1.9	-	80
30	4.801	0.163	1.18	86	1.9	100	80
31	4.964	0.163	1.17	86	1.7	-	80

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 2

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/6/2023

Elapsed Time (min)	Particulate Sampling 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)
32	5.128	0.164	1.18	86	1.8	-	80
33	5.291	0.163	1.16	86	1.9	-	80
34	5.456	0.165	1.18	87	1.7	-	80
35	5.619	0.163	1.17	87	1.8	-	80
36	5.784	0.165	1.18	87	1.9	-	80
37	5.947	0.163	1.18	87	1.7	-	80
38	6.112	0.165	1.17	88	1.9	-	81
39	6.277	0.165	1.18	88	1.8	-	81
40	6.442	0.165	1.18	88	1.8	100	81
41	6.606	0.164	1.19	88	1.8	-	81
42	6.771	0.165	1.18	88	1.9	-	81
43	6.936	0.165	1.19	89	1.7	-	80
44	7.100	0.164	1.18	89	1.7	-	81
45	7.266	0.166	1.19	89	1.8	-	81
46	7.431	0.165	1.18	90	1.9	-	81
47	7.597	0.166	1.19	89	1.7	-	81
48	7.761	0.164	1.18	90	1.8	-	81
49	7.928	0.167	1.19	89	1.7	-	81
50	8.092	0.164	1.18	90	1.8	101	81
51	8.259	0.167	1.19	90	1.9	-	81
52	8.423	0.164	1.18	90	1.7	-	81
53	8.590	0.167	1.19	90	1.7	-	81
54	8.755	0.165	1.18	90	1.9	-	81
55	8.921	0.166	1.19	90	1.9	-	81
56	9.087	0.166	1.18	91	1.9	-	81
57	9.253	0.166	1.19	91	1.9	-	81
58	9.419	0.166	1.18	91	1.7	-	82
59	9.584	0.165	1.19	92	1.8	-	82
60	9.751	0.167	1.19	92	1.8	101	82
Avg/Tot	9.751	0.163	1.15	85.5	1.8	100	80.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

Stove ΔT: 12

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	363	307	258	224	265	283.5	511.3
1	362	306	259	223	266	283.4	437.3
2	360	305	260	223	268	282.9	420.7
3	356	303	260	221	268	281.5	457.2
4	352	300	260	219	269	280.0	516.7
5	348	298	260	219	269	278.6	553.2
6	344	295	259	217	269	276.9	570.4
7	340	292	259	216	270	275.3	580.1
8	336	289	258	215	270	273.5	585.9
9	332	286	258	214	270	271.9	594.4
10	328	284	257	213	270	270.2	613.5
11	324	281	256	211	270	268.5	631.4
12	320	279	255	210	270	266.9	635.9
13	316	277	254	209	270	265.2	634.5
14	313	275	253	208	270	263.8	632.4
15	310	272	252	207	270	262.1	633.7
16	306	271	250	207	270	260.9	649.4
17	304	269	249	206	270	259.5	665.3
18	301	267	247	205	269	258.0	674.2
19	299	265	246	205	268	256.9	682.6
20	297	264	245	205	268	255.8	687.3
21	295	262	244	205	268	254.7	691.9
22	293	261	242	205	267	253.6	696.0
23	291	260	241	205	267	252.6	702.7
24	289	258	240	205	267	251.7	714.4
25	287	257	239	205	266	250.7	721.8
26	286	256	238	205	265	249.8	730.1
27	284	255	237	205	265	249.0	739.9
28	282	255	235	205	264	248.2	746.9
29	281	254	234	205	264	247.6	756.6
30	280	253	233	205	263	246.9	764.5
31	278	253	232	206	263	246.4	771.6
32	277	253	231	206	262	245.9	777.9
33	276	252	230	207	262	245.6	789.7
34	275	252	229	208	262	245.2	802.1
35	275	252	228	209	262	245.2	817.6
36	274	252	227	210	262	245.0	835.2
37	274	252	226	210	261	244.7	845.9
38	274	253	225	212	261	244.9	849.9
39	274	253	225	213	261	245.0	853.1
40	274	254	224	214	260	245.1	855.9
41	275	255	223	215	261	245.6	858.0
42	275	256	223	217	260	246.2	860.0
43	276	257	222	219	260	246.7	862.9
44	277	258	222	221	260	247.5	866.4
45	279	259	221	223	260	248.4	873.5
46	281	261	221	225	260	249.6	877.7
47	283	263	220	227	261	250.8	884.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

Stove ΔT: 12

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	286	265	220	230	261	252.1	887.4
49	289	267	219	232	261	253.6	891.1
50	292	269	219	234	261	255.0	890.6
51	296	271	219	237	261	256.6	890.0
52	300	274	219	239	260	258.3	888.5
53	304	278	218	241	261	260.1	887.0
54	307	282	218	244	261	262.2	886.9
55	311	286	218	245	261	264.2	885.5
56	315	291	218	248	261	266.3	886.1
57	319	295	217	250	261	268.3	887.3
58	323	299	217	251	261	270.1	890.4
59	327	302	217	253	261	272.1	892.4
60	331	305	217	254	261	273.5	892.8
61	336	308	217	256	260	275.3	896.0
62	339	311	217	257	261	277.0	898.5
63	343	314	217	259	260	278.4	900.9
64	347	316	217	260	260	279.7	902.6
65	351	318	217	261	260	281.3	902.3
66	355	319	217	263	259	282.6	902.9
67	359	322	217	265	259	284.1	903.2
68	363	324	217	265	258	285.5	903.7
69	366	327	218	267	258	287.0	903.8
70	370	330	218	268	257	288.7	905.9
71	374	333	218	269	257	290.2	907.3
72	378	336	219	271	257	291.8	907.2
73	381	339	219	272	256	293.3	908.1
74	385	341	219	273	255	294.6	907.1
75	388	343	220	274	255	295.9	906.3
76	390	345	220	276	254	297.1	904.8
77	393	347	220	277	254	298.2	903.6
78	396	349	221	278	253	299.3	904.4
79	399	351	221	278	253	300.3	904.6
80	401	353	222	281	252	301.6	909.4
81	403	355	222	282	252	302.7	913.8
82	406	357	222	282	251	303.7	916.7
83	408	359	223	283	251	304.7	918.4
84	410	360	223	284	250	305.6	920.0
85	412	362	224	286	250	306.7	922.8
86	414	364	224	287	250	307.8	922.7
87	416	366	225	288	249	308.9	922.7
88	418	368	226	289	249	309.9	922.6
89	420	370	226	289	248	310.7	922.7
90	422	371	227	289	247	311.4	922.6
91	424	373	228	290	247	312.1	922.1
92	425	374	228	291	246	312.8	921.6
93	427	375	229	292	245	313.6	919.7
94	428	376	230	292	245	313.9	917.9
95	428	376	231	292	244	314.3	911.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

Stove ΔT: 12

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	429	377	231	293	243	314.6	902.5
97	430	377	232	293	243	315.0	888.0
98	430	379	233	294	243	315.7	873.6
99	431	380	234	294	242	316.1	861.8
100	430	382	235	295	242	316.6	850.1
101	431	383	236	294	242	316.9	838.4
102	430	383	237	295	242	317.2	828.8
103	430	384	238	294	242	317.6	820.8
104	430	384	239	293	242	317.6	813.7
105	429	384	240	293	242	317.7	808.6
106	429	385	241	292	242	317.7	802.7
107	428	384	242	291	241	317.3	796.7
108	427	384	243	291	242	317.2	797.8
109	426	383	244	290	241	316.8	811.6
110	424	382	245	289	241	316.1	825.4
111	422	381	246	288	241	315.4	835.5
112	420	380	246	287	241	314.8	840.6
113	417	378	247	287	241	314.2	838.8
114	415	377	248	286	241	313.5	841.0
115	413	376	249	286	241	313.0	843.3
116	411	375	250	285	242	312.6	841.6
117	409	374	251	284	242	312.1	840.1
118	408	374	251	283	243	311.7	837.5
119	406	374	252	283	244	311.8	830.7
120	405	373	253	283	244	311.7	825.1
121	404	373	254	282	245	311.7	820.6
122	403	374	255	282	245	311.7	821.4
123	402	374	256	281	246	311.5	822.8
124	402	374	257	280	246	311.7	824.3
125	401	374	258	280	247	311.9	828.7
126	401	374	258	280	247	311.9	833.5
127	401	373	259	279	248	311.9	839.6
128	400	373	260	279	248	311.9	838.3
129	399	372	261	279	249	312.0	831.2
130	399	371	261	278	249	311.7	824.4
131	399	370	262	278	250	311.8	819.7
132	398	370	263	278	250	311.8	816.4
133	398	369	264	277	251	311.9	816.7
134	397	369	265	277	252	311.9	817.7
135	397	369	266	277	253	312.1	821.1
136	396	369	267	276	253	312.3	818.2
137	396	368	267	276	254	312.2	820.7
138	396	368	268	275	254	312.3	817.8
139	395	367	269	275	255	312.4	815.5
140	395	367	270	274	256	312.4	818.1
141	395	366	271	273	257	312.5	824.7
142	395	366	273	273	257	312.7	832.5
143	395	365	273	272	258	312.6	840.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

Stove ΔT: 12

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
144	395	365	275	272	259	312.8	845.7
145	395	364	276	271	259	312.8	847.3
146	394	363	277	271	259	312.9	846.3
147	395	363	278	270	260	313.0	832.5
148	394	363	279	270	260	313.2	810.6
149	394	363	280	269	261	313.3	789.2
150	393	362	281	268	261	313.3	770.8
151	393	362	282	268	261	313.2	756.2
152	392	362	284	267	262	313.4	742.3
153	392	361	285	266	263	313.4	728.1
154	391	361	286	266	264	313.5	716.4
155	391	361	287	265	264	313.4	707.4
156	390	361	288	263	265	313.2	700.6
157	389	360	289	263	265	313.1	693.8
158	388	360	289	261	266	312.7	687.6
159	387	360	290	260	267	312.6	682.6
160	386	360	291	259	267	312.4	673.6
161	385	360	291	257	268	312.0	665.0
162	383	359	292	256	268	311.8	657.3
163	382	359	292	254	269	311.4	649.7
164	382	359	292	252	269	310.9	644.6
165	381	359	293	251	270	310.7	639.4
166	380	359	293	249	270	310.3	635.9
167	379	358	294	248	271	310.0	632.2
168	378	358	294	247	272	309.5	629.0
169	377	357	294	245	272	309.1	624.4
170	376	357	294	243	273	308.5	621.8
171	375	356	294	242	272	307.9	617.8
172	374	356	294	240	273	307.5	616.1
173	374	355	294	238	273	306.9	614.2
174	373	355	294	237	274	306.6	613.2
175	372	354	294	236	274	306.2	611.3
176	372	354	294	235	275	305.9	609.2
177	371	353	294	233	276	305.4	608.2
178	370	352	294	232	276	305.1	607.9
179	370	352	294	231	277	304.7	605.9
180	370	351	294	229	278	304.3	602.2
181	369	350	294	229	278	304.0	598.8
182	369	349	294	227	279	303.5	597.7
183	368	349	294	225	279	303.0	596.5
184	368	348	294	224	279	302.7	593.9
185	367	347	294	223	279	302.2	592.7
186	367	346	294	222	279	301.7	592.8
187	366	346	294	221	280	301.4	589.6
188	366	345	294	220	280	301.0	589.8
189	365	344	294	219	280	300.7	589.8
190	365	344	294	219	281	300.3	589.6
191	364	343	294	218	281	299.9	589.5

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

Stove ΔT: 12

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
192	364	342	293	217	281	299.4	588.8
193	363	342	293	216	281	298.9	587.2
194	362	341	293	215	282	298.5	589.6
195	362	341	292	214	282	298.2	588.4
196	361	340	292	213	282	297.8	588.9
197	361	339	292	214	283	297.6	586.9
198	360	339	292	212	283	297.1	585.6
199	359	338	291	212	284	296.9	586.2
200	359	338	291	211	284	296.4	587.0
201	358	337	290	211	284	296.0	587.7
202	358	336	290	210	284	295.8	586.3
203	357	336	290	209	284	295.1	588.2
204	357	335	289	209	284	294.8	587.9
205	356	335	289	208	284	294.3	585.9
206	356	334	289	208	284	294.0	587.0
207	355	334	288	208	284	293.7	590.3
208	355	333	288	207	284	293.4	591.6
209	354	332	288	207	284	293.0	587.8
210	354	332	287	207	284	292.6	589.0
211	353	331	287	205	283	292.1	587.7
212	353	331	286	206	283	291.7	590.6
213	352	330	286	205	283	291.1	585.9
214	352	329	286	205	282	290.7	587.7
215	351	329	285	204	282	290.3	587.5
216	351	328	285	204	282	289.9	589.1
217	350	327	285	204	283	289.7	588.0
218	350	327	285	203	282	289.4	586.9
219	349	326	284	203	282	289.1	589.9
220	349	326	284	203	282	288.9	586.7
221	348	325	284	203	282	288.4	589.3
222	348	325	284	202	282	288.1	586.9
223	347	324	283	202	282	287.6	589.7
224	346	324	283	201	282	287.2	588.3
225	346	323	283	202	281	286.8	585.7
226	345	323	282	202	281	286.8	584.3
227	345	323	282	202	281	286.4	585.7
228	344	322	282	202	281	286.1	587.2
229	344	322	282	202	281	285.8	587.4
230	343	322	282	201	280	285.6	586.4
231	342	321	281	201	280	285.2	588.3
232	342	321	281	201	280	284.9	587.0
233	342	320	281	200	280	284.5	586.7
234	341	320	281	201	280	284.3	585.4
235	340	320	280	201	279	284.0	585.8
236	340	319	280	200	279	283.7	584.0
237	339	319	279	200	279	283.4	586.2
238	339	319	279	200	278	282.9	583.3
239	338	318	279	200	278	282.6	585.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 2

Technician: SJB

Date: 7/6/2023

Stove ΔT : 12

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
240	338	318	279	200	278	282.2	585.3
241	337	317	278	200	277	281.8	585.2
242	337	317	278	199	276	281.4	583.9
243	336	317	277	199	277	281.2	585.8
244	335	317	277	199	276	281.0	582.9
245	335	316	277	199	276	280.5	583.1
246	334	316	277	199	275	280.2	582.3
247	334	315	276	199	275	279.9	582.9
248	333	315	276	199	275	279.6	582.6
249	332	315	275	198	275	279.1	583.0
250	331	314	275	199	274	278.6	580.2
251	331	314	275	198	273	278.2	579.8
252	331	313	274	198	273	277.8	583.5
253	330	313	274	198	272	277.5	583.1
254	329	312	274	198	272	276.9	576.7
255	328	312	273	198	271	276.5	578.7
256	328	311	273	199	272	276.4	582.8
257	328	311	273	198	271	276.0	583.7
258	327	310	272	198	271	275.7	577.4
259	326	310	272	198	270	275.2	578.0
260	326	309	271	198	270	274.7	578.5
261	325	309	271	197	269	274.2	579.8
262	324	308	271	197	269	273.9	578.8
263	324	308	270	197	269	273.5	567.8
264	323	307	270	197	269	273.2	566.1
265	323	307	269	197	268	272.9	562.4
266	323	307	269	197	268	272.7	557.7
267	323	306	269	197	267	272.3	556.1
268	322	305	268	197	267	272.1	554.9
269	322	305	268	197	267	271.8	557.0
Average	358.5	329.4	259.7	238.1	264.8	290.1	720.6

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Model: F445

Run #: 2

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/6/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G600	241.2	242.1	0.9
	B	G601	242.2	242.9	0.7
	C - 1st Hour	G602	241.6	242.0	0.4
	Amb	G603	242.6	242.6	0.0
Probes	A	6A	116381.8	116381.9	0.1
	B	6B	115953.0	115953.1	0.1
	C - 1st Hour	6C	115127.7	115127.9	0.2
O-rings	A	6A	3614.3	3614.4	0.1
	B	6B	3396.9	3397.0	0.1
	C - 1st Hour	6C	3401.9	3401.9	0.0

Placed in Dessicator on:

7/7/23 - 16:20

Balance Audit (mg):

100.0

100.0

Filters	A	242.0	7/10 9:00	242.1	7/11 9:00				
	B	242.9	7/10 9:00	242.9	7/11 9:00				
	C - 1st Hour	241.9	7/10 9:00	242.0	7/11 9:00				
	Amb	242.7	7/10 9:00	242.6	7/11 9:00				
Probes	A	116382.0	7/10 9:00	116381.9	7/11 9:00				
	B	115953.0	7/10 9:00	115953.1	7/11 9:00				
	C - 1st Hour	115127.7	7/10 9:00	115127.9	7/11 9:00				
O-Rings	A	3614.4	7/10 9:00	3614.4	7/11 9:00				
	B	3397.0	7/10 9:00	3397.0	7/11 9:00				
	C - 1st Hour	3401.9	7/10 9:00	3401.9	7/11 9:00				

Train A Aggregate, mg: 1.1

Train B Aggregate, mg: 0.9

Train C Aggregate, mg: 0.6

Ambient, mg: 0.0

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 3 Test Date: 7/7/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Fully Closed
Targeted Burn Category: Low

Preburn Notes

Time	Notes
7:18	Stared kindling fire with ~6 lbs of fuel, air set to fully open, fan off
7:40	With 1.6 lbs of coals left, added preburn fuel load, door closed immediately
8:06	Turned air down to halfway open
8:20	At 7.01 lbs turned air down to test setting, fan turned on low
9:24	At 3.66 lbs, stirred remaining fuel to ensure uniform charcoalization
10:03	@ 2.90lbs leveled coal bed in preparation of fuel loading, left fan on, air control at test setting

Test Notes

Test Burn Start Time: 10:04 Test Fuel Loaded by: 25 seconds
Door Closed: 30 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
10:04	Loaded test fuel, door closed immediately, fan on a low, air set to test setting
15:28	End of test

Test Burn End Time: 15:28

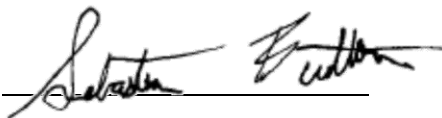
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	7:29	7:32	7:35	16:00	16:04	16:02
CO ₂	0.00	10.15	17.04	-0.04	10.01	16.95
CO	0.000	2.506	4.283	-0.003	2.501	4.296

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

Technician Signature:  Date: 7/7/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 3

Tracking #: 152
Test Date: 7/7/2023



Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: _____

Sebastian E. Cotton

Date: 7/7/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 3 Test Date: 7/7/2023

REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



Technician Signature: _____

Date: 7/7/2023

WOOD STOVE TEST DATA PACKET

ASTM E2780/E2515



Run 3 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/7/2023

A handwritten signature in black ink, appearing to read "Sebastian Euteneier", is written over a horizontal line.

Techician Signature

7/13/2023

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 3

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/7/2023

Burn Rate (kg/hr):	1.01
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	37.984	51.347	48.025	9.537
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.1			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	21607.6			
Average Gas Meter Temperature (°F)	72.3	97.0	96.0	80.9
Total Sample Volume (dscf)	38.378	49.194	45.655	9.146
Average Tunnel Temperature (°F)	86.7			
Total Time of Test (min)	324			
Total Particulate Catch (mg)	0.1	1.3	1.0	0.7
Particulate Concentration, dry-standard (g/dscf)	0.0000026	0.0000264	0.0000219	0.0000765
Total PM Emissions (g)	0.30	2.78	2.25	1.60
Particulate Emission Rate (g/hr)	0.06	0.51	0.42	1.60
Emissions Factor (g/kg)	-	0.51	0.41	-
Difference from Average Total Particulate Emissions (g)	-	0.26	0.26	-
Difference from Average Total Particulate Emissions (%)	-	10.5%	10.5%	-
Difference from Average Emissions Factor (g/kg)	-	0.05	0.05	-

Final Average Results	
Total Particulate Emissions (g)	2.52
Particulate Emission Rate (g/hr)	0.47
Emissions Factor (g/kg)	0.46
HHV Efficiency (%)	70.1%
LHV Efficiency (%)	75.8%
CO Emissions (g/min)	1.24

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	9.0	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min:68.7/Max:75.3	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	11.0	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/07/23
Run: 3
Control #: 23-167
Test Duration: 324
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	70.1%	75.8%
Combustion Efficiency	95.9%	95.9%
Heat Transfer Efficiency	73.1%	79.0%

Output Rate (kJ/h)	13,927	13,212	(Btu/h)
Burn Rate (kg/h)	1.00	2.21	(lb/h)
Input (kJ/h)	19,870	18,849	(Btu/h)

Test Load Weight (dry kg)	5.42	11.94	dry lb
MC wet (%)	17.10		
MC dry (%)	20.63		
Particulate (g)	2.52		
CO (g)	403		
Test Duration (h)	5.40		

Emissions	Particulate	CO
g/MJ Output	0.03	5.35
g/kg Dry Fuel	0.46	74.34
g/h	0.47	74.57
g/min	0.01	1.24
lb/MM Btu Output	0.08	12.44

Air/Fuel Ratio (A/F)	36.82
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	21.1		2x4	11.00	21.2
2x4	18.25	20.3		2x4	11.00	20.0
2x4	18.25	19.5				
2x4	18.25	20.1				
2x4	18.25	22.4				
2x4	11.00	19.6				
2x4	11.00	22.4				
2x4	11.00	20.1				
Total Fuel Weight (lbs):		13.74	Average Moisture (%DB):		20.7	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 5.11
 Total 4x4 Crib Weight, with spacers (lbs): 9.30
 Total Wet Fuel Weight, with spacers (lbs): 14.41

Coal Bed Range (20-25%):

Min (lbs): 2.88
 Max (lbs): 3.60

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.10	19.7	19.3	23.1	1.74
2x4	18.25	2.14	20.8	21.4	19.4	1.78
4x4	18.25	4.86	21.5	22.0	22.3	3.99
4x4	18.25	4.03	19.5	18.2	20.3	3.38
Total Dry Weight, no spacers (lbs):						10.88
Total Dry Weight, with spacers (lbs):						12.06

Spacer Moisture Readings (%DB)							
9.8	7.9	7.7					
7.2	8.5	7.0					
9.2	7.2	8.3					
10.3	7.9	8.2					

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.4	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	7.10	OK
2x4 Fuel Mix	35 - 65 % of total weight	35%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 3
 Test Start Time: 10:04

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

Total Sampling Time (min): 324
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.81	29.74	29.78
Relative Humidity (%)	40.1	35.0	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:		37.984	ft ³

Sample Train Leak Checks

	Pre-test	Post-test		
Induced Draft Check (in. H ₂ O):	0	(A) 0.002	cfm @	-5 in. Hg
Smoke Capture Check (%):	100%	(B) 0.000	cfm @	-5 in. Hg
Date Flue Pipe Last Cleaned:	7/3/2023	(C) 0.001	cfm @	-5 in. Hg
Test Fuel Scale Audit (lbs)	10.00	(Ambient) 0.001	cfm @	-5 in. Hg
Platform Scale Audit (lbs)	10.0			

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.012	97
2	0.014	97
3	0.018	97
4	0.018	97
5	0.016	97
6	0.010	97
7	0.012	97
8	0.016	97
9	0.018	97
10	0.018	97
11	0.012	97
12	0.012	97
Center	0.017	97

Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 12 inches
 Pitot Tube Cp: 0.99 [unitless]
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.7854 ft²

V_{strav} : 8.22 ft/sec

V_{scent} : 8.89 ft/sec

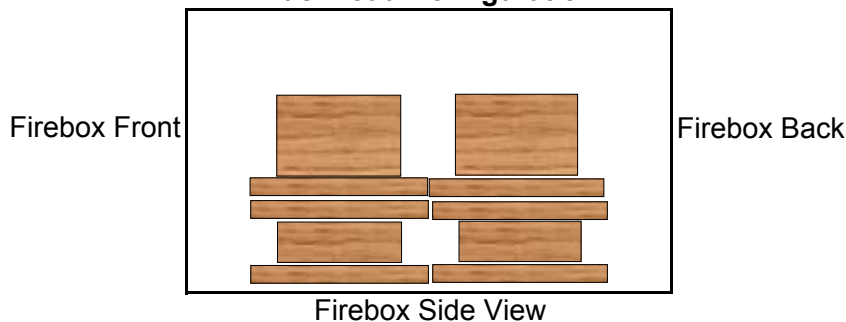
F_p : 0.924 [ratio]

Initial Tunnel Flow: 358.2 scf/min

Static Pressure: -0.091 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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)	20.6

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 3

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/7/2023

Recording Interval (min): 1
Run Time (min): 103

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	7.01	-0.093	471	381	214	336	248	330.0	467	71
1	6.86	-0.090	476	385	218	339	250	333.5	434	71
2	6.75	-0.087	479	388	221	341	251	336.2	414	71
3	6.63	-0.087	483	391	223	343	252	338.5	399	71
4	6.53	-0.085	486	393	225	344	252	340.0	387	71
5	6.41	-0.084	488	394	227	346	252	341.5	378	71
6	6.32	-0.085	491	394	228	346	252	342.1	371	71
7	6.23	-0.082	493	394	230	345	251	342.6	364	71
8	6.15	-0.079	495	394	231	345	250	343.2	359	70
9	6.06	-0.080	497	394	232	345	250	343.6	352	71
10	5.98	-0.079	500	393	233	342	249	343.5	346	70
11	5.91	-0.078	501	393	234	342	248	343.7	340	71
12	5.83	-0.077	501	393	235	342	247	343.7	335	70
13	5.77	-0.077	501	392	236	339	246	343.1	330	71
14	5.70	-0.077	500	392	237	338	246	342.6	324	71
15	5.64	-0.073	499	391	238	337	245	341.9	321	70
16	5.58	-0.074	497	390	239	334	243	340.5	316	70
17	5.51	-0.072	494	389	239	332	243	339.5	312	70
18	5.46	-0.071	492	388	240	330	243	338.5	308	71
19	5.41	-0.071	489	387	241	329	242	337.5	305	71
20	5.36	-0.070	485	386	241	328	241	336.3	301	71
21	5.31	-0.071	481	384	242	324	240	334.2	298	71
22	5.27	-0.069	477	383	243	322	239	332.9	294	71
23	5.23	-0.067	474	383	243	319	239	331.5	290	71
24	5.19	-0.067	470	382	244	317	238	330.2	288	71
25	5.15	-0.065	466	382	244	313	237	328.4	285	71
26	5.11	-0.065	462	381	244	310	236	326.7	282	70
27	5.07	-0.066	458	381	245	309	235	325.5	280	70
28	5.03	-0.064	454	381	245	306	235	324.1	278	70
29	4.99	-0.063	450	381	245	304	234	322.9	276	70
30	4.95	-0.064	446	381	245	300	234	321.2	275	70
31	4.91	-0.063	442	381	246	299	233	320.1	273	70
32	4.87	-0.063	439	381	246	296	233	318.7	273	70
33	4.84	-0.064	435	380	246	293	233	317.2	271	70
34	4.80	-0.063	432	380	246	290	232	315.8	270	70
35	4.75	-0.062	428	379	246	287	232	314.4	268	70
36	4.71	-0.063	425	379	246	286	232	313.4	267	70
37	4.67	-0.062	422	378	245	285	231	312.3	267	70
38	4.62	-0.064	418	378	245	283	231	311.1	266	70
39	4.58	-0.062	416	378	245	281	231	310.2	265	69
40	4.54	-0.061	413	378	245	278	231	309.0	265	69
41	4.50	-0.062	410	378	245	277	231	308.0	263	69
42	4.46	-0.063	408	378	245	276	231	307.4	262	69
43	4.42	-0.060	405	378	245	274	230	306.2	262	69
44	4.38	-0.059	403	377	244	272	231	305.4	261	69

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 3

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/7/2023

Recording Interval (min): 1
Run Time (min): 103

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
45	4.34	-0.061	401	377	244	271	231	304.6	261	69
46	4.30	-0.061	399	376	244	271	231	304.1	260	69
47	4.26	-0.063	397	375	244	269	231	303.1	259	69
48	4.22	-0.061	395	375	244	269	231	302.7	258	69
49	4.18	-0.060	393	375	244	268	231	302.0	258	69
50	4.14	-0.059	391	374	243	266	231	301.2	257	69
51	4.10	-0.060	389	374	243	265	231	300.6	257	69
52	4.06	-0.060	388	374	243	264	232	299.9	255	69
53	4.02	-0.060	386	374	243	263	232	299.5	254	69
54	3.98	-0.057	385	374	243	263	232	299.3	252	69
55	3.95	-0.058	383	375	243	263	232	299.0	251	69
56	3.91	-0.057	382	375	243	262	232	298.8	250	69
57	3.88	-0.057	381	376	243	260	232	298.4	248	69
58	3.84	-0.058	380	376	242	259	233	298.0	249	69
59	3.81	-0.057	379	377	243	258	233	297.9	247	69
60	3.78	-0.057	378	377	242	258	233	297.6	246	69
61	3.75	-0.058	376	377	242	257	234	297.1	245	69
62	3.72	-0.056	375	376	243	256	234	296.7	245	69
63	3.69	-0.056	374	377	242	254	234	296.2	244	69
64	3.66	-0.059	373	377	243	255	234	296.3	244	69
65	3.58	-0.054	372	377	243	254	235	296.0	297	69
66	3.55	-0.055	371	376	243	253	235	295.4	263	69
67	3.52	-0.056	369	376	243	253	235	295.2	250	69
68	3.50	-0.056	369	374	243	251	235	294.5	245	69
69	3.47	-0.054	368	371	243	251	235	293.7	244	69
70	3.44	-0.057	367	369	243	251	235	292.8	242	69
71	3.42	-0.056	365	366	243	249	236	291.8	241	69
72	3.40	-0.058	364	363	243	249	236	291.0	241	69
73	3.37	-0.056	362	361	243	248	236	290.1	240	69
74	3.36	-0.055	361	358	243	248	237	289.2	239	69
75	3.34	-0.056	359	355	243	247	237	288.0	238	69
76	3.31	-0.052	358	352	243	246	238	287.1	236	69
77	3.29	-0.055	356	350	242	245	238	286.3	236	69
78	3.28	-0.055	355	348	242	245	238	285.5	234	69
79	3.26	-0.054	353	346	242	243	238	284.3	233	69
80	3.24	-0.053	352	344	242	241	239	283.5	231	69
81	3.22	-0.053	350	342	242	242	240	283.0	229	70
82	3.21	-0.055	349	340	242	241	240	282.1	228	69
83	3.19	-0.052	348	338	242	240	240	281.4	226	70
84	3.17	-0.051	346	336	241	238	241	280.3	224	69
85	3.16	-0.050	345	334	241	238	241	279.7	223	70
86	3.15	-0.051	344	333	240	237	242	278.9	223	70
87	3.13	-0.052	343	331	240	236	242	278.2	221	70
88	3.11	-0.050	341	329	240	234	242	277.3	220	70
89	3.10	-0.051	340	328	240	233	243	276.6	219	69

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

Recording Interval (min): 1
 Run Time (min): 103

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
90	3.08	-0.050	339	326	239	231	243	275.8	218	69
91	3.07	-0.049	338	325	239	230	244	275.2	216	69
92	3.05	-0.050	337	323	239	228	244	274.4	215	69
93	3.03	-0.048	336	322	239	228	244	273.8	213	69
94	3.02	-0.048	336	321	239	226	244	273.1	212	69
95	3.01	-0.048	334	319	239	225	245	272.5	211	69
96	3.00	-0.048	333	318	238	224	246	271.9	210	70
97	2.98	-0.048	332	317	238	223	246	271.3	209	70
98	2.97	-0.046	331	316	238	222	246	270.6	208	70
99	2.95	-0.046	331	314	238	221	247	270.1	207	69
100	2.94	-0.046	330	313	238	220	247	269.7	206	69
101	2.93	-0.046	329	312	238	219	247	269.2	205	69
102	2.91	-0.047	328	311	238	218	248	268.6	204	69
103	2.90	-0.047	327	310	238	216	248	267.9	203	69

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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		0.017	0.15	76	0.3		14.40		90	249	73	70
1	0.138	0.138	0.017	1.99	76	0.8	-	14.38	-0.02	93	255	74	70
2	0.279	0.141	0.017	2.02	76	0.8	-	14.37	-0.01	87	220	74	70
3	0.425	0.146	0.017	2.05	76	0.8	-	14.34	-0.03	85	203	74	70
4	0.566	0.141	0.017	2.07	76	0.8	-	14.31	-0.03	85	196	74	70
5	0.712	0.146	0.018	2.09	76	0.8	-	14.30	-0.01	84	193	74	69
6	0.854	0.142	0.016	2.11	76	0.8	-	14.28	-0.02	84	190	75	69
7	1.003	0.149	0.017	2.12	76	0.8	-	14.25	-0.03	84	189	75	69
8	1.148	0.145	0.017	2.13	76	0.8	-	14.23	-0.02	83	187	75	69
9	1.297	0.149	0.017	2.15	77	0.8	-	14.21	-0.02	83	185	75	69
10	1.442	0.145	0.017	2.17	77	0.9	94	14.18	-0.03	82	184	75	69
11	1.591	0.149	0.017	2.18	77	0.8	-	14.16	-0.02	82	183	75	69
12	1.737	0.146	0.017	2.19	77	0.8	-	14.13	-0.03	83	182	75	69
13	1.886	0.149	0.017	2.21	77	0.8	-	14.11	-0.02	83	181	75	69
14	2.034	0.148	0.017	2.22	77	0.8	-	14.08	-0.03	82	180	75	69
15	2.183	0.149	0.017	2.22	78	0.8	-	14.05	-0.03	82	180	75	69
16	2.332	0.149	0.017	2.22	78	0.8	-	14.02	-0.03	82	179	75	69
17	2.482	0.150	0.017	2.23	78	0.8	-	13.99	-0.03	82	178	75	69
18	2.632	0.150	0.017	2.23	78	0.9	-	13.96	-0.03	82	177	75	69
19	2.782	0.150	0.017	2.25	79	0.8	-	13.93	-0.03	82	177	75	69
20	2.932	0.150	0.017	2.25	79	0.8	97	13.90	-0.03	82	176	75	69
21	3.083	0.151	0.017	2.26	79	0.8	-	13.86	-0.04	82	175	75	69
22	3.234	0.151	0.017	2.28	79	0.8	-	13.83	-0.03	82	175	75	69
23	3.387	0.153	0.017	2.28	80	0.9	-	13.79	-0.04	82	174	75	69
24	3.537	0.150	0.017	2.28	80	0.8	-	13.76	-0.03	81	173	75	69
25	3.690	0.153	0.017	2.30	80	0.8	-	13.73	-0.03	81	172	75	69
26	3.840	0.150	0.017	2.30	81	0.8	-	13.69	-0.04	82	171	75	69
27	3.994	0.154	0.017	2.29	81	0.8	-	13.66	-0.03	82	171	75	69
28	4.145	0.151	0.017	2.31	81	0.8	-	13.62	-0.04	81	170	75	70
29	4.299	0.154	0.017	2.32	81	0.8	-	13.58	-0.04	81	170	75	70
30	4.448	0.149	0.017	2.30	82	0.8	98	13.54	-0.04	81	169	75	70
31	4.604	0.156	0.017	2.32	82	0.8	-	13.50	-0.04	81	169	75	70

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
32	4.753	0.149	0.017	2.31	82	0.9	-	13.46	-0.04	81	169	75	70
33	4.909	0.156	0.017	2.32	83	0.9	-	13.42	-0.04	81	169	75	70
34	5.060	0.151	0.017	2.32	83	0.8	-	13.39	-0.03	81	169	75	70
35	5.217	0.157	0.017	2.34	83	0.9	-	13.34	-0.05	81	168	75	71
36	5.368	0.151	0.018	2.34	83	0.8	-	13.31	-0.03	81	168	75	70
37	5.523	0.155	0.017	2.35	84	0.8	-	13.27	-0.04	81	168	75	70
38	5.675	0.152	0.017	2.34	84	0.9	-	13.22	-0.05	81	168	75	71
39	5.829	0.154	0.017	2.34	84	0.8	-	13.18	-0.04	81	167	75	71
40	5.984	0.155	0.017	2.35	85	0.8	98	13.14	-0.04	81	167	75	70
41	6.138	0.154	0.017	2.36	85	0.9	-	13.10	-0.04	81	166	75	70
42	6.294	0.156	0.017	2.35	86	0.8	-	13.07	-0.03	81	166	75	70
43	6.445	0.151	0.017	2.36	86	0.8	-	13.02	-0.05	81	165	75	70
44	6.603	0.158	0.017	2.35	86	0.9	-	12.98	-0.04	81	165	75	71
45	6.754	0.151	0.017	2.36	86	0.8	-	12.95	-0.03	81	165	75	71
46	6.913	0.159	0.017	2.37	87	0.8	-	12.91	-0.04	81	165	75	71
47	7.065	0.152	0.017	2.37	87	0.8	-	12.87	-0.04	81	164	75	71
48	7.222	0.157	0.017	2.38	87	0.9	-	12.83	-0.04	80	164	75	71
49	7.376	0.154	0.017	2.37	87	0.9	-	12.79	-0.04	81	164	75	71
50	7.532	0.156	0.017	2.37	88	0.8	99	12.75	-0.04	81	164	75	71
51	7.689	0.157	0.017	2.38	88	0.8	-	12.71	-0.04	81	164	75	71
52	7.843	0.154	0.017	2.38	88	0.9	-	12.66	-0.05	81	164	75	71
53	8.001	0.158	0.017	2.39	89	0.9	-	12.62	-0.04	81	165	75	71
54	8.153	0.152	0.017	2.38	89	0.9	-	12.58	-0.04	81	165	75	71
55	8.313	0.160	0.017	2.39	89	0.8	-	12.53	-0.05	81	165	75	71
56	8.467	0.154	0.017	2.39	89	0.9	-	12.48	-0.05	81	166	75	71
57	8.624	0.157	0.017	2.40	90	0.8	-	12.44	-0.04	81	168	76	71
58	8.779	0.155	0.017	2.38	90	0.9	-	12.40	-0.04	81	168	75	71
59	8.936	0.157	0.017	2.40	90	0.9	-	12.35	-0.05	81	168	76	70
60	9.095	0.159	0.017	2.40	90	0.9	99	12.30	-0.05	81	168	76	70
61	9.248	0.153	0.017	2.40	91	0.9	-	12.26	-0.04	81	169	76	70
62	9.408	0.160	0.017	2.41	91	0.9	-	12.21	-0.05	81	169	76	70
63	9.562	0.154	0.017	2.39	91	0.8	-	12.16	-0.05	81	169	76	69

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
64	9.720	0.158	0.017	2.40	91	0.8	-	12.12	-0.04	81	170	76	70
65	9.876	0.156	0.017	2.40	92	0.9	-	12.07	-0.05	81	171	76	70
66	10.034	0.158	0.017	2.41	92	0.9	-	12.02	-0.05	81	172	76	70
67	10.193	0.159	0.017	2.41	92	0.9	-	11.96	-0.06	81	173	76	69
68	10.347	0.154	0.017	2.40	92	0.9	-	11.92	-0.04	81	174	76	69
69	10.507	0.160	0.017	2.41	92	0.9	-	11.87	-0.05	81	175	76	70
70	10.662	0.155	0.017	2.40	92	0.9	99	11.81	-0.06	81	176	75	70
71	10.820	0.158	0.017	2.41	93	0.9	-	11.75	-0.06	81	177	75	70
72	10.977	0.157	0.017	2.41	93	0.9	-	11.69	-0.06	81	179	76	70
73	11.135	0.158	0.017	2.41	93	0.9	-	11.63	-0.06	81	181	76	70
74	11.294	0.159	0.017	2.42	93	0.9	-	11.57	-0.06	81	182	76	70
75	11.448	0.154	0.017	2.40	93	0.9	-	11.50	-0.07	81	183	76	70
76	11.611	0.163	0.017	2.42	94	0.9	-	11.44	-0.06	81	184	76	70
77	11.766	0.155	0.017	2.43	94	0.8	-	11.38	-0.06	81	185	76	70
78	11.924	0.158	0.017	2.42	94	0.9	-	11.32	-0.06	81	186	76	70
79	12.083	0.159	0.016	2.42	94	0.9	-	11.26	-0.06	81	186	76	69
80	12.240	0.157	0.017	2.42	94	0.9	99	11.19	-0.07	82	187	76	70
81	12.399	0.159	0.017	2.42	94	0.9	-	11.13	-0.06	82	189	76	70
82	12.555	0.156	0.017	2.42	95	0.9	-	11.07	-0.06	82	190	76	70
83	12.716	0.161	0.017	2.42	95	0.9	-	11.00	-0.07	82	192	76	69
84	12.872	0.156	0.017	2.42	95	0.8	-	10.94	-0.06	82	195	76	70
85	13.031	0.159	0.017	2.42	95	0.9	-	10.87	-0.07	82	197	76	70
86	13.191	0.160	0.017	2.42	95	0.9	-	10.79	-0.08	82	200	76	70
87	13.346	0.155	0.017	2.43	95	0.9	-	10.71	-0.08	83	202	76	70
88	13.508	0.162	0.017	2.42	95	0.9	-	10.62	-0.09	83	208	76	70
89	13.664	0.156	0.017	2.42	95	0.9	-	10.51	-0.11	83	213	76	70
90	13.823	0.159	0.017	2.42	96	0.9	99	10.39	-0.12	83	218	76	70
91	13.982	0.159	0.017	2.42	96	0.9	-	10.26	-0.13	84	222	76	70
92	14.139	0.157	0.017	2.43	96	0.9	-	10.15	-0.11	84	224	76	70
93	14.299	0.160	0.017	2.43	96	0.8	-	10.04	-0.11	84	227	76	71
94	14.456	0.157	0.017	2.42	96	0.8	-	9.94	-0.10	85	228	76	71
95	14.616	0.160	0.017	2.43	96	0.9	-	9.82	-0.12	85	231	76	71

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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
96	14.773	0.157	0.017	2.43	96	0.9	-	9.72	-0.10	85	233	76	70
97	14.933	0.160	0.017	2.43	96	0.9	-	9.60	-0.12	85	236	76	70
98	15.093	0.160	0.017	2.43	97	0.9	-	9.49	-0.11	85	238	76	70
99	15.248	0.155	0.017	2.42	97	0.9	-	9.38	-0.11	85	241	76	70
100	15.411	0.163	0.017	2.42	97	0.9	100	9.28	-0.10	85	244	76	70
101	15.566	0.155	0.017	2.43	97	0.9	-	9.17	-0.11	86	246	76	71
102	15.726	0.160	0.017	2.43	97	0.9	-	9.05	-0.12	86	247	76	71
103	15.887	0.161	0.017	2.43	97	0.9	-	8.94	-0.11	86	251	77	71
104	16.042	0.155	0.017	2.43	97	0.9	-	8.84	-0.10	87	254	77	71
105	16.204	0.162	0.017	2.43	97	0.9	-	8.72	-0.12	87	257	77	71
106	16.361	0.157	0.017	2.44	97	0.9	-	8.61	-0.11	87	258	77	71
107	16.520	0.159	0.017	2.44	97	0.9	-	8.50	-0.11	88	260	77	71
108	16.680	0.160	0.017	2.43	97	0.9	-	8.39	-0.11	88	263	77	72
109	16.837	0.157	0.017	2.44	97	0.9	-	8.28	-0.11	88	266	77	72
110	16.998	0.161	0.017	2.44	98	0.9	100	8.17	-0.11	88	267	77	72
111	17.155	0.157	0.017	2.43	98	0.9	-	8.05	-0.12	89	270	77	72
112	17.316	0.161	0.017	2.43	98	0.9	-	7.95	-0.10	89	272	77	72
113	17.474	0.158	0.017	2.44	98	0.9	-	7.83	-0.12	89	274	77	72
114	17.633	0.159	0.017	2.43	98	0.9	-	7.72	-0.11	89	278	77	72
115	17.794	0.161	0.017	2.45	98	0.9	-	7.61	-0.11	90	279	77	72
116	17.950	0.156	0.017	2.44	98	0.9	-	7.51	-0.10	90	279	78	72
117	18.113	0.163	0.017	2.43	98	0.9	-	7.40	-0.11	90	280	78	72
118	18.269	0.156	0.017	2.42	98	0.9	-	7.29	-0.11	90	282	78	72
119	18.429	0.160	0.017	2.45	98	0.9	-	7.17	-0.12	90	285	78	72
120	18.590	0.161	0.017	2.44	98	0.9	100	7.07	-0.10	90	287	78	72
121	18.745	0.155	0.017	2.43	99	0.9	-	6.95	-0.12	91	289	78	72
122	18.909	0.164	0.017	2.43	99	0.9	-	6.83	-0.12	91	290	78	72
123	19.065	0.156	0.017	2.45	99	0.9	-	6.72	-0.11	91	291	78	72
124	19.226	0.161	0.016	2.44	99	0.9	-	6.61	-0.11	92	294	78	72
125	19.387	0.161	0.017	2.45	99	0.9	-	6.48	-0.13	92	299	78	72
126	19.542	0.155	0.016	2.44	99	0.9	-	6.34	-0.14	92	302	78	72
127	19.706	0.164	0.017	2.45	99	0.9	-	6.23	-0.11	93	302	78	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
128	19.862	0.156	0.017	2.44	99	0.9	-	6.12	-0.11	92	302	79	72
129	20.022	0.160	0.016	2.44	99	0.9	-	6.00	-0.12	93	303	79	73
130	20.184	0.162	0.017	2.45	99	0.9	100	5.91	-0.09	93	303	79	73
131	20.340	0.156	0.017	2.45	99	0.9	-	5.81	-0.10	92	302	79	73
132	20.503	0.163	0.017	2.44	99	0.9	-	5.71	-0.10	92	301	79	73
133	20.660	0.157	0.017	2.46	99	0.9	-	5.62	-0.09	92	299	79	73
134	20.820	0.160	0.017	2.44	99	0.9	-	5.54	-0.08	92	298	79	73
135	20.982	0.162	0.017	2.44	99	0.9	-	5.46	-0.08	93	298	79	73
136	21.138	0.156	0.017	2.44	100	0.9	-	5.38	-0.08	93	297	79	73
137	21.301	0.163	0.017	2.45	100	0.9	-	5.30	-0.08	93	297	79	73
138	21.458	0.157	0.017	2.45	100	0.9	-	5.22	-0.08	93	295	79	73
139	21.618	0.160	0.017	2.44	100	0.9	-	5.14	-0.08	92	295	79	73
140	21.780	0.162	0.017	2.45	100	0.9	100	5.07	-0.07	93	293	79	73
141	21.936	0.156	0.017	2.44	100	0.9	-	4.99	-0.08	92	292	79	73
142	22.100	0.164	0.017	2.43	100	0.9	-	4.92	-0.07	93	291	79	74
143	22.257	0.157	0.017	2.44	100	0.9	-	4.85	-0.07	93	289	79	73
144	22.417	0.160	0.017	2.44	100	0.9	-	4.78	-0.07	92	289	79	73
145	22.579	0.162	0.017	2.45	100	0.9	-	4.71	-0.07	92	287	79	73
146	22.736	0.157	0.017	2.45	100	0.9	-	4.64	-0.07	92	285	79	73
147	22.899	0.163	0.017	2.45	100	0.9	-	4.57	-0.07	92	285	80	73
148	23.057	0.158	0.017	2.45	100	0.9	-	4.51	-0.06	91	284	79	73
149	23.217	0.160	0.017	2.45	100	0.9	-	4.45	-0.06	91	283	79	73
150	23.379	0.162	0.018	2.46	100	0.9	99	4.37	-0.08	92	282	79	73
151	23.535	0.156	0.017	2.46	100	0.9	-	4.32	-0.05	91	281	79	73
152	23.699	0.164	0.017	2.45	101	0.9	-	4.25	-0.07	92	281	80	73
153	23.857	0.158	0.017	2.45	101	0.9	-	4.18	-0.07	92	280	80	73
154	24.017	0.160	0.017	2.45	101	0.9	-	4.11	-0.07	91	280	80	73
155	24.179	0.162	0.017	2.44	101	0.9	-	4.05	-0.06	92	280	80	73
156	24.336	0.157	0.017	2.44	101	0.9	-	3.99	-0.06	92	279	80	73
157	24.499	0.163	0.017	2.44	101	0.9	-	3.92	-0.07	91	279	79	73
158	24.657	0.158	0.017	2.44	101	0.9	-	3.87	-0.05	91	279	79	73
159	24.817	0.160	0.017	2.43	101	0.9	-	3.80	-0.07	91	277	79	73

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
160	24.979	0.162	0.017	2.42	101	0.9	99	3.74	-0.06	92	276	79	73
161	25.136	0.157	0.017	2.44	101	0.9	-	3.68	-0.06	92	275	80	73
162	25.300	0.164	0.017	2.44	101	0.9	-	3.62	-0.06	92	276	80	72
163	25.457	0.157	0.017	2.46	101	0.9	-	3.56	-0.06	91	275	79	73
164	25.618	0.161	0.017	2.44	101	0.9	-	3.51	-0.05	91	274	79	73
165	25.780	0.162	0.017	2.45	101	0.9	-	3.46	-0.05	91	273	79	73
166	25.937	0.157	0.017	2.45	101	0.9	-	3.40	-0.06	91	274	80	73
167	26.101	0.164	0.018	2.45	101	0.9	-	3.34	-0.06	92	273	80	73
168	26.258	0.157	0.017	2.45	101	0.9	-	3.28	-0.06	91	273	80	73
169	26.420	0.162	0.017	2.43	101	0.9	-	3.23	-0.05	92	273	79	73
170	26.582	0.162	0.017	2.45	101	0.9	100	3.17	-0.06	91	273	79	74
171	26.738	0.156	0.017	2.45	101	0.9	-	3.11	-0.06	91	273	79	74
172	26.903	0.165	0.017	2.45	101	0.9	-	3.06	-0.05	92	273	80	73
173	27.060	0.157	0.017	2.45	101	0.9	-	3.01	-0.05	92	272	80	73
174	27.221	0.161	0.017	2.45	101	0.9	-	2.95	-0.06	93	272	80	74
175	27.383	0.162	0.017	2.47	101	0.9	-	2.90	-0.05	93	272	80	74
176	27.540	0.157	0.017	2.45	101	0.9	-	2.85	-0.05	92	273	80	74
177	27.705	0.165	0.017	2.45	101	0.9	-	2.79	-0.06	92	273	80	74
178	27.862	0.157	0.017	2.46	101	0.9	-	2.73	-0.06	92	274	80	74
179	28.024	0.162	0.017	2.44	101	0.9	-	2.67	-0.06	92	276	80	73
180	28.185	0.161	0.017	2.44	101	0.9	100	2.62	-0.05	92	276	80	73
181	28.343	0.158	0.017	2.43	101	0.9	-	2.57	-0.05	92	277	80	73
182	28.506	0.163	0.017	2.45	101	0.9	-	2.51	-0.06	92	277	80	74
183	28.665	0.159	0.017	2.44	101	0.9	-	2.47	-0.04	92	276	80	74
184	28.826	0.161	0.018	2.44	101	0.9	-	2.42	-0.05	92	276	80	75
185	28.988	0.162	0.017	2.45	102	0.9	-	2.37	-0.05	92	274	80	74
186	29.147	0.159	0.017	2.45	102	0.9	-	2.32	-0.05	91	274	80	74
187	29.308	0.161	0.017	2.44	102	0.9	-	2.28	-0.04	91	272	80	74
188	29.469	0.161	0.017	2.44	102	0.9	-	2.24	-0.04	92	272	80	74
189	29.628	0.159	0.017	2.44	102	0.9	-	2.21	-0.03	92	271	80	73
190	29.791	0.163	0.017	2.42	102	0.9	101	2.16	-0.05	92	270	80	73
191	29.950	0.159	0.017	2.42	102	0.9	-	2.14	-0.02	91	268	80	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
192	30.111	0.161	0.017	2.43	102	0.9	-	2.10	-0.04	91	266	80	74
193	30.273	0.162	0.017	2.42	102	0.9	-	2.07	-0.03	90	264	80	74
194	30.430	0.157	0.017	2.43	102	0.9	-	2.05	-0.02	90	260	80	74
195	30.595	0.165	0.017	2.43	102	0.9	-	2.02	-0.03	90	259	80	74
196	30.753	0.158	0.017	2.44	102	0.9	-	1.99	-0.03	90	255	80	74
197	30.913	0.160	0.017	2.43	102	0.9	-	1.97	-0.02	90	253	80	74
198	31.076	0.163	0.017	2.43	102	0.9	-	1.94	-0.03	90	251	80	73
199	31.233	0.157	0.017	2.44	102	0.9	-	1.93	-0.01	89	249	80	73
200	31.398	0.165	0.017	2.44	102	0.9	100	1.90	-0.03	89	246	80	74
201	31.555	0.157	0.017	2.45	102	0.9	-	1.88	-0.02	89	243	80	73
202	31.717	0.162	0.017	2.45	102	0.9	-	1.86	-0.02	89	242	80	74
203	31.880	0.163	0.017	2.46	102	0.9	-	1.84	-0.02	90	239	80	73
204	32.036	0.156	0.016	2.44	102	0.9	-	1.82	-0.02	89	237	79	73
205	32.201	0.165	0.015	2.45	102	0.9	-	1.80	-0.02	89	236	79	73
206	32.359	0.158	0.017	2.46	102	0.9	-	1.78	-0.02	89	234	79	73
207	32.521	0.162	0.017	2.45	102	0.9	-	1.77	-0.01	90	232	79	73
208	32.683	0.162	0.017	2.46	102	0.9	-	1.75	-0.02	90	231	79	73
209	32.841	0.158	0.017	2.46	102	0.9	-	1.73	-0.02	90	229	79	74
210	33.004	0.163	0.017	2.46	102	0.9	100	1.71	-0.02	90	228	79	73
211	33.163	0.159	0.017	2.46	102	0.9	-	1.69	-0.02	90	228	79	73
212	33.324	0.161	0.016	2.45	102	0.9	-	1.68	-0.01	90	226	80	73
213	33.486	0.162	0.016	2.45	102	0.9	-	1.66	-0.02	90	225	79	73
214	33.645	0.159	0.017	2.45	102	0.9	-	1.64	-0.02	89	224	79	73
215	33.807	0.162	0.017	2.46	102	0.9	-	1.63	-0.01	89	223	79	74
216	33.968	0.161	0.017	2.46	102	0.9	-	1.61	-0.02	88	222	80	74
217	34.126	0.158	0.017	2.45	102	0.9	-	1.60	-0.01	89	221	80	74
218	34.290	0.164	0.018	2.44	102	0.9	-	1.57	-0.03	89	220	80	74
219	34.449	0.159	0.017	2.44	102	0.9	-	1.56	-0.01	89	220	80	74
220	34.610	0.161	0.017	2.44	102	0.9	100	1.54	-0.02	89	219	80	74
221	34.772	0.162	0.016	2.43	102	0.9	-	1.52	-0.02	88	219	80	74
222	34.930	0.158	0.016	2.45	102	0.9	-	1.50	-0.02	87	219	79	74
223	35.094	0.164	0.017	2.44	102	0.9	-	1.48	-0.02	88	217	79	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
224	35.252	0.158	0.017	2.44	102	0.9	-	1.46	-0.02	88	217	79	74
225	35.414	0.162	0.016	2.43	102	0.9	-	1.46	0.00	88	216	79	74
226	35.576	0.162	0.016	2.45	102	0.9	-	1.43	-0.03	88	215	79	74
227	35.733	0.157	0.016	2.44	102	0.9	-	1.41	-0.02	88	215	79	74
228	35.898	0.165	0.016	2.45	102	0.9	-	1.40	-0.01	88	215	79	74
229	36.056	0.158	0.016	2.45	103	0.9	-	1.36	-0.04	88	215	79	74
230	36.218	0.162	0.016	2.45	103	0.9	102	1.37	0.01	87	213	79	74
231	36.379	0.161	0.017	2.45	103	0.9	-	1.34	-0.03	87	213	79	74
232	36.538	0.159	0.017	2.45	102	0.9	-	1.33	-0.01	88	213	79	74
233	36.701	0.163	0.017	2.47	102	0.9	-	1.32	-0.01	88	212	79	74
234	36.860	0.159	0.017	2.46	103	0.9	-	1.30	-0.02	87	212	79	74
235	37.022	0.162	0.017	2.46	103	0.9	-	1.27	-0.03	86	212	79	74
236	37.184	0.162	0.017	2.45	103	0.9	-	1.26	-0.01	87	211	79	74
237	37.343	0.159	0.017	2.46	103	0.9	-	1.24	-0.02	87	211	79	74
238	37.505	0.162	0.016	2.46	103	0.9	-	1.23	-0.01	87	211	79	74
239	37.667	0.162	0.015	2.46	103	0.9	-	1.21	-0.02	86	210	79	74
240	37.824	0.157	0.015	2.46	103	0.9	105	1.19	-0.02	87	209	79	74
241	37.989	0.165	0.016	2.46	103	0.9	-	1.18	-0.01	87	209	79	74
242	38.147	0.158	0.016	2.46	103	0.9	-	1.16	-0.02	87	209	79	74
243	38.306	0.159	0.015	2.46	103	0.9	-	1.15	-0.01	86	209	79	74
244	38.468	0.162	0.014	2.46	103	0.9	-	1.14	-0.01	85	208	79	73
245	38.626	0.158	0.015	2.47	103	0.9	-	1.12	-0.02	85	208	79	73
246	38.790	0.164	0.017	2.46	103	0.9	-	1.10	-0.02	86	207	79	73
247	38.951	0.161	0.017	2.46	103	0.9	-	1.08	-0.02	87	208	79	73
248	39.113	0.162	0.016	2.46	103	0.9	-	1.06	-0.02	86	207	79	73
249	39.275	0.162	0.017	2.46	103	0.9	-	1.04	-0.02	86	206	79	73
250	39.433	0.158	0.016	2.45	103	0.9	105	1.03	-0.01	86	207	79	73
251	39.597	0.164	0.017	2.46	103	0.9	-	1.02	-0.01	86	207	79	73
252	39.755	0.158	0.017	2.46	103	0.9	-	1.02	0.00	86	206	79	73
253	39.917	0.162	0.016	2.45	103	0.9	-	0.99	-0.03	88	205	79	73
254	40.080	0.163	0.016	2.45	103	0.9	-	0.98	-0.01	88	205	79	74
255	40.238	0.158	0.017	2.44	103	0.9	-	0.96	-0.02	88	205	79	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
256	40.400	0.162	0.017	2.44	103	0.9	-	0.95	-0.01	87	204	79	74
257	40.562	0.162	0.017	2.45	103	0.9	-	0.94	-0.01	86	204	79	74
258	40.721	0.159	0.017	2.45	103	0.9	-	0.93	-0.01	86	204	79	74
259	40.884	0.163	0.017	2.45	103	0.9	-	0.92	-0.01	88	203	79	74
260	41.040	0.156	0.017	2.44	103	0.9	102	0.90	-0.02	89	204	79	74
261	41.204	0.164	0.017	2.45	103	0.9	-	0.87	-0.03	88	204	79	74
262	41.367	0.163	0.016	2.43	103	0.9	-	0.85	-0.02	88	204	79	74
263	41.525	0.158	0.015	2.46	103	0.9	-	0.83	-0.02	87	204	79	74
264	41.689	0.164	0.015	2.44	103	0.9	-	0.82	-0.01	86	204	79	74
265	41.845	0.156	0.016	2.44	103	0.9	-	0.80	-0.02	87	204	79	74
266	42.006	0.161	0.016	2.42	103	0.9	-	0.79	-0.01	87	204	79	74
267	42.172	0.166	0.016	2.42	103	0.9	-	0.78	-0.01	87	204	79	74
268	42.328	0.156	0.016	2.41	103	0.9	-	0.75	-0.03	87	204	79	74
269	42.494	0.166	0.017	2.42	103	0.9	-	0.75	0.00	87	204	80	74
270	42.649	0.155	0.016	2.43	103	0.9	102	0.74	-0.01	87	203	80	74
271	42.811	0.162	0.018	2.42	103	0.9	-	0.73	-0.01	87	202	80	74
272	42.976	0.165	0.017	2.43	103	0.9	-	0.71	-0.02	87	202	79	74
273	43.134	0.158	0.016	2.42	103	0.9	-	0.69	-0.02	88	202	80	74
274	43.295	0.161	0.016	2.44	103	0.9	-	0.69	0.00	88	201	80	74
275	43.454	0.159	0.017	2.44	103	0.9	-	0.67	-0.02	87	201	80	74
276	43.618	0.164	0.016	2.44	103	0.9	-	0.66	-0.01	87	201	80	74
277	43.778	0.160	0.017	2.44	103	0.9	-	0.65	-0.01	87	201	80	74
278	43.937	0.159	0.017	2.45	103	0.9	-	0.63	-0.02	86	200	80	75
279	44.099	0.162	0.018	2.45	103	0.9	-	0.62	-0.01	86	200	79	75
280	44.264	0.165	0.017	2.45	103	0.9	102	0.60	-0.02	87	199	80	75
281	44.419	0.155	0.018	2.45	103	0.9	-	0.59	-0.01	87	199	80	75
282	44.586	0.167	0.016	2.47	103	0.9	-	0.56	-0.03	87	199	80	75
283	44.742	0.156	0.017	2.46	103	0.9	-	0.55	-0.01	87	199	79	74
284	44.906	0.164	0.017	2.47	103	0.9	-	0.53	-0.02	86	197	79	74
285	45.066	0.160	0.017	2.46	103	0.9	-	0.53	0.00	87	197	79	75
286	45.226	0.160	0.017	2.46	103	0.9	-	0.52	-0.01	85	196	79	74
287	45.388	0.162	0.017	2.46	103	0.9	-	0.49	-0.03	86	197	79	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

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
288	45.549	0.161	0.016	2.45	103	0.9	-	0.47	-0.02	87	197	80	74
289	45.706	0.157	0.017	2.45	103	0.9	-	0.46	-0.01	87	197	80	74
290	45.873	0.167	0.017	2.46	103	0.9	100	0.44	-0.02	87	196	80	74
291	46.025	0.152	0.017	2.45	103	0.9	-	0.43	-0.01	87	196	80	74
292	46.193	0.168	0.017	2.45	103	0.9	-	0.42	-0.01	87	195	80	74
293	46.355	0.162	0.017	2.46	103	0.9	-	0.40	-0.02	88	195	80	74
294	46.511	0.156	0.017	2.45	103	0.9	-	0.39	-0.01	87	195	80	74
295	46.678	0.167	0.017	2.46	103	0.9	-	0.37	-0.02	87	194	80	74
296	46.838	0.160	0.017	2.46	103	0.9	-	0.35	-0.02	87	195	80	74
297	46.999	0.161	0.017	2.46	103	0.9	-	0.34	-0.01	87	194	80	74
298	47.162	0.163	0.016	2.46	104	0.9	-	0.33	-0.01	87	194	80	74
299	47.320	0.158	0.017	2.48	104	0.9	-	0.32	-0.01	87	193	80	74
300	47.485	0.165	0.017	2.46	104	0.9	100	0.32	0.00	86	194	80	74
301	47.642	0.157	0.017	2.46	104	0.9	-	0.29	-0.03	85	193	80	74
302	47.805	0.163	0.017	2.45	104	0.9	-	0.27	-0.02	86	193	80	74
303	47.965	0.160	0.017	2.46	104	0.9	-	0.27	0.00	86	193	80	74
304	48.122	0.157	0.017	2.45	104	0.9	-	0.25	-0.02	87	193	80	74
305	48.287	0.165	0.016	2.44	104	0.9	-	0.23	-0.02	87	192	80	74
306	48.448	0.161	0.017	2.44	104	0.9	-	0.23	0.00	87	192	80	74
307	48.610	0.162	0.017	2.43	104	0.9	-	0.21	-0.02	87	192	80	74
308	48.773	0.163	0.017	2.43	104	0.9	-	0.21	0.00	87	193	80	74
309	48.932	0.159	0.017	2.43	104	0.9	-	0.20	-0.01	87	192	80	74
310	49.094	0.162	0.017	2.43	104	0.9	100	0.18	-0.02	86	192	80	74
311	49.255	0.161	0.017	2.43	104	0.9	-	0.17	-0.01	87	192	80	74
312	49.415	0.160	0.017	2.43	104	0.9	-	0.16	-0.01	87	191	80	74
313	49.579	0.164	0.017	2.43	104	0.9	-	0.14	-0.02	87	192	80	74
314	49.735	0.156	0.017	2.42	104	0.9	-	0.13	-0.01	87	191	80	74
315	49.897	0.162	0.017	2.44	104	0.9	-	0.12	-0.01	86	191	80	75
316	50.063	0.166	0.017	2.43	104	0.9	-	0.11	-0.01	86	192	80	75
317	50.218	0.155	0.017	2.44	104	0.9	-	0.10	-0.01	85	191	80	75
318	50.386	0.168	0.018	2.45	104	0.9	-	0.09	-0.01	84	191	80	75
319	50.541	0.155	0.017	2.45	104	0.9	-	0.05	-0.04	85	191	80	75

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: <u>Jotul</u>	Job #: <u>23-167</u>
Model: <u>F445</u>	Tracking #: <u>152</u>
Run #: <u>3</u>	Technician: <u>SJB</u>
	Date: <u>7/7/2023</u>

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	50.704	0.163	0.017	2.46	104	0.9	100	0.06	0.01	86	191	80	75
321	50.865	0.161	0.017	2.45	104	0.9	-	0.05	-0.01	85	191	80	75
322	51.028	0.163	0.018	2.43	104	0.9	-	0.04	-0.01	86	191	80	75
323	51.186	0.158	0.017	2.43	104	0.9	-	0.02	-0.02	86	190	80	75
324	51.347	0.161	0.017	2.43	104	0.9	100	0.00	-0.02	86	189	80	75
Avg/Tot	51.347	0.158	0.017	2.40	97.0	0.9	100			86.7	221.2	77.9	72.3

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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		0.18	76	1.1		74	-0.047	2.51	0.055
1	0.137	0.137	2.09	76	1.8	-	74	-0.045	1.21	0.117
2	0.282	0.145	2.09	76	1.8	-	75	-0.045	1.20	0.254
3	0.422	0.140	2.10	76	1.9	-	75	-0.045	1.36	0.032
4	0.567	0.145	2.09	76	1.8	-	75	-0.047	1.24	0.026
5	0.709	0.142	2.11	76	1.8	-	75	-0.048	1.24	0.029
6	0.853	0.144	2.10	76	1.5	-	75	-0.045	1.27	0.029
7	0.996	0.143	2.11	76	1.9	-	75	-0.045	1.35	0.027
8	1.138	0.142	2.10	76	1.7	-	75	-0.046	1.27	0.028
9	1.283	0.145	2.11	76	2.0	-	75	-0.045	1.29	0.031
10	1.425	0.142	2.11	76	1.5	99	75	-0.045	1.33	0.031
11	1.571	0.146	2.11	77	2.0	-	75	-0.044	1.36	0.030
12	1.711	0.140	2.12	77	1.9	-	75	-0.042	1.49	0.019
13	1.857	0.146	2.11	77	1.8	-	75	-0.043	1.50	0.028
14	1.999	0.142	2.11	77	1.8	-	75	-0.042	1.48	0.026
15	2.145	0.146	2.12	77	1.7	-	75	-0.044	1.58	0.032
16	2.288	0.143	2.12	77	1.6	-	75	-0.043	1.55	0.028
17	2.431	0.143	2.12	78	1.4	-	75	-0.044	1.57	0.024
18	2.575	0.144	2.12	78	1.9	-	75	-0.041	1.65	0.028
19	2.718	0.143	2.12	78	1.6	-	75	-0.041	1.70	0.033
20	2.865	0.147	2.12	79	1.5	100	75	-0.042	1.92	0.031
21	3.007	0.142	2.12	79	1.6	-	75	-0.043	1.84	0.034
22	3.153	0.146	2.13	79	1.5	-	75	-0.043	1.85	0.027
23	3.295	0.142	2.12	79	1.5	-	75	-0.042	1.83	0.032
24	3.442	0.147	2.13	80	2.0	-	75	-0.042	1.80	0.027
25	3.585	0.143	2.13	80	1.5	-	75	-0.042	1.79	0.028
26	3.732	0.147	2.13	80	1.9	-	75	-0.043	2.01	0.034
27	3.875	0.143	2.13	81	2.0	-	75	-0.040	2.14	0.033
28	4.020	0.145	2.13	81	1.5	-	75	-0.040	2.14	0.028
29	4.165	0.145	2.13	81	1.4	-	75	-0.040	2.18	0.032
30	4.309	0.144	2.13	82	1.6	99	75	-0.040	2.21	0.037
31	4.455	0.146	2.13	82	2.0	-	75	-0.038	2.44	0.029

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
32	4.599	0.144	2.14	82	1.4	-	75	-0.041	2.31	0.034
33	4.747	0.148	2.14	83	1.8	-	75	-0.040	2.38	0.034
34	4.890	0.143	2.14	83	2.0	-	75	-0.041	2.46	0.037
35	5.038	0.148	2.14	84	1.7	-	75	-0.040	2.45	0.031
36	5.180	0.142	2.14	84	1.8	-	75	-0.039	2.43	0.035
37	5.328	0.148	2.14	84	2.0	-	75	-0.041	2.61	0.032
38	5.472	0.144	2.14	84	1.5	-	75	-0.041	2.63	0.032
39	5.620	0.148	2.14	85	2.0	-	75	-0.040	2.68	0.033
40	5.765	0.145	2.15	85	1.8	100	75	-0.041	2.47	0.032
41	5.913	0.148	2.15	85	1.9	-	75	-0.038	2.51	0.029
42	6.057	0.144	2.14	85	2.0	-	75	-0.040	2.53	0.034
43	6.204	0.147	2.15	86	1.9	-	75	-0.040	2.63	0.034
44	6.350	0.146	2.15	86	2.0	-	75	-0.039	2.79	0.035
45	6.495	0.145	2.15	87	1.7	-	75	-0.040	2.76	0.038
46	6.642	0.147	2.14	87	1.7	-	76	-0.040	2.73	0.033
47	6.788	0.146	2.15	88	1.8	-	76	-0.036	2.76	0.033
48	6.936	0.148	2.15	88	2.0	-	76	-0.039	2.83	0.035
49	7.080	0.144	2.15	88	1.4	-	76	-0.039	2.88	0.041
50	7.229	0.149	2.16	89	1.7	99	76	-0.038	3.02	0.042
51	7.375	0.146	2.16	89	1.9	-	76	-0.040	2.97	0.042
52	7.524	0.149	2.16	89	1.9	-	76	-0.038	3.16	0.037
53	7.669	0.145	2.16	89	2.0	-	76	-0.039	3.25	0.040
54	7.818	0.149	2.16	89	1.9	-	76	-0.040	3.58	0.039
55	7.963	0.145	2.16	89	2.0	-	76	-0.040	3.49	0.039
56	8.112	0.149	2.16	90	1.7	-	76	-0.041	3.33	0.037
57	8.257	0.145	2.16	90	2.0	-	76	-0.043	3.43	0.045
58	8.406	0.149	2.16	90	1.4	-	75	-0.043	3.26	0.036
59	8.551	0.145	2.16	90	2.0	-	75	-0.039	3.19	0.032
60	8.700	0.149	2.15	90	1.4	99	75	-0.041	3.01	0.037
61	8.845	0.145	2.16	90	1.9	-	75	-0.039	3.34	0.039
62	8.995	0.150	2.17	90	1.6	-	75	-0.042	3.19	0.036
63	9.140	0.145	2.17	91	1.6	-	75	-0.041	3.37	0.036

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
64	9.289	0.149	2.17	91	1.9	-	75	-0.040	3.36	0.036
65	9.435	0.146	2.16	91	1.7	-	75	-0.043	3.44	0.041
66	9.584	0.149	2.17	91	2.0	-	76	-0.043	3.62	0.040
67	9.730	0.146	2.17	91	1.9	-	75	-0.043	3.63	0.040
68	9.879	0.149	2.17	92	1.7	-	75	-0.042	3.82	0.038
69	10.026	0.147	2.17	92	2.0	-	75	-0.042	3.70	0.040
70	10.174	0.148	2.17	92	1.7	99	75	-0.044	3.93	0.037
71	10.321	0.147	2.17	92	1.7	-	75	-0.047	4.19	0.046
72	10.469	0.148	2.16	92	1.7	-	75	-0.047	3.79	0.076
73	10.616	0.147	2.17	93	2.0	-	75	-0.045	3.78	0.223
74	10.764	0.148	2.17	93	1.8	-	75	-0.045	3.64	0.297
75	10.912	0.148	2.17	93	1.4	-	75	-0.045	3.78	0.304
76	11.060	0.148	2.18	93	1.5	-	75	-0.047	3.97	0.207
77	11.208	0.148	2.17	93	2.0	-	75	-0.048	4.16	0.200
78	11.355	0.147	2.17	93	1.9	-	75	-0.048	3.74	0.191
79	11.504	0.149	2.17	93	1.5	-	75	-0.048	3.96	0.170
80	11.651	0.147	2.17	94	2.0	99	75	-0.046	3.99	0.177
81	11.799	0.148	2.17	94	1.5	-	75	-0.047	4.17	0.121
82	11.946	0.147	2.17	94	2.0	-	75	-0.050	4.41	0.152
83	12.095	0.149	2.17	94	1.6	-	75	-0.048	4.08	0.181
84	12.242	0.147	2.17	94	1.4	-	75	-0.050	4.28	0.173
85	12.391	0.149	2.17	94	1.6	-	75	-0.048	3.91	0.227
86	12.538	0.147	2.17	94	2.0	-	75	-0.053	3.79	0.350
87	12.688	0.150	2.17	95	2.0	-	75	-0.056	3.80	0.565
88	12.835	0.147	2.18	94	1.8	-	75	-0.055	3.96	0.858
89	12.984	0.149	2.17	95	1.7	-	75	-0.055	3.76	1.148
90	13.131	0.147	2.17	95	1.5	99	75	-0.057	3.87	1.448
91	13.281	0.150	2.18	95	1.9	-	75	-0.056	3.74	1.502
92	13.428	0.147	2.18	95	1.6	-	76	-0.058	3.75	1.411
93	13.577	0.149	2.18	96	1.4	-	76	-0.057	3.80	1.334
94	13.724	0.147	2.18	95	1.4	-	76	-0.056	3.98	1.269
95	13.874	0.150	2.18	95	2.0	-	76	-0.057	3.78	1.186

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
96	14.020	0.146	2.18	96	1.5	-	76	-0.061	3.77	1.116
97	14.170	0.150	2.17	96	1.7	-	76	-0.058	4.15	1.147
98	14.317	0.147	2.18	96	1.7	-	76	-0.060	3.83	1.044
99	14.467	0.150	2.17	96	1.6	-	76	-0.060	4.09	1.107
100	14.614	0.147	2.17	96	1.8	100	76	-0.061	3.80	1.076
101	14.764	0.150	2.17	96	1.5	-	76	-0.062	3.81	1.048
102	14.911	0.147	2.18	96	1.7	-	76	-0.061	4.22	1.170
103	15.061	0.150	2.18	96	2.0	-	76	-0.065	4.10	1.026
104	15.207	0.146	2.18	96	1.9	-	76	-0.064	3.93	0.943
105	15.358	0.151	2.18	96	1.9	-	76	-0.068	4.19	1.076
106	15.504	0.146	2.18	96	1.4	-	76	-0.062	4.39	1.093
107	15.655	0.151	2.18	97	1.7	-	76	-0.065	4.16	1.004
108	15.801	0.146	2.18	97	1.6	-	77	-0.064	4.22	0.935
109	15.952	0.151	2.17	97	2.0	-	77	-0.069	4.39	0.948
110	16.098	0.146	2.17	97	1.9	100	77	-0.067	4.20	0.862
111	16.249	0.151	2.17	97	1.9	-	77	-0.069	4.67	0.887
112	16.395	0.146	2.17	97	1.7	-	77	-0.068	4.68	0.801
113	16.546	0.151	2.17	97	1.7	-	77	-0.071	4.69	0.873
114	16.692	0.146	2.18	97	2.0	-	77	-0.070	4.56	0.761
115	16.843	0.151	2.18	97	1.5	-	77	-0.065	4.36	0.675
116	16.990	0.147	2.17	97	1.9	-	77	-0.072	4.87	0.708
117	17.140	0.150	2.17	97	1.9	-	77	-0.074	4.69	0.666
118	17.286	0.146	2.17	98	2.0	-	77	-0.071	4.50	0.590
119	17.437	0.151	2.17	98	1.5	-	77	-0.071	4.86	0.603
120	17.583	0.146	2.17	98	2.0	100	77	-0.074	4.40	0.526
121	17.734	0.151	2.17	98	1.5	-	77	-0.069	4.84	0.569
122	17.880	0.146	2.17	98	2.0	-	77	-0.071	4.58	0.527
123	18.031	0.151	2.17	98	1.8	-	77	-0.072	4.77	0.532
124	18.177	0.146	2.17	98	1.6	-	77	-0.072	4.68	0.463
125	18.328	0.151	2.17	98	1.9	-	77	-0.072	5.26	0.644
126	18.474	0.146	2.17	98	1.9	-	78	-0.077	5.20	0.736
127	18.625	0.151	2.17	98	1.5	-	78	-0.074	4.79	0.559

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
128	18.772	0.147	2.17	98	1.8	-	78	-0.071	5.09	0.476
129	18.922	0.150	2.17	98	1.7	-	78	-0.073	4.66	0.411
130	19.069	0.147	2.17	98	1.7	100	78	-0.071	4.77	0.343
131	19.220	0.151	2.17	98	1.9	-	78	-0.070	4.78	0.274
132	19.366	0.146	2.17	98	1.7	-	78	-0.071	4.55	0.180
133	19.517	0.151	2.17	98	1.5	-	78	-0.073	4.53	0.138
134	19.664	0.147	2.17	98	2.0	-	78	-0.072	4.43	0.097
135	19.815	0.151	2.17	98	1.7	-	78	-0.070	4.43	0.061
136	19.961	0.146	2.17	99	2.0	-	78	-0.072	4.35	0.040
137	20.112	0.151	2.18	99	1.5	-	78	-0.068	4.09	0.032
138	20.258	0.146	2.17	99	2.0	-	78	-0.071	4.09	0.030
139	20.410	0.152	2.17	99	1.7	-	79	-0.070	4.41	0.024
140	20.556	0.146	2.17	99	1.5	100	79	-0.069	4.15	0.024
141	20.707	0.151	2.17	99	1.9	-	79	-0.070	4.45	0.023
142	20.854	0.147	2.17	99	1.6	-	79	-0.071	4.10	0.023
143	21.005	0.151	2.17	99	2.0	-	79	-0.069	4.27	0.027
144	21.151	0.146	2.17	99	1.6	-	79	-0.069	3.95	0.027
145	21.303	0.152	2.18	99	1.6	-	79	-0.069	4.09	0.024
146	21.449	0.146	2.17	99	1.6	-	79	-0.068	4.11	0.025
147	21.600	0.151	2.18	99	1.5	-	79	-0.068	4.25	0.025
148	21.747	0.147	2.17	99	1.9	-	79	-0.068	4.23	0.029
149	21.898	0.151	2.17	99	1.6	-	79	-0.066	4.00	0.024
150	22.045	0.147	2.18	99	2.0	99	79	-0.069	4.19	0.024
151	22.196	0.151	2.18	99	1.8	-	79	-0.068	3.86	0.026
152	22.343	0.147	2.18	100	1.9	-	79	-0.069	3.78	0.024
153	22.494	0.151	2.18	99	1.5	-	79	-0.067	4.15	0.026
154	22.640	0.146	2.17	99	1.6	-	79	-0.068	4.02	0.026
155	22.792	0.152	2.18	99	1.5	-	79	-0.066	4.08	0.025
156	22.938	0.146	2.18	99	1.9	-	79	-0.065	4.02	0.024
157	23.089	0.151	2.17	99	1.5	-	79	-0.066	3.95	0.026
158	23.236	0.147	2.17	99	1.5	-	79	-0.066	3.87	0.024
159	23.387	0.151	2.17	99	1.5	-	79	-0.068	3.86	0.018

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
160	23.534	0.147	2.18	99	1.8	99	79	-0.064	4.00	0.025
161	23.685	0.151	2.17	99	1.6	-	79	-0.066	4.03	0.027
162	23.831	0.146	2.18	99	1.7	-	79	-0.066	4.08	0.023
163	23.982	0.151	2.18	99	1.9	-	79	-0.066	3.98	0.028
164	24.129	0.147	2.18	100	2.0	-	79	-0.066	3.66	0.030
165	24.280	0.151	2.18	99	1.5	-	79	-0.067	4.06	0.029
166	24.427	0.147	2.18	100	2.0	-	79	-0.068	4.09	0.027
167	24.578	0.151	2.18	100	1.7	-	79	-0.064	3.93	0.028
168	24.725	0.147	2.18	100	1.6	-	79	-0.065	3.89	0.025
169	24.876	0.151	2.18	100	1.7	-	79	-0.068	3.85	0.019
170	25.023	0.147	2.18	100	1.6	100	79	-0.063	3.81	0.026
171	25.174	0.151	2.18	100	1.7	-	79	-0.067	4.16	0.030
172	25.321	0.147	2.18	100	1.4	-	79	-0.065	3.70	0.028
173	25.472	0.151	2.18	100	1.5	-	79	-0.067	4.11	0.029
174	25.619	0.147	2.18	100	1.9	-	79	-0.064	4.01	0.031
175	25.769	0.150	2.17	100	2.0	-	80	-0.063	3.75	0.025
176	25.917	0.148	2.18	100	2.0	-	79	-0.063	3.67	0.024
177	26.068	0.151	2.18	100	1.5	-	80	-0.065	3.86	0.032
178	26.215	0.147	2.18	100	1.5	-	80	-0.065	4.17	0.030
179	26.366	0.151	2.18	100	1.6	-	80	-0.067	3.75	0.032
180	26.513	0.147	2.18	100	2.0	100	80	-0.064	3.90	0.029
181	26.664	0.151	2.18	100	1.7	-	80	-0.066	3.97	0.031
182	26.812	0.148	2.18	101	1.7	-	80	-0.067	3.72	0.030
183	26.962	0.150	2.18	101	1.5	-	80	-0.065	3.72	0.028
184	27.110	0.148	2.18	101	1.5	-	80	-0.066	3.37	0.028
185	27.260	0.150	2.18	100	1.6	-	80	-0.064	3.75	0.028
186	27.408	0.148	2.18	100	1.7	-	80	-0.066	3.63	0.027
187	27.559	0.151	2.17	100	1.6	-	80	-0.066	3.69	0.029
188	27.706	0.147	2.17	100	1.5	-	80	-0.066	3.35	0.027
189	27.857	0.151	2.17	100	1.9	-	80	-0.062	3.60	0.025
190	28.005	0.148	2.17	100	1.6	100	80	-0.064	3.56	0.019
191	28.155	0.150	2.17	100	1.8	-	80	-0.065	2.79	0.027

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
192	28.303	0.148	2.17	101	2.0	-	80	-0.062	2.75	0.026
193	28.454	0.151	2.18	101	2.0	-	80	-0.061	2.50	0.026
194	28.602	0.148	2.17	101	1.8	-	80	-0.061	3.13	0.026
195	28.752	0.150	2.18	101	1.9	-	80	-0.062	2.86	0.025
196	28.900	0.148	2.17	101	1.7	-	80	-0.060	2.98	0.027
197	29.051	0.151	2.17	101	1.8	-	80	-0.059	2.82	0.025
198	29.199	0.148	2.18	101	1.6	-	80	-0.057	2.99	0.018
199	29.349	0.150	2.17	101	1.4	-	80	-0.055	2.84	0.025
200	29.498	0.149	2.17	101	1.4	100	80	-0.059	2.89	0.022
201	29.648	0.150	2.17	101	1.8	-	80	-0.060	2.60	0.026
202	29.797	0.149	2.17	101	1.7	-	80	-0.058	2.85	0.023
203	29.946	0.149	2.17	101	1.5	-	80	-0.056	2.87	0.027
204	30.095	0.149	2.18	101	1.9	-	80	-0.056	2.66	0.022
205	30.245	0.150	2.18	101	1.8	-	80	-0.056	2.94	0.025
206	30.394	0.149	2.18	101	1.6	-	80	-0.058	2.89	0.019
207	30.543	0.149	2.17	101	2.0	-	79	-0.053	2.78	0.022
208	30.693	0.150	2.17	101	1.8	-	79	-0.054	2.77	0.023
209	30.842	0.149	2.17	101	1.8	-	79	-0.056	2.97	0.022
210	30.992	0.150	2.17	101	1.4	100	79	-0.054	2.90	0.024
211	31.140	0.148	2.17	101	1.5	-	79	-0.054	3.10	0.024
212	31.290	0.150	2.17	101	1.5	-	79	-0.050	2.96	0.022
213	31.439	0.149	2.18	101	1.5	-	79	-0.052	3.00	0.021
214	31.589	0.150	2.18	101	1.9	-	79	-0.051	2.85	0.020
215	31.738	0.149	2.18	101	1.5	-	79	-0.054	2.88	0.024
216	31.888	0.150	2.17	101	1.5	-	80	-0.049	2.91	0.019
217	32.036	0.148	2.18	101	1.8	-	80	-0.054	3.05	0.020
218	32.186	0.150	2.18	101	2.0	-	80	-0.051	2.81	0.024
219	32.334	0.148	2.18	101	2.0	-	80	-0.050	3.04	0.028
220	32.484	0.150	2.18	101	1.5	100	80	-0.053	3.06	0.032
221	32.632	0.148	2.18	101	1.9	-	80	-0.055	2.82	0.021
222	32.783	0.151	2.18	102	1.9	-	80	-0.050	2.74	0.020
223	32.931	0.148	2.18	101	2.0	-	80	-0.051	2.67	0.024

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
224	33.081	0.150	2.17	101	2.0	-	80	-0.049	2.67	0.023
225	33.229	0.148	2.18	101	1.5	-	80	-0.050	2.92	0.020
226	33.380	0.151	2.18	101	1.4	-	80	-0.051	2.86	0.021
227	33.528	0.148	2.18	101	1.9	-	80	-0.048	2.96	0.022
228	33.679	0.151	2.18	101	1.9	-	80	-0.049	2.78	0.023
229	33.827	0.148	2.18	101	1.9	-	80	-0.053	2.80	0.021
230	33.978	0.151	2.18	101	1.8	101	79	-0.050	2.94	0.022
231	34.125	0.147	2.17	101	1.9	-	79	-0.049	2.66	0.028
232	34.276	0.151	2.17	101	2.0	-	79	-0.054	2.73	0.024
233	34.423	0.147	2.17	101	2.0	-	79	-0.054	2.68	0.019
234	34.575	0.152	2.17	102	1.7	-	80	-0.051	2.80	0.030
235	34.722	0.147	2.17	102	1.4	-	79	-0.048	2.79	0.020
236	34.874	0.152	2.18	101	2.0	-	79	-0.051	2.72	0.022
237	35.021	0.147	2.18	101	1.5	-	79	-0.049	2.75	0.020
238	35.174	0.153	2.18	101	2.0	-	79	-0.049	3.12	0.020
239	35.321	0.147	2.18	101	1.6	-	79	-0.050	2.63	0.021
240	35.472	0.151	2.17	101	2.0	104	79	-0.047	2.80	0.025
241	35.619	0.147	2.17	101	1.5	-	79	-0.049	3.22	0.019
242	35.771	0.152	2.18	101	1.5	-	79	-0.049	3.00	0.021
243	35.916	0.145	2.17	101	1.6	-	79	-0.050	2.77	0.027
244	36.067	0.151	2.18	101	1.4	-	79	-0.049	2.56	0.023
245	36.215	0.148	2.18	101	2.0	-	79	-0.047	2.55	0.021
246	36.367	0.152	2.18	101	1.9	-	79	-0.051	2.94	0.021
247	36.516	0.149	2.17	101	1.8	-	79	-0.048	2.71	0.023
248	36.668	0.152	2.17	101	2.0	-	79	-0.047	2.70	0.032
249	36.815	0.147	2.17	101	1.6	-	79	-0.048	2.68	0.026
250	36.967	0.152	2.18	101	1.7	104	79	-0.047	2.76	0.022
251	37.114	0.147	2.18	101	1.6	-	79	-0.047	2.89	0.025
252	37.266	0.152	2.18	101	2.0	-	79	-0.046	2.62	0.024
253	37.413	0.147	2.18	101	1.4	-	79	-0.049	2.78	0.026
254	37.565	0.152	2.18	101	1.5	-	79	-0.050	2.73	0.026
255	37.712	0.147	2.18	101	1.6	-	79	-0.048	2.85	0.030

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
256	37.863	0.151	2.18	101	1.6	-	79	-0.048	2.87	0.024
257	38.010	0.147	2.18	101	1.9	-	79	-0.046	2.87	0.021
258	38.161	0.151	2.18	101	1.8	-	79	-0.048	2.91	0.027
259	38.309	0.148	2.17	101	1.6	-	79	-0.048	2.85	0.025
260	38.458	0.149	2.18	101	1.5	101	79	-0.048	2.79	0.026
261	38.608	0.150	2.18	101	2.0	-	79	-0.049	2.69	0.025
262	38.759	0.151	2.18	101	2.0	-	79	-0.047	2.88	0.024
263	38.907	0.148	2.18	101	1.7	-	79	-0.048	2.67	0.022
264	39.058	0.151	2.18	101	1.6	-	79	-0.047	2.41	0.025
265	39.204	0.146	2.18	101	1.5	-	79	-0.049	2.85	0.022
266	39.355	0.151	2.18	101	1.8	-	79	-0.047	2.60	0.022
267	39.505	0.150	2.17	101	1.9	-	79	-0.048	2.62	0.024
268	39.656	0.151	2.17	101	1.5	-	79	-0.045	2.63	0.025
269	39.804	0.148	2.18	101	1.4	-	79	-0.048	2.62	0.022
270	39.952	0.148	2.17	101	1.5	101	79	-0.046	2.79	0.024
271	40.100	0.148	2.17	101	2.0	-	79	-0.047	2.95	0.021
272	40.254	0.154	2.17	101	2.0	-	79	-0.046	2.65	0.022
273	40.403	0.149	2.17	101	1.9	-	79	-0.046	2.86	0.021
274	40.551	0.148	2.18	102	1.5	-	79	-0.049	2.87	0.025
275	40.699	0.148	2.17	102	1.8	-	80	-0.048	2.82	0.020
276	40.852	0.153	2.17	102	1.5	-	79	-0.045	2.45	0.025
277	40.999	0.147	2.17	102	1.6	-	79	-0.048	2.80	0.022
278	41.149	0.150	2.18	102	1.9	-	80	-0.048	2.47	0.023
279	41.298	0.149	2.17	102	1.8	-	80	-0.049	2.69	0.017
280	41.450	0.152	2.18	102	1.8	101	80	-0.047	2.52	0.028
281	41.597	0.147	2.17	102	1.5	-	80	-0.045	2.57	0.021
282	41.749	0.152	2.18	102	1.9	-	80	-0.047	2.91	0.026
283	41.896	0.147	2.17	102	1.7	-	80	-0.042	2.71	0.024
284	42.048	0.152	2.18	102	1.5	-	80	-0.045	2.81	0.026
285	42.195	0.147	2.17	102	1.7	-	80	-0.045	2.96	0.026
286	42.346	0.151	2.18	102	1.5	-	79	-0.046	2.69	0.023
287	42.495	0.149	2.18	102	1.7	-	79	-0.044	2.56	0.021

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

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 (%)
288	42.645	0.150	2.18	102	2.0	-	79	-0.046	3.01	0.024
289	42.791	0.146	2.18	102	2.0	-	80	-0.047	2.94	0.021
290	42.943	0.152	2.17	102	1.9	99	80	-0.044	2.71	0.018
291	43.090	0.147	2.18	102	1.7	-	79	-0.046	2.71	0.024
292	43.240	0.150	2.18	102	1.5	-	80	-0.043	2.94	0.026
293	43.394	0.154	2.18	102	1.7	-	79	-0.048	2.80	0.026
294	43.537	0.143	2.18	102	1.5	-	79	-0.043	2.89	0.023
295	43.693	0.156	2.18	102	1.5	-	79	-0.045	2.69	0.027
296	43.840	0.147	2.18	102	1.6	-	80	-0.045	2.54	0.022
297	43.991	0.151	2.17	102	1.6	-	80	-0.043	2.82	0.025
298	44.139	0.148	2.17	102	2.0	-	80	-0.047	2.68	0.023
299	44.290	0.151	2.17	102	1.5	-	80	-0.047	2.65	0.036
300	44.438	0.148	2.17	102	1.6	99	80	-0.049	2.70	0.028
301	44.589	0.151	2.17	102	1.7	-	79	-0.045	2.46	0.020
302	44.737	0.148	2.18	102	1.5	-	79	-0.043	2.60	0.026
303	44.886	0.149	2.17	102	2.0	-	79	-0.047	2.59	0.023
304	45.033	0.147	2.17	102	1.5	-	80	-0.044	2.67	0.027
305	45.185	0.152	2.18	102	1.6	-	80	-0.047	2.50	0.027
306	45.335	0.150	2.17	102	1.5	-	80	-0.046	2.53	0.021
307	45.487	0.152	2.18	102	2.0	-	80	-0.046	2.52	0.025
308	45.634	0.147	2.17	102	2.0	-	80	-0.042	2.59	0.021
309	45.786	0.152	2.18	102	1.5	-	80	-0.044	2.53	0.026
310	45.933	0.147	2.17	102	1.7	99	80	-0.045	2.56	0.027
311	46.085	0.152	2.18	102	1.4	-	80	-0.045	2.44	0.026
312	46.232	0.147	2.17	102	1.6	-	80	-0.047	2.49	0.021
313	46.385	0.153	2.18	102	1.5	-	80	-0.044	2.31	0.022
314	46.529	0.144	2.17	102	1.7	-	80	-0.043	2.43	0.026
315	46.681	0.152	2.17	102	1.8	-	80	-0.044	2.29	0.032
316	46.831	0.150	2.18	102	1.5	-	80	-0.046	2.31	0.021
317	46.981	0.150	2.18	102	1.9	-	80	-0.046	2.23	0.025
318	47.130	0.149	2.18	102	1.5	-	80	-0.042	2.39	0.026
319	47.280	0.150	2.18	102	1.9	-	80	-0.044	2.25	0.023

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: JotulJob #: 23-167Model: F445Tracking #: 152Run #: 3Technician: SJBDate: 7/7/2023

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	47.427	0.147	2.18	102	1.8	99	80	-0.046	2.26	0.022
321	47.577	0.150	2.18	102	2.0	-	80	-0.042	2.31	0.026
322	47.728	0.151	2.18	102	1.6	-	80	-0.042	2.21	0.028
323	47.875	0.147	2.18	102	1.5	-	80	-0.045	2.43	0.029
324	48.025	0.150	2.18	102	2.0	99	80	-0.043	2.30	0.031
Avg/Tot	48.025	0.148	2.16	96.0	1.7	100	77.8	-0.053	3.17	0.153

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 3

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/7/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.000		0.11	76	0.6		72
1	0.151	0.151	1.05	76	1.7	-	73
2	0.303	0.152	1.06	76	1.9	-	73
3	0.455	0.152	1.06	75	1.9	-	73
4	0.608	0.153	1.07	75	1.9	-	72
5	0.762	0.154	1.07	75	1.9	-	72
6	0.916	0.154	1.08	75	1.9	-	72
7	1.070	0.154	1.09	75	1.9	-	72
8	1.225	0.155	1.09	75	1.8	-	72
9	1.380	0.155	1.09	76	1.8	-	72
10	1.535	0.155	1.09	76	1.9	97	72
11	1.690	0.155	1.08	76	1.9	-	72
12	1.846	0.156	1.09	76	1.8	-	72
13	2.003	0.157	1.09	76	1.7	-	72
14	2.159	0.156	1.10	77	1.7	-	72
15	2.315	0.156	1.10	77	1.9	-	72
16	2.472	0.157	1.10	77	1.7	-	72
17	2.627	0.155	1.10	77	1.8	-	72
18	2.784	0.157	1.10	78	1.7	-	72
19	2.941	0.157	1.10	78	1.9	-	72
20	3.099	0.158	1.11	78	1.9	98	72
21	3.256	0.157	1.11	78	1.9	-	72
22	3.414	0.158	1.12	78	1.7	-	72
23	3.570	0.156	1.11	79	1.8	-	72
24	3.729	0.159	1.11	79	1.8	-	72
25	3.888	0.159	1.12	79	1.9	-	72
26	4.047	0.159	1.13	80	1.8	-	73
27	4.205	0.158	1.13	80	1.9	-	73
28	4.364	0.159	1.12	81	1.7	-	73
29	4.525	0.161	1.13	81	1.8	-	73
30	4.685	0.160	1.14	81	1.9	99	73
31	4.843	0.158	1.13	81	1.9	-	73

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 3

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/7/2023

Elapsed Time (min)	Particulate Sampling 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)
32	5.004	0.161	1.13	81	1.8	-	73
33	5.164	0.160	1.14	82	1.8	-	73
34	5.324	0.160	1.14	82	1.9	-	73
35	5.484	0.160	1.13	83	2.0	-	74
36	5.646	0.162	1.14	83	2.0	-	74
37	5.806	0.160	1.15	83	1.8	-	73
38	5.967	0.161	1.14	83	1.8	-	73
39	6.129	0.162	1.15	84	1.9	-	74
40	6.290	0.161	1.15	84	1.9	100	73
41	6.450	0.160	1.14	84	1.7	-	73
42	6.613	0.163	1.15	84	1.7	-	73
43	6.774	0.161	1.15	84	1.9	-	73
44	6.936	0.162	1.14	85	1.9	-	74
45	7.098	0.162	1.15	86	1.8	-	74
46	7.259	0.161	1.15	86	1.9	-	74
47	7.422	0.163	1.15	86	2.0	-	75
48	7.585	0.163	1.16	86	1.7	-	74
49	7.746	0.161	1.15	86	2.0	-	74
50	7.909	0.163	1.16	87	1.9	100	75
51	8.071	0.162	1.16	87	1.7	-	74
52	8.233	0.162	1.15	87	2.0	-	75
53	8.397	0.164	1.16	87	1.8	-	74
54	8.558	0.161	1.15	87	1.7	-	74
55	8.722	0.164	1.16	86	1.9	-	74
56	8.885	0.163	1.16	87	1.7	-	74
57	9.047	0.162	1.15	87	1.8	-	74
58	9.211	0.164	1.16	86	1.9	-	73
59	9.373	0.162	1.15	87	1.9	-	73
60	9.537	0.164	1.16	87	1.9	100	73
Avg/Tot	9.537	0.159	1.11	80.9	1.8	99	73.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	326	310	239	215	249	267.6	544.6
1	325	309	240	215	249	267.5	448.3
2	323	307	239	214	250	266.5	417.2
3	320	305	239	213	250	265.2	429.9
4	317	302	239	211	250	263.8	459.7
5	314	299	239	210	249	262.2	476.6
6	311	296	239	209	249	260.7	483.4
7	308	293	239	208	249	259.2	485.8
8	305	290	238	206	249	257.5	484.4
9	301	287	238	204	249	255.8	482.9
10	298	285	238	203	249	254.2	485.0
11	295	282	238	201	249	252.8	483.8
12	292	279	237	200	249	251.3	484.5
13	288	277	236	199	248	249.7	483.2
14	285	274	236	197	248	248.0	485.4
15	282	272	235	196	248	246.5	486.2
16	280	269	234	195	248	245.1	486.8
17	277	267	233	194	247	243.7	483.3
18	274	265	233	193	247	242.4	480.7
19	272	263	232	192	246	241.1	482.4
20	270	261	232	191	246	239.8	483.8
21	267	259	231	190	246	238.5	484.2
22	265	257	230	189	245	237.2	484.6
23	263	255	230	188	245	236.0	484.0
24	260	253	229	187	245	234.8	482.4
25	258	252	229	187	244	233.8	483.7
26	256	250	228	186	243	232.6	485.9
27	254	249	228	185	243	231.5	488.8
28	253	247	227	184	243	230.7	489.5
29	250	246	226	184	242	229.7	493.5
30	249	245	226	183	241	228.7	495.1
31	247	243	226	182	241	227.8	496.7
32	246	242	225	182	240	226.9	498.6
33	244	241	224	182	239	226.1	499.5
34	243	240	224	182	238	225.4	500.6
35	242	239	223	183	238	224.9	499.7
36	240	238	223	182	237	224.0	500.0
37	239	237	222	181	236	223.3	501.1
38	238	237	222	181	236	222.6	500.9
39	237	236	221	181	235	222.1	500.2
40	236	235	221	181	234	221.4	499.7
41	235	235	221	180	233	220.7	499.2
42	234	234	220	181	232	220.3	497.8
43	233	234	220	180	232	219.6	496.4
44	232	233	219	180	231	219.2	497.3
45	231	233	219	180	230	218.7	500.4
46	231	232	218	181	230	218.3	500.6
47	230	232	217	181	229	218.1	502.8

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	229	232	217	180	228	217.3	503.3
49	229	232	217	180	228	217.0	506.3
50	229	232	216	181	227	216.8	508.4
51	228	231	216	181	226	216.4	512.1
52	227	231	215	181	226	216.1	515.9
53	227	231	215	181	225	215.8	521.1
54	227	231	215	181	224	215.4	526.9
55	226	231	214	181	223	215.1	535.0
56	226	231	214	181	222	214.8	541.9
57	226	231	213	182	222	214.7	547.2
58	226	230	213	182	221	214.3	551.0
59	227	230	213	182	220	214.3	551.9
60	227	230	212	182	220	214.2	553.3
61	227	230	212	183	219	214.2	551.4
62	227	230	212	183	219	214.1	553.8
63	228	230	212	183	218	214.1	558.4
64	228	230	211	183	218	214.1	566.3
65	229	230	211	183	217	214.1	570.5
66	229	231	211	184	217	214.3	574.9
67	229	231	211	184	216	214.2	578.5
68	230	231	210	184	216	214.3	586.0
69	230	232	210	185	216	214.5	591.8
70	231	232	210	186	215	214.7	598.6
71	232	232	209	186	215	214.8	609.4
72	232	233	209	187	214	215.1	620.4
73	233	233	209	188	214	215.5	623.0
74	234	234	209	189	213	215.9	625.9
75	235	235	209	190	213	216.2	623.8
76	236	236	209	191	212	216.7	627.7
77	237	236	208	192	212	217.0	632.6
78	238	237	208	193	212	217.5	637.2
79	239	238	208	194	211	218.0	641.0
80	241	239	208	195	211	218.6	645.2
81	242	240	207	195	211	219.0	651.9
82	243	241	207	197	210	219.5	658.9
83	244	242	207	198	210	219.9	667.0
84	245	243	206	199	209	220.3	673.9
85	247	244	206	200	209	220.9	681.6
86	248	245	206	201	208	221.5	691.4
87	249	246	205	202	208	221.9	703.8
88	251	247	204	203	208	222.5	724.9
89	252	247	204	205	208	223.0	742.0
90	254	248	203	206	207	223.7	749.4
91	255	249	202	208	207	224.3	748.5
92	257	251	202	209	207	225.2	743.0
93	259	252	201	210	207	225.8	742.6
94	261	253	200	212	207	226.6	749.8
95	262	255	200	213	207	227.3	758.1

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	264	256	199	214	207	228.1	763.2
97	266	257	199	215	207	228.9	769.6
98	268	259	198	216	207	229.6	775.9
99	270	261	198	217	207	230.4	782.4
100	272	262	197	218	208	231.4	788.6
101	274	264	197	219	208	232.4	795.1
102	276	266	197	220	208	233.4	798.8
103	279	268	197	222	208	234.5	805.2
104	281	270	196	223	208	235.7	813.1
105	284	272	196	224	208	236.8	817.9
106	287	274	196	226	208	238.1	819.7
107	290	276	196	227	209	239.5	821.9
108	293	279	196	229	210	241.3	825.7
109	296	282	196	230	210	242.8	825.7
110	300	285	196	231	210	244.5	825.6
111	304	288	197	232	210	246.2	830.3
112	308	291	197	233	210	247.8	836.1
113	312	295	197	234	211	249.8	840.2
114	316	300	197	236	211	252.1	840.8
115	320	304	198	238	211	254.2	840.1
116	325	309	198	239	211	256.2	840.4
117	329	313	198	239	211	258.1	841.6
118	333	318	199	241	212	260.5	844.5
119	337	322	199	242	212	262.4	848.8
120	341	326	200	243	212	264.3	852.9
121	344	329	200	245	213	266.1	856.8
122	348	333	201	246	213	268.0	859.1
123	351	336	201	248	213	269.9	860.9
124	355	340	202	249	214	271.6	865.5
125	358	343	203	250	214	273.3	875.4
126	360	345	203	251	215	274.7	879.9
127	363	347	204	253	215	276.4	882.2
128	366	349	205	254	215	277.8	885.1
129	369	351	206	256	216	279.5	888.4
130	371	352	207	258	216	280.7	890.7
131	374	354	208	259	217	282.1	890.6
132	376	354	209	260	217	283.2	890.4
133	379	354	210	262	217	284.5	891.5
134	381	354	211	264	218	285.7	892.6
135	385	354	212	265	218	286.9	897.3
136	388	355	213	268	219	288.4	910.7
137	390	356	214	269	219	289.7	911.5
138	393	357	215	271	220	291.1	893.2
139	395	357	216	272	220	292.1	878.0
140	397	359	217	273	221	293.3	866.3
141	399	360	219	273	221	294.3	857.1
142	401	360	220	275	222	295.5	846.9
143	402	362	221	275	222	296.3	840.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
144	403	362	222	275	223	296.9	836.8
145	404	363	223	275	223	297.6	833.6
146	404	364	224	276	224	298.3	830.9
147	404	364	225	276	225	298.8	829.6
148	405	364	226	276	225	299.2	826.8
149	405	364	227	276	225	299.5	824.4
150	405	364	228	277	226	299.9	823.2
151	405	364	229	276	227	300.1	823.9
152	405	365	230	276	228	300.6	823.7
153	404	365	231	276	228	300.9	823.5
154	404	365	232	276	229	301.0	824.7
155	404	365	233	276	229	301.3	823.8
156	403	365	234	275	230	301.2	821.7
157	403	365	234	275	230	301.4	820.4
158	403	365	235	274	232	301.7	818.6
159	403	365	236	276	232	302.4	815.9
160	403	365	237	276	233	302.7	816.8
161	403	365	237	276	234	303.0	817.0
162	403	365	238	275	235	303.1	816.9
163	403	365	239	276	236	303.6	816.2
164	403	365	239	275	237	303.7	813.4
165	403	365	240	275	237	304.1	812.9
166	404	365	241	275	238	304.3	814.9
167	404	365	242	274	239	304.4	814.3
168	403	365	242	274	239	304.6	814.0
169	403	364	242	274	240	304.7	814.3
170	403	365	243	273	241	304.9	817.2
171	403	365	244	273	242	305.3	817.7
172	402	365	245	275	243	305.9	818.5
173	402	364	245	275	244	306.1	818.0
174	401	364	246	274	245	306.3	817.0
175	401	365	247	276	247	306.8	819.1
176	400	365	247	275	248	306.9	817.1
177	399	364	248	275	248	307.1	827.5
178	399	364	249	274	250	307.0	838.0
179	398	364	250	275	251	307.4	845.9
180	397	363	250	275	252	307.5	848.7
181	397	363	251	275	253	307.7	850.4
182	396	363	252	275	254	308.2	847.4
183	396	363	253	275	255	308.4	840.9
184	396	362	254	275	255	308.5	830.8
185	396	362	255	275	256	308.8	824.3
186	395	362	256	274	257	308.7	821.6
187	395	362	258	274	258	309.2	813.6
188	395	362	259	273	258	309.3	804.2
189	394	362	260	273	259	309.5	789.4
190	393	362	261	273	260	309.7	786.3
191	392	362	262	271	261	309.7	783.8

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
192	391	362	263	271	261	309.6	768.0
193	390	362	265	270	262	309.6	752.8
194	389	362	266	268	263	309.3	736.8
195	387	361	266	268	263	309.1	725.6
196	386	361	268	267	264	309.0	712.9
197	385	360	268	266	264	308.6	702.5
198	384	360	269	264	265	308.3	695.6
199	383	360	269	264	265	308.0	688.6
200	382	359	270	262	266	307.6	679.2
201	381	358	270	261	267	307.4	672.1
202	380	358	270	260	267	306.9	666.4
203	379	357	270	258	268	306.4	659.0
204	378	357	270	256	267	305.6	654.1
205	378	356	270	254	267	305.0	649.8
206	377	356	271	253	268	304.8	644.8
207	376	355	271	252	268	304.3	640.3
208	374	355	271	250	269	303.5	634.3
209	374	354	271	249	269	303.2	631.1
210	373	354	271	247	270	302.9	627.5
211	372	353	271	246	270	302.5	623.8
212	372	353	270	244	271	301.8	622.0
213	371	352	271	243	271	301.5	622.1
214	370	351	270	241	272	300.7	621.3
215	369	351	271	240	272	300.6	618.4
216	369	350	270	238	273	299.9	614.7
217	368	349	271	237	273	299.6	614.0
218	367	348	270	236	273	298.8	611.5
219	366	348	270	234	274	298.2	608.0
220	366	347	270	233	274	297.9	608.5
221	365	346	269	232	274	297.4	601.3
222	365	345	269	230	275	296.8	601.9
223	364	344	269	230	275	296.3	601.1
224	363	344	269	228	275	295.6	603.4
225	362	343	269	228	275	295.5	600.6
226	362	342	268	226	275	294.7	598.5
227	361	342	268	225	275	294.4	596.4
228	360	341	268	225	275	293.8	593.7
229	359	339	268	223	274	292.4	595.8
230	359	338	268	222	274	292.3	591.6
231	358	337	268	221	275	291.8	587.3
232	357	336	267	220	276	291.2	585.6
233	356	336	267	220	276	290.9	583.9
234	356	335	267	219	277	290.6	584.6
235	355	334	266	218	278	290.1	583.5
236	354	333	266	217	278	289.7	578.0
237	354	332	266	216	277	289.1	579.5
238	353	331	266	215	277	288.2	577.9
239	352	330	266	214	276	287.6	575.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT : 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
240	352	329	265	213	277	287.4	577.2
241	352	329	265	213	277	287.3	577.0
242	350	328	265	212	277	286.4	578.8
243	349	326	265	211	275	285.3	575.4
244	348	324	266	211	274	284.6	575.3
245	347	323	266	210	274	283.8	574.7
246	347	323	265	210	275	283.7	573.4
247	346	323	264	210	275	283.5	572.1
248	345	322	264	209	276	283.3	569.4
249	345	322	263	209	276	282.8	568.1
250	343	320	263	207	275	281.9	568.1
251	343	320	263	208	276	281.9	564.5
252	342	320	262	208	277	281.7	566.0
253	342	319	262	207	276	281.4	564.3
254	341	319	262	207	277	281.1	561.1
255	341	319	262	206	277	280.9	561.6
256	340	318	262	206	278	280.7	559.0
257	339	317	261	206	278	280.1	558.7
258	338	317	261	205	278	279.8	559.7
259	338	317	261	206	278	279.8	559.3
260	337	316	260	205	278	279.4	558.2
261	336	316	260	205	279	279.1	557.8
262	335	315	260	204	278	278.4	557.4
263	333	314	260	204	275	277.3	554.9
264	333	313	260	204	275	276.9	554.8
265	331	313	260	203	274	276.1	551.7
266	331	312	260	203	273	275.4	554.3
267	330	311	259	202	271	274.8	550.9
268	329	310	259	202	270	274.0	550.3
269	328	309	259	202	270	273.5	550.4
270	328	309	259	202	269	273.2	547.6
271	327	309	258	202	270	273.2	546.3
272	327	308	258	202	270	272.9	546.2
273	326	308	257	201	270	272.3	544.0
274	325	308	257	201	269	272.1	543.6
275	325	307	257	201	270	271.9	543.6
276	323	306	257	200	269	271.0	543.4
277	323	306	257	200	270	271.1	542.7
278	323	305	256	200	270	271.0	541.9
279	323	305	256	199	271	270.7	542.1
280	322	305	255	200	271	270.5	542.5
281	321	305	256	200	271	270.5	539.4
282	321	304	255	199	270	269.8	538.5
283	321	303	255	199	269	269.3	536.2
284	320	303	255	199	269	269.0	534.8
285	320	302	255	199	269	268.9	534.1
286	320	301	255	198	269	268.6	534.6
287	319	301	254	198	269	268.2	532.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 3

Technician: SJB

Date: 7/7/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
288	318	300	254	198	268	267.5	531.2
289	319	300	254	198	269	267.7	529.7
290	318	299	254	198	269	267.3	530.8
291	318	299	253	197	268	267.0	530.1
292	318	298	253	197	268	266.9	529.8
293	317	298	253	197	267	266.5	530.0
294	317	297	253	197	267	266.3	528.8
295	317	296	253	197	267	266.0	529.0
296	317	296	253	197	267	265.8	528.5
297	316	295	253	197	267	265.5	525.6
298	315	295	253	196	266	264.9	525.5
299	315	294	253	196	267	264.8	525.3
300	314	294	253	195	266	264.5	524.3
301	313	293	253	195	266	264.1	525.7
302	313	292	252	195	266	263.6	525.5
303	313	292	252	195	266	263.4	524.3
304	312	291	252	195	265	263.2	523.0
305	310	291	252	194	264	262.2	523.0
306	310	291	252	195	264	262.3	522.7
307	310	290	252	194	264	261.9	521.6
308	309	290	252	194	264	261.7	521.7
309	309	289	251	194	264	261.3	521.3
310	309	289	251	193	264	261.1	521.7
311	308	288	251	193	264	260.7	522.6
312	307	288	250	193	264	260.5	523.6
313	307	288	250	193	264	260.4	522.3
314	306	287	250	193	264	260.1	521.5
315	305	287	250	193	264	259.7	521.2
316	305	286	250	193	264	259.4	521.1
317	304	286	250	193	264	259.2	521.3
318	304	286	250	192	263	258.8	521.3
319	302	284	249	192	262	257.9	520.3
320	302	284	249	192	261	257.7	520.4
321	302	284	248	192	261	257.3	520.0
322	301	284	248	192	261	257.2	519.5
323	301	283	248	191	261	256.8	518.8
324	301	283	248	192	261	256.6	517.5
Average	322.5	304.8	237.2	221.0	245.1	266.1	644.4

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Model: F445

Run #: 3

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/7/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G604	242.3	243.4	1.1
	B	G605	242.9	243.4	0.5
	C - 1st Hour	G606	242.4	242.6	0.2
	Amb	G607	242.0	242.1	0.1
Probes	A	7A	116557.1	116557.2	0.1
	B	7B	117127.7	117127.9	0.2
	C - 1st Hour	7C	116550.3	116550.7	0.4
O-rings	A	7A	3572.3	3572.4	0.1
	B	7B	3523.4	3523.7	0.3
	C - 1st Hour	7C	3407.5	3407.6	0.1

Placed in Dessicator on:

7/7 - 15:40

Balance Audit (mg):

100.0

100.0

Filters	A	243.5	7/10 9:00	243.4	7/11 9:00				
	B	243.4	7/10 9:00	243.4	7/11 9:00				
	C - 1st Hour	242.6	7/10 9:00	242.6	7/11 9:00				
	Amb	242.1	7/10 9:00	242.1	7/11 9:00				
Probes	A	116557.2	7/10 9:00	116557.2	7/11 9:00				
	B	117127.7	7/10 9:00	117127.9	7/11 9:00				
	C - 1st Hour	116550.4	7/10 9:00	116550.7	7/11 9:00				
O-Rings	A	3572.3	7/10 9:00	3572.4	7/11 9:00				
	B	3523.8	7/10 9:00	3523.7	7/11 9:00				
	C - 1st Hour	3407.6	7/10 9:00	3407.6	7/11 9:00				

Train A Aggregate, mg: 1.3

Train B Aggregate, mg: 1.0

Train C Aggregate, mg: 0.7

Ambient, mg: 0.1

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 4 Test Date: 7/10/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Fully Closed
Targeted Burn Category: Low

Preburn Notes

Time	Notes
7:20	Started kindling fire with ~6 lbs of fuel, air set to fully open, fan off
7:50	With 1.5 lbs of coals left, added preburn fuel load, door closed immediately
8:10	Turned air down to halfway open
8:22	At 8.86 lbs turned air down to test setting, fan turned on low
9:47	At 3.75 lbs, stirred remaining fuel to ensure uniform charcoalization
10:32	@ 2.97lbs leveled coal bed in preparation of fuel loading, left fan on, air control at test setting

Test Notes

Test Burn Start Time: 10:32 Test Fuel Loaded by: 30 seconds
Door Closed: 35 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
10:32	Loaded test fuel, door closed immediately, fan on a low, air set to test setting
16:15	End of test

Test Burn End Time: 16:15

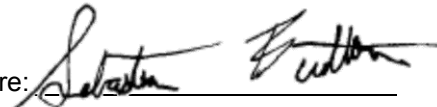
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	6:45	6:51	6:48	16:35	16:40	16:38
CO ₂	0.00	10.15	17.03	0.05	10.18	17.13
CO	0.000	2.516	4.308	0.007	2.555	4.346

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

Technician Signature: 

Date: 7/10/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 4

Tracking #: 152
Test Date: 7/10/2023



Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: _____

Sebastian E. Collins

Date: 7/10/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 4 Test Date: 7/10/2023

REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



Technician Signature: _____

Sebastian Eustice

Date: 7/10/2023

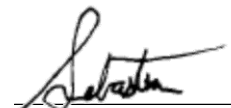
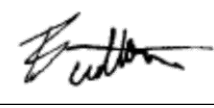
WOOD STOVE TEST DATA PACKET

ASTM E2780/E2515



Run 4 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/10/2023

Technician Signature

7/17/2023

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 4

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/10/2023

Burn Rate (kg/hr):	0.95
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	39.792	53.897	50.608	9.555
Average Gas Velocity in Dilution Tunnel (ft/sec)	7.9			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	21154.7			
Average Gas Meter Temperature (°F)	70.5	95.6	94.6	79.0
Total Sample Volume (dscf)	40.573	52.060	48.507	9.250
Average Tunnel Temperature (°F)	86.2			
Total Time of Test (min)	342			
Total Particulate Catch (mg)	0.0	0.9	0.9	0.5
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000173	0.0000186	0.0000541
Total PM Emissions (g)	0.00	2.08	2.24	1.14
Particulate Emission Rate (g/hr)	0.00	0.37	0.39	1.14
Emissions Factor (g/kg)	-	0.39	0.41	-
Difference from Average Total Particulate Emissions (g)	-	0.08	0.08	-
Difference from Average Total Particulate Emissions (%)	-	3.5%	3.5%	-
Difference from Average Emissions Factor (g/kg)	-	0.01	0.01	-

Final Average Results	
Total Particulate Emissions (g)	2.16
Particulate Emission Rate (g/hr)	0.38
Emissions Factor (g/kg)	0.40
HHV Efficiency (%)	77.7%
LHV Efficiency (%)	83.9%
CO Emissions (g/min)	0.61

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	79.6	OK
Face Velocity	< 30 ft/min	8.8	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min:67.4/Max:73.1	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	11.3	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/10/23
Run: 4
Control #: 23-167
Test Duration: 342
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	77.7%	83.9%
Combustion Efficiency	97.8%	97.8%
Heat Transfer Efficiency	79.5%	85.9%

Output Rate (kJ/h)	14,470	13,726	(Btu/h)
Burn Rate (kg/h)	0.94	2.07	(lb/h)
Input (kJ/h)	18,631	17,674	(Btu/h)

Test Load Weight (dry kg)	5.36	11.82	dry lb
MC wet (%)	17.89		
MC dry (%)	21.79		
Particulate (g)	2.16		
CO (g)	208		
Test Duration (h)	5.70		

Emissions	Particulate	CO
g/MJ Output	0.03	2.52
g/kg Dry Fuel	0.40	38.77
g/h	0.38	36.46
g/min	0.01	0.61
lb/MM Btu Output	0.06	5.86

Air/Fuel Ratio (A/F)	21.09
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	19.2		2x4	18.25	18.3
2x4	18.25	20.3		2x4	18.25	21.1
2x4	18.25	22.6				
2x4	18.25	20.1				
2x4	18.25	19.7				
2x4	11.00	18.4				
2x4	11.00	19.4				
2x4	11.00	20.3				
Total Fuel Weight (lbs):		14.01	Average Moisture (%DB):		19.9	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 5.08
 Total 4x4 Crib Weight, with spacers (lbs): 9.34
 Total Wet Fuel Weight, with spacers (lbs): 14.42

Coal Bed Range (20-25%):

Min (lbs): 2.88
 Max (lbs): 3.61

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.13	19.5	21.2	18.2	1.78
2x4	18.25	2.08	19.7	22.5	22.2	1.71
4x4	18.25	4.54	20.5	23.8	20.5	3.73
4x4	18.25	4.39	25.4	24.1	23.9	3.53
Total Dry Weight, no spacers (lbs):						10.75
Total Dry Weight, with spacers (lbs):						11.92

Spacer Moisture Readings (%DB)							
10.1	10.1	11.9					
7.9	11.5	8.3					
9.6	8.0	12.3					
11.9	7.1	11.6					

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.1	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	7.10	OK
2x4 Fuel Mix	35 - 65 % of total weight	35%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 4
 Test Start Time: 10:33

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

Total Sampling Time (min): 342
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.96	29.93	29.95
Relative Humidity (%)	38.7	34.5	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:		39.792	ft ³

Sample Train Leak Checks

	Pre-test	Post-test		
Induced Draft Check (in. H ₂ O):	0	(A) 0.002	cfm @	-5 in. Hg
Smoke Capture Check (%):	100%	(B) 0.001	cfm @	-5 in. Hg
Date Flue Pipe Last Cleaned:	7/3/2023	(C) 0.001	cfm @	-5 in. Hg
Test Fuel Scale Audit (lbs)	10.00	(Ambient) 0.001	cfm @	-5 in. Hg
Platform Scale Audit (lbs)	10.0			

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.010	93
2	0.014	93
3	0.016	93
4	0.018	93
5	0.014	93
6	0.008	93
7	0.014	93
8	0.016	93
9	0.018	93
10	0.018	93
11	0.014	93
12	0.010	93
Center	0.017	93

Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 12 inches
 Pitot Tube Cp: 0.99 [unitless]
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.7854 ft²

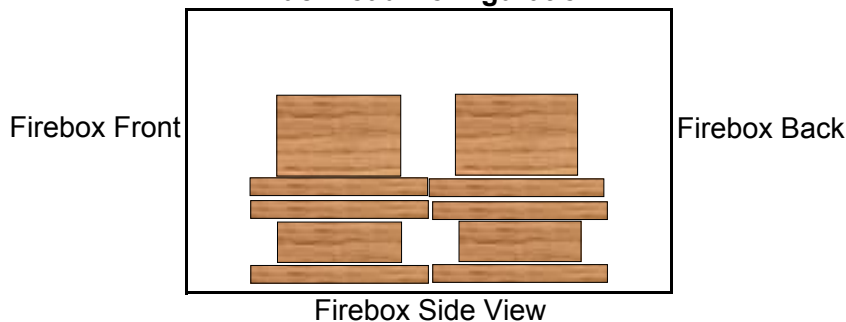
V_{strav} : 8.01 ft/sec
 V_{scent} : 8.84 ft/sec
 F_p : 0.906 [ratio]

Initial Tunnel Flow: 353.6 scf/min

Static Pressure: -0.093 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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): 21.8

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 4

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/10/2023

Recording Interval (min): 1
Run Time (min): 130

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	8.86	-0.093	431	393	209	315	205	310.4	454	71
1	8.71	-0.090	436	397	211	318	206	313.5	424	71
2	8.59	-0.087	439	400	213	321	207	315.9	405	71
3	8.48	-0.087	441	401	214	324	207	317.5	391	71
4	8.37	-0.084	442	402	215	327	207	318.7	379	71
5	8.27	-0.083	443	403	216	328	207	319.5	369	70
6	8.25	-0.081	445	405	217	328	207	320.2	360	70
7	8.09	-0.078	443	407	217	330	206	320.6	351	70
8	8.01	-0.079	443	409	218	331	206	321.2	343	70
9	7.93	-0.077	443	411	218	329	206	321.3	336	70
10	7.85	-0.076	443	412	219	328	205	321.2	330	70
11	7.77	-0.074	442	413	219	327	204	321.1	325	70
12	7.72	-0.074	441	413	220	326	203	320.6	319	70
13	7.64	-0.076	439	413	220	325	203	319.8	315	70
14	7.56	-0.072	438	411	220	324	202	319.1	312	70
15	7.50	-0.074	436	410	221	322	202	318.0	308	70
16	7.43	-0.075	434	408	221	321	201	317.0	304	70
17	7.34	-0.072	433	406	221	319	200	315.8	302	70
18	7.28	-0.073	432	404	222	316	200	314.7	299	69
19	7.22	-0.072	430	402	222	313	199	313.2	297	69
20	7.15	-0.072	429	400	222	311	198	312.0	295	69
21	7.09	-0.071	427	398	222	309	197	310.4	293	69
22	7.04	-0.070	426	396	222	307	196	309.4	291	69
23	6.96	-0.068	424	394	223	306	196	308.5	288	69
24	6.89	-0.067	423	392	223	302	196	307.1	286	69
25	6.83	-0.069	422	391	223	300	195	306.1	285	69
26	6.76	-0.069	420	388	223	297	194	304.6	284	69
27	6.68	-0.070	418	387	224	295	193	303.4	284	69
28	6.62	-0.070	417	385	224	294	192	302.4	284	69
29	6.53	-0.069	414	384	224	293	192	301.4	284	69
30	6.45	-0.068	413	383	224	291	192	300.4	284	69
31	6.37	-0.070	411	382	225	290	192	299.7	285	69
32	6.28	-0.071	409	381	224	288	192	298.9	286	69
33	6.18	-0.068	407	380	225	286	192	297.9	287	69
34	6.06	-0.069	408	379	224	286	192	297.7	289	69
35	5.83	-0.069	409	378	225	285	192	297.6	289	69
36	5.93	-0.070	411	377	225	284	192	297.6	288	69
37	5.86	-0.069	413	376	226	284	191	297.7	288	69
38	5.78	-0.068	414	374	226	283	191	297.8	287	69
39	5.71	-0.068	417	373	226	283	191	297.8	286	69
40	5.64	-0.068	418	372	226	282	191	297.8	285	69
41	5.60	-0.068	419	372	226	281	191	297.8	282	69
42	5.53	-0.065	419	371	227	280	191	297.5	279	69
43	5.47	-0.066	419	370	227	280	191	297.4	276	69
44	5.42	-0.067	419	369	227	279	191	297.1	273	69

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 4

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/10/2023

Recording Interval (min): 1
Run Time (min): 130

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
45	5.35	-0.065	420	368	227	277	190	296.4	272	68
46	5.30	-0.064	420	367	227	276	190	295.9	270	68
47	5.25	-0.063	419	366	227	275	189	295.1	269	68
48	5.20	-0.063	418	364	227	273	189	294.4	267	68
49	5.14	-0.064	416	363	227	272	189	293.5	268	68
50	5.09	-0.064	415	362	227	272	188	292.8	267	68
51	5.05	-0.064	412	362	227	270	188	291.9	268	68
52	4.99	-0.061	410	361	228	270	189	291.6	267	68
53	4.93	-0.064	409	360	227	268	189	290.9	266	68
54	4.88	-0.066	408	360	227	267	189	290.4	264	68
55	4.83	-0.063	407	360	227	266	189	289.9	264	69
56	4.77	-0.065	406	359	228	266	190	289.8	264	69
57	4.72	-0.063	404	359	228	264	190	288.9	264	68
58	4.67	-0.062	403	359	228	264	190	288.6	264	68
59	4.62	-0.061	402	359	228	264	191	288.8	263	68
60	4.57	-0.063	401	359	228	263	192	288.6	261	68
61	4.52	-0.063	401	358	229	261	193	288.3	260	68
62	4.47	-0.062	401	358	229	261	193	288.3	260	69
63	4.43	-0.063	401	358	229	261	194	288.5	258	69
64	4.38	-0.061	401	358	229	261	195	288.7	256	69
65	4.34	-0.060	401	357	230	260	196	288.7	255	69
66	4.29	-0.060	401	356	230	259	197	288.4	253	68
67	4.25	-0.060	401	355	230	258	197	288.2	252	68
68	4.21	-0.060	401	354	230	257	198	288.0	251	68
69	4.18	-0.060	400	354	230	256	199	287.8	249	68
70	4.14	-0.059	399	353	230	255	200	287.5	248	68
71	4.10	-0.061	398	353	230	255	201	287.1	246	68
72	4.07	-0.059	396	352	231	254	202	286.6	245	68
73	4.04	-0.059	394	351	231	252	202	286.0	244	68
74	4.01	-0.060	392	350	231	251	203	285.3	243	68
75	3.99	-0.058	390	349	231	250	204	284.7	241	68
76	3.95	-0.056	388	348	231	249	205	284.3	240	68
77	3.93	-0.057	386	347	231	248	206	283.6	239	69
78	3.91	-0.057	384	346	231	247	207	282.9	238	68
79	3.88	-0.055	383	345	230	246	207	282.2	236	68
80	3.85	-0.055	380	345	231	245	208	281.8	235	69
81	3.83	-0.056	379	344	230	245	209	281.2	233	68
82	3.81	-0.055	377	343	231	243	210	280.7	232	68
83	3.79	-0.054	376	342	231	242	211	280.2	231	68
84	3.77	-0.055	373	341	231	242	212	279.6	229	68
85	3.75	-0.054	372	340	231	240	212	279.0	229	68
86	3.68	-0.055	370	339	232	240	214	278.9	284	69
87	3.66	-0.054	368	338	232	238	215	278.2	250	69
88	3.63	-0.054	366	337	232	237	216	277.5	238	69
89	3.60	-0.056	364	336	231	236	216	276.6	232	68

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 4

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/10/2023

Recording Interval (min): 1
Run Time (min): 130

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
90	3.58	-0.055	361	335	232	233	217	275.4	230	68
91	3.56	-0.053	359	333	232	233	217	274.7	230	68
92	3.53	-0.056	357	332	232	231	218	273.8	229	68
93	3.52	-0.052	355	330	231	231	218	273.1	227	69
94	3.49	-0.054	353	328	231	230	219	272.3	226	68
95	3.48	-0.053	352	327	231	229	220	271.8	225	68
96	3.46	-0.054	350	326	231	227	220	271.0	223	68
97	3.44	-0.053	349	324	231	227	221	270.5	221	69
98	3.43	-0.050	348	323	230	226	222	269.7	219	69
99	3.41	-0.052	346	322	231	225	223	269.3	217	69
100	3.40	-0.052	345	320	231	223	223	268.5	216	69
101	3.38	-0.051	343	319	230	223	224	267.9	214	68
102	3.35	-0.050	342	318	230	222	225	267.5	213	68
103	3.35	-0.050	342	317	230	221	226	266.9	211	68
104	3.33	-0.048	341	316	230	221	226	266.7	209	68
105	3.32	-0.048	340	316	230	220	227	266.4	207	68
106	3.30	-0.048	340	314	230	218	227	265.9	206	68
107	3.29	-0.048	339	314	230	217	228	265.4	204	68
108	3.27	-0.045	338	313	230	216	229	265.1	202	68
109	3.26	-0.045	337	312	230	215	229	264.6	201	68
110	3.25	-0.046	337	311	230	214	230	264.1	199	68
111	3.24	-0.046	336	310	230	214	231	263.8	198	68
112	3.21	-0.044	335	308	230	212	231	263.2	197	68
113	3.20	-0.046	334	307	230	211	231	262.8	196	68
114	3.19	-0.045	334	306	230	210	232	262.3	195	68
115	3.18	-0.046	333	305	230	209	233	261.8	193	68
116	3.16	-0.046	333	304	230	208	233	261.4	192	68
117	3.14	-0.044	332	303	230	207	233	261.2	191	68
118	3.13	-0.046	332	302	231	206	233	260.8	189	68
119	3.12	-0.044	332	301	231	204	234	260.3	188	68
120	3.10	-0.045	331	300	231	204	234	260.0	186	68
121	3.10	-0.043	331	300	231	203	235	260.0	185	68
122	3.08	-0.042	331	300	232	202	235	259.9	184	68
123	3.07	-0.043	331	299	232	201	235	259.6	183	68
124	3.06	-0.042	331	298	232	201	236	259.4	181	68
125	3.04	-0.041	330	298	232	200	236	259.1	180	68
126	3.03	-0.040	330	297	232	199	237	259.0	179	68
127	3.02	-0.040	330	296	233	198	237	258.6	178	68
128	3.00	-0.040	330	295	233	198	237	258.5	178	68
129	3.00	-0.038	329	295	233	196	238	257.9	176	68
130	2.97	-0.040	328	294	233	196	239	257.8	175	68

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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		0.016	1.25	75	0.7		14.39		86	223	72	68
1	0.137	0.136	0.017	1.97	75	0.8	-	14.39	0.00	90	233	73	68
2	0.277	0.140	0.016	2.00	75	0.8	-	14.38	-0.01	83	202	73	68
3	0.423	0.146	0.017	2.03	75	0.8	-	14.36	-0.02	82	189	73	68
4	0.562	0.139	0.017	2.06	75	0.8	-	14.34	-0.02	81	182	73	68
5	0.709	0.147	0.017	2.08	75	0.8	-	14.33	-0.01	81	179	73	68
6	0.850	0.141	0.017	2.11	75	0.8	-	14.30	-0.03	81	177	73	68
7	0.999	0.149	0.016	2.13	75	0.9	-	14.28	-0.02	81	176	73	68
8	1.142	0.143	0.017	2.14	75	0.8	-	14.26	-0.02	81	175	73	68
9	1.290	0.148	0.016	2.16	75	0.8	-	14.24	-0.02	80	174	73	68
10	1.435	0.145	0.017	2.16	75	0.8	95	14.22	-0.02	79	173	73	68
11	1.581	0.146	0.017	2.17	76	0.8	-	14.19	-0.03	79	171	73	68
12	1.730	0.149	0.017	2.19	76	0.8	-	14.17	-0.02	79	170	73	68
13	1.876	0.146	0.017	2.18	76	0.8	-	14.15	-0.02	79	169	73	68
14	2.026	0.150	0.017	2.20	76	0.9	-	14.12	-0.03	79	167	73	68
15	2.172	0.146	0.017	2.20	76	0.8	-	14.10	-0.02	78	166	73	68
16	2.323	0.151	0.017	2.21	77	0.8	-	14.08	-0.02	78	165	73	68
17	2.469	0.146	0.017	2.22	77	0.8	-	14.06	-0.02	78	163	73	68
18	2.620	0.151	0.017	2.23	77	0.8	-	14.04	-0.02	78	163	73	68
19	2.767	0.147	0.017	2.23	77	0.8	-	14.02	-0.02	78	161	73	68
20	2.919	0.152	0.017	2.25	78	0.9	96	13.99	-0.03	79	160	73	68
21	3.066	0.147	0.017	2.26	78	0.8	-	13.96	-0.03	78	159	73	67
22	3.218	0.152	0.017	2.25	78	0.8	-	13.95	-0.01	78	158	73	68
23	3.366	0.148	0.017	2.26	78	0.9	-	13.93	-0.02	78	157	73	68
24	3.519	0.153	0.017	2.28	79	0.9	-	13.91	-0.02	78	156	73	68
25	3.666	0.147	0.017	2.27	79	0.8	-	13.88	-0.03	78	155	73	68
26	3.820	0.154	0.018	2.28	79	0.8	-	13.86	-0.02	78	154	73	68
27	3.968	0.148	0.017	2.28	80	0.9	-	13.83	-0.03	78	152	73	68
28	4.122	0.154	0.017	2.29	80	0.8	-	13.81	-0.02	78	151	73	68
29	4.271	0.149	0.017	2.28	80	0.8	-	13.78	-0.03	77	150	73	67
30	4.424	0.153	0.017	2.30	80	0.9	97	13.75	-0.03	77	149	73	68
31	4.573	0.149	0.016	2.29	81	0.8	-	13.74	-0.01	77	148	73	67

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
32	4.726	0.153	0.017	2.29	81	0.9	-	13.71	-0.03	77	146	73	68
33	4.877	0.151	0.017	2.30	81	0.9	-	13.68	-0.03	77	146	73	68
34	5.030	0.153	0.017	2.31	82	0.9	-	13.66	-0.02	77	145	73	68
35	5.182	0.152	0.017	2.31	82	0.8	-	13.64	-0.02	77	144	73	68
36	5.335	0.153	0.017	2.32	82	0.9	-	13.61	-0.03	77	144	73	68
37	5.489	0.154	0.017	2.32	82	0.9	-	13.60	-0.01	77	143	73	68
38	5.640	0.151	0.017	2.32	83	0.8	-	13.57	-0.03	78	142	73	68
39	5.796	0.156	0.017	2.33	83	0.8	-	13.55	-0.02	78	143	73	68
40	5.946	0.150	0.017	2.33	83	0.9	97	13.53	-0.02	79	143	73	68
41	6.101	0.155	0.017	2.33	84	0.9	-	13.50	-0.03	79	143	73	68
42	6.251	0.150	0.017	2.33	84	0.9	-	13.47	-0.03	79	143	73	68
43	6.407	0.156	0.017	2.33	84	0.8	-	13.44	-0.03	79	144	73	68
44	6.559	0.152	0.017	2.34	84	0.9	-	13.41	-0.03	79	145	73	68
45	6.716	0.157	0.017	2.35	85	0.9	-	13.38	-0.03	79	145	73	68
46	6.867	0.151	0.017	2.35	85	0.9	-	13.35	-0.03	79	146	73	68
47	7.022	0.155	0.017	2.35	85	0.9	-	13.32	-0.03	79	145	73	68
48	7.175	0.153	0.017	2.35	86	0.8	-	13.29	-0.03	79	145	73	68
49	7.329	0.154	0.017	2.35	86	0.9	-	13.26	-0.03	79	146	73	68
50	7.485	0.156	0.017	2.36	86	0.9	98	13.24	-0.02	79	146	73	68
51	7.638	0.153	0.017	2.36	86	0.9	-	13.21	-0.03	79	146	73	68
52	7.796	0.158	0.017	2.37	87	0.9	-	13.18	-0.03	79	145	73	68
53	7.946	0.150	0.017	2.36	87	0.9	-	13.15	-0.03	79	145	73	68
54	8.104	0.158	0.017	2.36	87	0.9	-	13.12	-0.03	79	145	73	68
55	8.256	0.152	0.018	2.36	87	0.9	-	13.09	-0.03	79	145	73	68
56	8.414	0.158	0.017	2.38	88	0.9	-	13.06	-0.03	79	145	73	68
57	8.567	0.153	0.016	2.38	88	0.9	-	13.04	-0.02	79	145	73	68
58	8.723	0.156	0.017	2.36	88	0.9	-	13.01	-0.03	79	144	73	68
59	8.877	0.154	0.017	2.37	88	0.9	-	12.98	-0.03	79	145	74	68
60	9.033	0.156	0.017	2.37	88	0.9	98	12.95	-0.03	79	144	74	68
61	9.191	0.158	0.017	2.39	89	0.9	-	12.92	-0.03	79	144	74	68
62	9.344	0.153	0.017	2.39	89	0.9	-	12.89	-0.03	79	143	73	69
63	9.502	0.158	0.017	2.39	89	0.9	-	12.87	-0.02	79	143	74	69

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
64	9.654	0.152	0.017	2.39	89	0.9	-	12.84	-0.03	79	144	74	68
65	9.814	0.160	0.017	2.39	90	0.9	-	12.82	-0.02	79	143	74	68
66	9.967	0.153	0.017	2.40	90	0.9	-	12.79	-0.03	79	143	74	68
67	10.124	0.157	0.017	2.40	90	0.9	-	12.76	-0.03	79	143	74	68
68	10.280	0.156	0.017	2.40	90	0.9	-	12.74	-0.02	79	143	74	68
69	10.436	0.156	0.017	2.40	90	0.9	-	12.71	-0.03	79	143	74	68
70	10.594	0.158	0.017	2.40	91	0.9	99	12.69	-0.02	79	143	74	68
71	10.747	0.153	0.017	2.40	91	0.9	-	12.65	-0.04	79	143	74	68
72	10.906	0.159	0.017	2.40	91	0.9	-	12.63	-0.02	79	144	74	69
73	11.061	0.155	0.017	2.39	91	0.9	-	12.60	-0.03	79	143	74	69
74	11.219	0.158	0.017	2.40	91	0.9	-	12.57	-0.03	79	144	74	69
75	11.374	0.155	0.017	2.40	92	0.9	-	12.55	-0.02	79	143	74	69
76	11.531	0.157	0.017	2.40	92	0.9	-	12.51	-0.04	79	144	74	69
77	11.689	0.158	0.017	2.40	92	0.9	-	12.49	-0.02	79	145	74	69
78	11.843	0.154	0.017	2.40	92	0.9	-	12.46	-0.03	79	145	74	69
79	12.002	0.159	0.017	2.40	92	0.9	-	12.42	-0.04	79	145	74	69
80	12.158	0.156	0.017	2.41	92	0.9	98	12.39	-0.03	79	146	74	68
81	12.317	0.159	0.017	2.41	93	0.9	-	12.36	-0.03	79	146	74	69
82	12.471	0.154	0.017	2.40	93	0.9	-	12.33	-0.03	79	147	74	69
83	12.630	0.159	0.017	2.41	93	0.9	-	12.30	-0.03	79	148	74	69
84	12.788	0.158	0.017	2.40	93	0.9	-	12.27	-0.03	79	148	74	69
85	12.942	0.154	0.017	2.41	93	0.9	-	12.24	-0.03	79	148	74	69
86	13.102	0.160	0.017	2.42	93	0.9	-	12.21	-0.03	79	149	74	69
87	13.258	0.156	0.017	2.42	93	0.9	-	12.17	-0.04	79	150	74	69
88	13.417	0.159	0.017	2.43	94	0.9	-	12.14	-0.03	79	150	74	69
89	13.573	0.156	0.017	2.41	94	0.9	-	12.11	-0.03	79	150	74	69
90	13.731	0.158	0.017	2.42	94	0.9	99	12.08	-0.03	79	150	74	69
91	13.891	0.160	0.017	2.43	94	0.9	-	12.04	-0.04	79	151	74	69
92	14.045	0.154	0.017	2.42	94	0.9	-	12.01	-0.03	79	151	74	69
93	14.206	0.161	0.017	2.42	94	0.9	-	11.97	-0.04	79	151	74	69
94	14.361	0.155	0.017	2.42	94	0.9	-	11.95	-0.02	79	151	74	69
95	14.520	0.159	0.017	2.43	94	0.9	-	11.91	-0.04	79	151	74	69

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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
96	14.677	0.157	0.017	2.41	95	0.9	-	11.88	-0.03	79	152	74	69
97	14.835	0.158	0.017	2.41	95	0.9	-	11.85	-0.03	79	153	74	69
98	14.994	0.159	0.017	2.43	95	0.9	-	11.82	-0.03	79	152	74	69
99	15.149	0.155	0.017	2.43	95	0.9	-	11.78	-0.04	79	153	74	69
100	15.311	0.162	0.017	2.42	95	0.9	99	11.75	-0.03	80	153	74	69
101	15.466	0.155	0.017	2.43	95	0.9	-	11.71	-0.04	79	153	74	69
102	15.625	0.159	0.017	2.43	95	0.9	-	11.68	-0.03	79	154	74	69
103	15.785	0.160	0.017	2.43	95	0.9	-	11.65	-0.03	79	154	74	69
104	15.940	0.155	0.017	2.42	95	0.9	-	11.62	-0.03	80	154	74	69
105	16.101	0.161	0.016	2.42	95	0.9	-	11.58	-0.04	80	155	74	69
106	16.257	0.156	0.016	2.42	96	0.9	-	11.54	-0.04	80	156	74	69
107	16.417	0.160	0.017	2.43	96	0.9	-	11.51	-0.03	80	155	74	69
108	16.574	0.157	0.017	2.42	96	0.9	-	11.48	-0.03	80	156	74	69
109	16.733	0.159	0.017	2.44	96	0.9	-	11.44	-0.04	79	156	74	69
110	16.892	0.159	0.016	2.44	96	0.9	100	11.40	-0.04	80	158	74	69
111	17.047	0.155	0.017	2.42	96	0.9	-	11.37	-0.03	80	158	74	69
112	17.210	0.163	0.017	2.43	96	0.9	-	11.33	-0.04	80	158	74	69
113	17.365	0.155	0.017	2.43	96	0.9	-	11.30	-0.03	80	158	74	69
114	17.525	0.160	0.017	2.43	96	0.9	-	11.26	-0.04	80	159	74	69
115	17.685	0.160	0.017	2.43	96	0.9	-	11.22	-0.04	80	160	74	69
116	17.840	0.155	0.017	2.43	96	0.9	-	11.18	-0.04	80	161	74	69
117	18.002	0.162	0.017	2.44	97	0.9	-	11.14	-0.04	80	161	74	70
118	18.158	0.156	0.017	2.43	97	0.9	-	11.10	-0.04	80	162	74	70
119	18.318	0.160	0.017	2.44	97	0.9	-	11.07	-0.03	80	163	74	69
120	18.477	0.159	0.017	2.43	97	0.9	100	11.02	-0.05	80	164	74	70
121	18.635	0.158	0.017	2.44	97	0.9	-	10.98	-0.04	80	165	74	69
122	18.795	0.160	0.017	2.42	97	0.9	-	10.93	-0.05	80	167	74	70
123	18.951	0.156	0.017	2.44	97	0.9	-	10.89	-0.04	80	168	74	70
124	19.112	0.161	0.017	2.44	97	0.9	-	10.84	-0.05	80	168	74	69
125	19.268	0.156	0.017	2.43	97	0.9	-	10.80	-0.04	80	170	75	69
126	19.428	0.160	0.016	2.44	97	0.9	-	10.76	-0.04	81	172	75	69
127	19.588	0.160	0.017	2.45	97	0.9	-	10.71	-0.05	81	173	75	69

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
128	19.743	0.155	0.017	2.43	97	0.9	-	10.66	-0.05	81	174	75	69
129	19.906	0.163	0.016	2.44	97	0.9	-	10.62	-0.04	81	177	75	69
130	20.062	0.156	0.016	2.44	98	0.9	100	10.58	-0.04	81	179	75	69
131	20.221	0.159	0.017	2.44	98	0.9	-	10.52	-0.06	81	180	75	70
132	20.382	0.161	0.017	2.43	98	0.9	-	10.47	-0.05	81	183	75	70
133	20.537	0.155	0.017	2.44	98	0.9	-	10.42	-0.05	81	185	75	70
134	20.699	0.162	0.017	2.44	98	0.9	-	10.37	-0.05	81	188	75	70
135	20.856	0.157	0.017	2.43	98	0.9	-	10.31	-0.06	82	190	75	70
136	21.016	0.160	0.017	2.44	98	0.9	-	10.26	-0.05	82	195	75	70
137	21.175	0.159	0.017	2.44	98	0.9	-	10.20	-0.06	82	198	75	70
138	21.333	0.158	0.017	2.45	98	0.9	-	10.14	-0.06	82	202	75	70
139	21.493	0.160	0.017	2.44	98	0.9	-	10.08	-0.06	83	204	75	70
140	21.650	0.157	0.016	2.45	98	0.9	102	10.02	-0.06	83	207	75	70
141	21.811	0.161	0.017	2.45	98	0.9	-	9.96	-0.06	83	211	75	70
142	21.968	0.157	0.017	2.44	98	0.9	-	9.88	-0.08	84	216	75	70
143	22.128	0.160	0.017	2.44	98	0.9	-	9.81	-0.07	84	222	75	71
144	22.288	0.160	0.017	2.44	98	0.9	-	9.74	-0.07	84	227	75	71
145	22.444	0.156	0.016	2.43	98	0.9	-	9.66	-0.08	85	233	75	71
146	22.606	0.162	0.017	2.44	98	0.9	-	9.59	-0.07	85	241	76	71
147	22.762	0.156	0.017	2.45	98	0.9	-	9.51	-0.08	86	247	76	70
148	22.923	0.161	0.016	2.44	98	0.9	-	9.42	-0.09	86	255	76	70
149	23.084	0.161	0.017	2.44	98	0.9	-	9.33	-0.09	87	261	76	70
150	23.239	0.155	0.016	2.44	98	0.9	102	9.25	-0.08	87	271	76	70
151	23.402	0.163	0.017	2.43	99	0.9	-	9.15	-0.10	88	277	76	70
152	23.558	0.156	0.016	2.44	99	0.9	-	9.06	-0.09	88	285	76	70
153	23.718	0.160	0.016	2.44	99	0.9	-	8.96	-0.10	89	294	76	70
154	23.879	0.161	0.017	2.45	99	0.9	-	8.87	-0.09	90	304	76	70
155	24.035	0.156	0.016	2.45	99	0.9	-	8.73	-0.14	90	318	77	71
156	24.197	0.162	0.016	2.44	99	0.9	-	8.57	-0.16	92	330	77	71
157	24.354	0.157	0.017	2.43	99	0.9	-	8.38	-0.19	93	337	77	71
158	24.514	0.160	0.017	2.44	99	0.9	-	8.20	-0.18	93	335	77	71
159	24.673	0.159	0.016	2.44	99	0.9	-	8.03	-0.17	93	336	77	71

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
160	24.831	0.158	0.017	2.44	99	0.9	101	7.87	-0.16	94	334	77	71
161	24.992	0.161	0.016	2.45	99	0.9	-	7.72	-0.15	94	333	77	71
162	25.149	0.157	0.016	2.44	99	0.9	-	7.57	-0.15	94	330	77	71
163	25.310	0.161	0.016	2.45	99	0.9	-	7.43	-0.14	94	331	78	71
164	25.467	0.157	0.016	2.44	99	0.9	-	7.29	-0.14	94	330	78	71
165	25.627	0.160	0.016	2.44	99	0.9	-	7.17	-0.12	94	330	78	71
166	25.787	0.160	0.016	2.44	99	0.9	-	7.04	-0.13	94	329	78	71
167	25.944	0.157	0.016	2.44	99	0.9	-	6.92	-0.12	94	328	78	71
168	26.106	0.162	0.016	2.44	99	0.9	-	6.80	-0.12	94	327	78	71
169	26.262	0.156	0.016	2.45	99	0.9	-	6.68	-0.12	94	325	78	71
170	26.422	0.160	0.017	2.44	99	0.9	100	6.57	-0.11	95	325	78	71
171	26.583	0.161	0.016	2.44	99	0.9	-	6.47	-0.10	95	323	78	71
172	26.738	0.155	0.016	2.44	99	0.9	-	6.36	-0.11	95	323	78	71
173	26.901	0.163	0.016	2.45	99	0.9	-	6.25	-0.11	95	321	78	71
174	27.057	0.156	0.016	2.44	99	0.9	-	6.15	-0.10	95	321	78	71
175	27.217	0.160	0.016	2.44	99	0.9	-	6.05	-0.10	95	320	78	72
176	27.378	0.161	0.016	2.43	100	0.9	-	5.95	-0.10	95	319	78	72
177	27.533	0.155	0.016	2.44	100	0.9	-	5.86	-0.09	95	319	78	72
178	27.696	0.163	0.016	2.44	100	0.9	-	5.77	-0.09	95	317	78	72
179	27.853	0.157	0.016	2.44	100	0.9	-	5.67	-0.10	94	317	78	72
180	28.013	0.160	0.017	2.44	100	0.9	100	5.58	-0.09	95	315	78	71
181	28.173	0.160	0.016	2.45	100	0.9	-	5.49	-0.09	95	314	79	71
182	28.330	0.157	0.017	2.46	100	0.9	-	5.40	-0.09	95	312	79	71
183	28.491	0.161	0.016	2.44	100	0.9	-	5.31	-0.09	95	311	79	71
184	28.648	0.157	0.016	2.45	100	0.9	-	5.24	-0.07	95	309	79	71
185	28.808	0.160	0.016	2.45	100	0.9	-	5.16	-0.08	94	307	79	71
186	28.967	0.159	0.017	2.45	100	0.9	-	5.09	-0.07	95	304	79	71
187	29.126	0.159	0.016	2.45	100	0.9	-	5.02	-0.07	95	303	79	71
188	29.287	0.161	0.016	2.46	100	0.9	-	4.94	-0.08	95	301	79	71
189	29.443	0.156	0.016	2.44	100	0.9	-	4.87	-0.07	95	299	79	71
190	29.605	0.162	0.017	2.45	100	0.9	100	4.81	-0.06	94	297	79	71
191	29.762	0.157	0.016	2.44	100	0.9	-	4.73	-0.08	95	299	79	71

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
192	29.922	0.160	0.017	2.45	100	0.9	-	4.66	-0.07	95	301	79	71
193	30.082	0.160	0.017	2.45	100	0.9	-	4.58	-0.08	95	306	79	71
194	30.238	0.156	0.017	2.44	100	0.9	-	4.50	-0.08	95	307	79	71
195	30.401	0.163	0.016	2.45	100	0.9	-	4.43	-0.07	95	308	79	71
196	30.558	0.157	0.016	2.45	100	0.9	-	4.35	-0.08	95	310	79	72
197	30.718	0.160	0.016	2.45	100	0.9	-	4.27	-0.08	95	307	79	72
198	30.880	0.162	0.017	2.45	100	0.9	-	4.19	-0.08	95	308	79	72
199	31.035	0.155	0.016	2.45	100	0.9	-	4.13	-0.06	95	308	79	72
200	31.198	0.163	0.017	2.45	100	0.9	100	4.06	-0.07	95	308	79	72
201	31.354	0.156	0.017	2.45	100	0.9	-	4.00	-0.06	95	304	79	72
202	31.514	0.160	0.017	2.45	100	0.9	-	3.93	-0.07	94	305	79	72
203	31.676	0.162	0.017	2.45	100	0.9	-	3.87	-0.06	94	303	79	72
204	31.831	0.155	0.016	2.45	100	0.9	-	3.80	-0.07	94	303	79	72
205	31.994	0.163	0.016	2.44	100	0.9	-	3.75	-0.05	94	303	79	72
206	32.151	0.157	0.016	2.45	100	0.9	-	3.68	-0.07	94	301	79	72
207	32.311	0.160	0.016	2.45	100	0.9	-	3.62	-0.06	94	301	79	72
208	32.472	0.161	0.017	2.44	100	0.9	-	3.56	-0.06	94	300	79	73
209	32.628	0.156	0.016	2.44	100	0.9	-	3.50	-0.06	94	299	79	72
210	32.790	0.162	0.016	2.44	100	0.9	102	3.44	-0.06	94	298	79	72
211	32.948	0.158	0.015	2.44	100	0.9	-	3.38	-0.06	94	297	79	72
212	33.108	0.160	0.016	2.45	100	0.9	-	3.32	-0.06	94	296	79	72
213	33.268	0.160	0.016	2.44	100	0.9	-	3.27	-0.05	94	295	79	72
214	33.426	0.158	0.017	2.46	100	0.9	-	3.20	-0.07	94	295	79	72
215	33.587	0.161	0.016	2.45	100	0.9	-	3.14	-0.06	94	294	79	72
216	33.744	0.157	0.017	2.45	100	0.9	-	3.09	-0.05	94	294	79	72
217	33.905	0.161	0.016	2.45	100	0.9	-	3.03	-0.06	94	294	79	72
218	34.064	0.159	0.016	2.45	100	0.9	-	2.98	-0.05	94	294	79	72
219	34.223	0.159	0.016	2.45	100	0.9	-	2.94	-0.04	94	292	79	72
220	34.384	0.161	0.017	2.45	100	0.9	102	2.89	-0.05	94	292	79	72
221	34.541	0.157	0.017	2.45	100	0.9	-	2.83	-0.06	94	290	79	72
222	34.703	0.162	0.016	2.46	100	0.9	-	2.78	-0.05	94	289	79	72
223	34.860	0.157	0.016	2.45	101	0.9	-	2.72	-0.06	94	290	79	73

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
224	35.020	0.160	0.017	2.45	101	0.9	-	2.68	-0.04	94	291	79	73
225	35.181	0.161	0.017	2.45	101	0.9	-	2.62	-0.06	94	290	79	72
226	35.338	0.157	0.017	2.46	101	0.9	-	2.57	-0.05	94	289	79	72
227	35.500	0.162	0.017	2.46	101	0.9	-	2.52	-0.05	94	288	79	72
228	35.657	0.157	0.016	2.46	101	0.9	-	2.47	-0.05	94	288	79	72
229	35.817	0.160	0.016	2.46	101	0.9	-	2.41	-0.06	94	287	79	72
230	35.978	0.161	0.017	2.45	101	0.9	100	2.37	-0.04	94	286	79	72
231	36.134	0.156	0.017	2.45	101	0.9	-	2.32	-0.05	94	286	79	72
232	36.298	0.164	0.017	2.45	101	0.9	-	2.27	-0.05	94	286	79	72
233	36.455	0.157	0.017	2.45	101	0.9	-	2.22	-0.05	94	285	79	72
234	36.615	0.160	0.016	2.44	101	0.9	-	2.17	-0.05	93	284	79	72
235	36.776	0.161	0.017	2.45	101	0.9	-	2.13	-0.04	93	284	79	72
236	36.932	0.156	0.016	2.44	101	0.9	-	2.08	-0.05	93	283	79	72
237	37.095	0.163	0.016	2.45	101	0.9	-	2.04	-0.04	93	281	79	72
238	37.251	0.156	0.017	2.44	101	0.9	-	1.99	-0.05	93	280	79	72
239	37.413	0.162	0.016	2.44	101	0.9	-	1.94	-0.05	93	279	79	72
240	37.574	0.161	0.017	2.45	101	0.9	100	1.90	-0.04	93	278	79	72
241	37.730	0.156	0.016	2.45	101	0.9	-	1.87	-0.03	93	276	79	72
242	37.894	0.164	0.017	2.45	101	0.9	-	1.84	-0.03	93	274	79	72
243	38.050	0.156	0.016	2.44	101	0.9	-	1.79	-0.05	93	272	79	72
244	38.211	0.161	0.016	2.44	101	0.9	-	1.75	-0.04	93	272	79	72
245	38.373	0.162	0.016	2.45	101	0.9	-	1.72	-0.03	92	269	79	72
246	38.529	0.156	0.016	2.44	101	0.9	-	1.69	-0.03	92	267	79	72
247	38.692	0.163	0.016	2.45	101	0.9	-	1.66	-0.03	92	264	79	72
248	38.849	0.157	0.016	2.45	101	0.9	-	1.63	-0.03	92	262	79	72
249	39.010	0.161	0.016	2.45	101	0.9	-	1.60	-0.03	92	262	79	72
250	39.172	0.162	0.017	2.45	101	0.9	100	1.57	-0.03	92	260	79	72
251	39.328	0.156	0.016	2.45	101	0.9	-	1.54	-0.03	92	259	79	72
252	39.492	0.164	0.016	2.46	101	0.9	-	1.52	-0.02	92	257	79	72
253	39.648	0.156	0.017	2.45	101	0.9	-	1.49	-0.03	91	257	79	72
254	39.809	0.161	0.016	2.46	101	0.9	-	1.46	-0.03	91	256	79	72
255	39.971	0.162	0.017	2.46	101	0.9	-	1.44	-0.02	91	254	79	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
256	40.127	0.156	0.017	2.46	101	0.9	-	1.41	-0.03	91	253	79	72
257	40.291	0.164	0.017	2.46	101	0.9	-	1.38	-0.03	91	252	79	72
258	40.447	0.156	0.017	2.47	101	0.9	-	1.36	-0.02	91	251	79	72
259	40.608	0.161	0.017	2.44	101	0.9	-	1.34	-0.02	91	249	79	72
260	40.770	0.162	0.016	2.45	101	0.9	102	1.32	-0.02	91	248	79	72
261	40.926	0.156	0.017	2.46	101	0.9	-	1.30	-0.02	90	247	79	72
262	41.090	0.164	0.017	2.46	101	0.9	-	1.27	-0.03	90	246	79	72
263	41.247	0.157	0.017	2.46	101	0.9	-	1.25	-0.02	90	245	79	72
264	41.407	0.160	0.016	2.46	101	0.9	-	1.24	-0.01	90	243	79	72
265	41.569	0.162	0.016	2.46	101	0.9	-	1.22	-0.02	90	241	79	72
266	41.726	0.157	0.017	2.45	101	0.9	-	1.20	-0.02	90	240	79	72
267	41.889	0.163	0.016	2.46	101	0.9	-	1.17	-0.03	90	239	79	72
268	42.046	0.157	0.017	2.46	101	0.9	-	1.16	-0.01	90	238	79	72
269	42.207	0.161	0.017	2.46	101	0.9	-	1.14	-0.02	90	237	79	72
270	42.369	0.162	0.017	2.45	101	0.9	101	1.13	-0.01	90	235	79	72
271	42.525	0.156	0.017	2.46	101	0.9	-	1.11	-0.02	90	235	79	72
272	42.689	0.164	0.017	2.45	101	0.9	-	1.09	-0.02	90	234	79	72
273	42.846	0.157	0.016	2.46	101	0.9	-	1.08	-0.01	90	233	79	72
274	43.006	0.160	0.017	2.44	101	0.9	-	1.06	-0.02	90	232	79	72
275	43.168	0.162	0.017	2.43	101	0.9	-	1.03	-0.03	90	232	79	72
276	43.325	0.157	0.016	2.43	101	0.9	-	1.02	-0.01	90	230	79	72
277	43.488	0.163	0.017	2.43	101	0.9	-	1.01	-0.01	90	230	79	72
278	43.645	0.157	0.016	2.44	101	0.9	-	0.98	-0.03	89	230	79	72
279	43.806	0.161	0.016	2.44	101	0.9	-	0.96	-0.02	89	228	79	72
280	43.968	0.162	0.017	2.44	101	0.9	100	0.95	-0.01	89	228	79	72
281	44.124	0.156	0.017	2.43	101	0.9	-	0.93	-0.02	89	227	79	72
282	44.288	0.164	0.016	2.45	101	0.9	-	0.91	-0.02	89	225	79	72
283	44.445	0.157	0.016	2.45	101	0.9	-	0.90	-0.01	89	225	79	72
284	44.606	0.161	0.017	2.44	101	0.9	-	0.88	-0.02	89	224	79	72
285	44.768	0.162	0.017	2.43	101	0.9	-	0.87	-0.01	89	224	78	72
286	44.924	0.156	0.017	2.44	101	0.9	-	0.85	-0.02	89	222	78	72
287	45.088	0.164	0.017	2.44	101	0.9	-	0.83	-0.02	89	222	78	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

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
288	45.245	0.157	0.017	2.44	101	0.9	-	0.81	-0.02	89	221	79	72
289	45.406	0.161	0.017	2.45	101	0.9	-	0.79	-0.02	89	220	79	72
290	45.568	0.162	0.017	2.44	101	0.9	100	0.78	-0.01	89	219	79	72
291	45.724	0.156	0.017	2.45	101	0.9	-	0.76	-0.02	89	219	79	72
292	45.888	0.164	0.017	2.45	101	0.9	-	0.75	-0.01	89	218	79	72
293	46.045	0.157	0.017	2.45	101	0.9	-	0.73	-0.02	89	217	79	72
294	46.206	0.161	0.017	2.45	102	0.9	-	0.71	-0.02	89	218	79	72
295	46.368	0.162	0.017	2.45	102	0.9	-	0.70	-0.01	89	217	79	72
296	46.524	0.156	0.017	2.45	102	0.9	-	0.67	-0.03	88	216	78	72
297	46.688	0.164	0.017	2.44	102	0.9	-	0.66	-0.01	88	215	78	72
298	46.845	0.157	0.016	2.44	102	0.9	-	0.65	-0.01	88	214	79	72
299	47.007	0.162	0.016	2.42	102	0.9	-	0.63	-0.02	88	214	78	72
300	47.169	0.162	0.017	2.43	102	0.9	100	0.62	-0.01	88	213	79	72
301	47.324	0.155	0.017	2.43	102	0.9	-	0.60	-0.02	88	213	78	72
302	47.489	0.165	0.016	2.44	102	0.9	-	0.59	-0.01	88	212	78	73
303	47.646	0.157	0.016	2.43	102	0.9	-	0.57	-0.02	88	211	79	73
304	47.807	0.161	0.017	2.43	102	0.9	-	0.56	-0.01	88	210	78	73
305	47.969	0.162	0.017	2.45	102	0.9	-	0.54	-0.02	88	209	78	73
306	48.125	0.156	0.017	2.44	102	0.9	-	0.53	-0.01	88	209	78	73
307	48.289	0.164	0.017	2.44	102	0.9	-	0.52	-0.01	88	209	78	73
308	48.446	0.157	0.017	2.44	102	0.9	-	0.49	-0.03	88	208	78	73
309	48.608	0.162	0.017	2.45	102	0.9	-	0.48	-0.01	88	208	78	73
310	48.769	0.161	0.017	2.45	102	0.9	100	0.47	-0.01	88	207	78	73
311	48.926	0.157	0.017	2.45	102	0.9	-	0.45	-0.02	88	208	78	73
312	49.090	0.164	0.017	2.47	102	0.9	-	0.44	-0.01	88	207	78	73
313	49.247	0.157	0.016	2.46	102	0.9	-	0.43	-0.01	88	207	78	72
314	49.408	0.161	0.017	2.46	102	0.9	-	0.41	-0.02	88	207	78	72
315	49.570	0.162	0.017	2.45	102	0.9	-	0.39	-0.02	88	206	78	72
316	49.728	0.158	0.017	2.45	102	0.9	-	0.38	-0.01	88	206	78	72
317	49.891	0.163	0.017	2.46	102	0.9	-	0.37	-0.01	87	206	78	73
318	50.049	0.158	0.017	2.46	102	0.9	-	0.35	-0.02	88	206	78	73
319	50.210	0.161	0.017	2.45	102	0.9	-	0.34	-0.01	87	206	78	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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	50.372	0.162	0.017	2.47	102	0.9	100	0.33	-0.01	87	205	78	73
321	50.529	0.157	0.017	2.46	102	0.9	-	0.31	-0.02	87	205	78	73
322	50.692	0.163	0.017	2.46	102	0.9	-	0.29	-0.02	87	205	78	73
323	50.851	0.159	0.017	2.46	102	0.9	-	0.28	-0.01	87	204	78	73
324	51.011	0.160	0.017	2.47	102	0.9	-	0.26	-0.02	87	205	78	73
325	51.173	0.162	0.017	2.46	102	0.9	-	0.25	-0.01	87	204	78	73
326	51.332	0.159	0.017	2.46	102	0.9	-	0.24	-0.01	87	204	78	73
327	51.493	0.161	0.017	2.47	102	0.9	-	0.22	-0.02	87	204	78	72
328	51.654	0.161	0.017	2.46	102	0.9	-	0.21	-0.01	87	204	78	72
329	51.813	0.159	0.017	2.46	102	0.9	-	0.19	-0.02	87	204	78	72
330	51.975	0.162	0.016	2.45	102	0.9	101	0.18	-0.01	87	204	78	72
331	52.133	0.158	0.016	2.45	102	0.9	-	0.16	-0.02	87	204	78	72
332	52.295	0.162	0.016	2.45	102	0.9	-	0.14	-0.02	87	204	78	72
333	52.456	0.161	0.017	2.45	102	0.9	-	0.13	-0.01	87	203	78	72
334	52.614	0.158	0.017	2.46	102	0.9	-	0.11	-0.02	87	204	78	73
335	52.777	0.163	0.017	2.45	102	0.9	-	0.10	-0.01	87	204	78	72
336	52.936	0.159	0.017	2.45	102	0.9	-	0.09	-0.01	87	205	78	73
337	53.096	0.160	0.017	2.46	102	0.9	-	0.07	-0.02	87	206	78	72
338	53.258	0.162	0.016	2.45	102	0.9	-	0.06	-0.01	87	206	78	73
339	53.415	0.157	0.017	2.47	102	0.9	-	0.04	-0.02	87	205	78	73
340	53.579	0.164	0.017	2.46	102	0.9	101	0.03	-0.01	87	205	78	73
341	53.737	0.158	0.016	2.46	102	0.9	-	0.01	-0.02	87	205	78	73
342	53.898	0.161	0.017	2.46	102	0.9	101	0.00	-0.01	87	205	78	73
Avg/Tot	53.897	0.158	0.017	2.41	95.6	0.9	100			86.2	218.9	76.5	70.5

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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		1.47	75	1.9		73	-0.040	3.56	0.047
1	0.133	0.133	2.09	75	1.8	-	73	-0.035	1.51	0.134
2	0.273	0.140	2.09	75	1.7	-	73	-0.040	2.34	0.857
3	0.417	0.144	2.10	75	1.7	-	73	-0.041	2.65	0.346
4	0.557	0.140	2.10	75	1.8	-	73	-0.040	2.74	0.053
5	0.703	0.146	2.10	75	1.9	-	73	-0.040	2.65	0.048
6	0.844	0.141	2.10	75	1.9	-	73	-0.040	2.56	0.046
7	0.985	0.141	2.11	75	1.5	-	73	-0.041	2.62	0.045
8	1.129	0.144	2.10	75	2.0	-	73	-0.039	2.61	0.048
9	1.271	0.142	2.11	75	1.6	-	73	-0.040	2.67	0.052
10	1.416	0.145	2.11	75	1.5	99	73	-0.039	2.57	0.050
11	1.557	0.141	2.11	75	1.5	-	73	-0.039	2.63	0.045
12	1.702	0.145	2.11	75	1.5	-	73	-0.040	2.63	0.051
13	1.843	0.141	2.11	76	1.7	-	73	-0.041	2.69	0.051
14	1.988	0.145	2.11	76	1.7	-	73	-0.038	2.69	0.047
15	2.131	0.143	2.11	76	1.7	-	73	-0.038	2.71	0.052
16	2.272	0.141	2.11	77	1.7	-	73	-0.037	2.83	0.050
17	2.418	0.146	2.12	77	1.6	-	73	-0.039	2.83	0.050
18	2.560	0.142	2.12	77	1.5	-	73	-0.035	2.78	0.054
19	2.706	0.146	2.12	77	1.9	-	73	-0.035	2.80	0.054
20	2.847	0.141	2.12	77	1.7	98	73	-0.036	2.90	0.045
21	2.992	0.145	2.12	78	1.8	-	73	-0.036	2.88	0.054
22	3.135	0.143	2.12	78	1.5	-	73	-0.037	2.85	0.054
23	3.281	0.146	2.13	79	1.5	-	73	-0.035	2.98	0.048
24	3.424	0.143	2.12	79	2.0	-	73	-0.033	2.88	0.055
25	3.568	0.144	2.13	79	1.7	-	73	-0.035	2.96	0.047
26	3.712	0.144	2.13	79	1.7	-	73	-0.035	2.91	0.054
27	3.856	0.144	2.13	80	1.5	-	73	-0.035	3.01	0.052
28	4.002	0.146	2.13	80	1.6	-	73	-0.035	3.03	0.055
29	4.146	0.144	2.14	80	1.5	-	73	-0.033	3.07	0.050
30	4.292	0.146	2.14	80	1.7	99	73	-0.033	3.19	0.048
31	4.435	0.143	2.14	81	1.5	-	73	-0.035	3.22	0.049

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
32	4.581	0.146	2.14	81	1.5	-	73	-0.032	3.40	0.048
33	4.724	0.143	2.14	81	1.7	-	73	-0.034	3.37	0.055
34	4.871	0.147	2.14	82	1.9	-	73	-0.032	3.33	0.054
35	5.015	0.144	2.15	82	1.9	-	73	-0.031	3.26	0.053
36	5.163	0.148	2.15	82	1.9	-	73	-0.032	3.55	0.049
37	5.307	0.144	2.15	82	1.8	-	73	-0.031	3.48	0.052
38	5.452	0.145	2.15	83	2.0	-	73	-0.031	3.61	0.052
39	5.598	0.146	2.15	83	1.5	-	73	-0.031	3.85	0.053
40	5.742	0.144	2.14	83	2.0	99	73	-0.030	4.04	0.054
41	5.889	0.147	2.15	83	2.0	-	73	-0.029	4.24	0.053
42	6.033	0.144	2.15	84	2.0	-	73	-0.033	4.30	0.058
43	6.181	0.148	2.16	84	1.9	-	73	-0.032	4.26	0.058
44	6.326	0.145	2.16	84	1.6	-	73	-0.032	4.42	0.052
45	6.474	0.148	2.15	85	1.6	-	73	-0.030	4.44	0.056
46	6.618	0.144	2.16	85	1.8	-	73	-0.033	4.47	0.059
47	6.766	0.148	2.15	85	1.5	-	73	-0.032	4.28	0.058
48	6.909	0.143	2.16	85	2.0	-	73	-0.033	4.44	0.057
49	7.058	0.149	2.15	85	1.9	-	73	-0.032	4.39	0.057
50	7.202	0.144	2.16	86	1.7	99	73	-0.031	4.45	0.060
51	7.351	0.149	2.16	86	1.7	-	73	-0.031	4.47	0.056
52	7.495	0.144	2.16	86	1.6	-	73	-0.032	4.45	0.061
53	7.644	0.149	2.17	87	1.6	-	73	-0.033	4.42	0.061
54	7.790	0.146	2.16	87	1.5	-	73	-0.034	4.42	0.055
55	7.937	0.147	2.17	87	1.5	-	73	-0.031	4.57	0.055
56	8.083	0.146	2.16	87	1.6	-	73	-0.034	4.65	0.063
57	8.230	0.147	2.17	88	2.0	-	73	-0.030	4.45	0.054
58	8.377	0.147	2.17	88	2.0	-	73	-0.031	4.29	0.057
59	8.524	0.147	2.17	88	1.5	-	73	-0.033	4.38	0.055
60	8.671	0.147	2.17	88	1.9	99	73	-0.032	4.23	0.062
61	8.816	0.145	2.17	89	2.0	-	73	-0.032	4.37	0.060
62	8.964	0.148	2.17	89	1.6	-	74	-0.030	4.32	0.058
63	9.110	0.146	2.18	89	1.4	-	73	-0.033	4.33	0.064

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
64	9.259	0.149	2.17	89	2.0	-	74	-0.031	4.40	0.063
65	9.404	0.145	2.17	89	1.5	-	74	-0.031	4.27	0.058
66	9.553	0.149	2.18	90	1.8	-	74	-0.030	4.37	0.061
67	9.699	0.146	2.18	90	1.5	-	74	-0.030	4.26	0.063
68	9.849	0.150	2.17	90	2.0	-	74	-0.031	4.42	0.062
69	9.994	0.145	2.18	90	1.7	-	74	-0.032	4.49	0.066
70	10.143	0.149	2.18	90	1.8	99	74	-0.032	4.58	0.061
71	10.288	0.145	2.17	90	1.7	-	74	-0.030	4.65	0.064
72	10.438	0.150	2.18	91	2.0	-	74	-0.031	4.64	0.063
73	10.583	0.145	2.18	91	2.0	-	74	-0.031	4.64	0.062
74	10.733	0.150	2.18	91	1.7	-	74	-0.034	4.92	0.064
75	10.877	0.144	2.17	91	1.7	-	74	-0.034	4.93	0.068
76	11.027	0.150	2.17	92	1.5	-	74	-0.031	4.82	0.063
77	11.172	0.145	2.18	92	1.8	-	74	-0.030	4.94	0.068
78	11.322	0.150	2.18	92	1.5	-	74	-0.030	4.89	0.066
79	11.467	0.145	2.17	92	1.5	-	74	-0.032	4.92	0.068
80	11.617	0.150	2.17	92	1.7	99	74	-0.033	5.10	0.068
81	11.763	0.146	2.18	92	1.7	-	74	-0.032	5.09	0.066
82	11.913	0.150	2.18	92	1.5	-	74	-0.033	5.13	0.064
83	12.059	0.146	2.18	92	2.0	-	74	-0.033	5.14	0.069
84	12.209	0.150	2.19	92	1.5	-	74	-0.032	5.28	0.064
85	12.354	0.145	2.19	93	2.0	-	74	-0.034	5.29	0.071
86	12.504	0.150	2.18	93	1.5	-	74	-0.035	5.34	0.066
87	12.650	0.146	2.18	93	1.4	-	74	-0.035	5.53	0.068
88	12.800	0.150	2.18	93	1.7	-	74	-0.035	5.32	0.067
89	12.947	0.147	2.19	93	1.5	-	74	-0.036	5.35	0.069
90	13.097	0.150	2.19	93	1.6	99	74	-0.033	5.49	0.070
91	13.243	0.146	2.19	93	2.0	-	74	-0.036	5.55	0.068
92	13.393	0.150	2.19	94	1.6	-	74	-0.033	5.48	0.069
93	13.540	0.147	2.19	94	1.5	-	74	-0.032	5.67	0.071
94	13.689	0.149	2.19	94	2.0	-	74	-0.034	5.55	0.067
95	13.836	0.147	2.19	94	1.6	-	74	-0.035	5.62	0.070

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
96	13.986	0.150	2.19	94	1.5	-	74	-0.035	5.62	0.065
97	14.133	0.147	2.19	94	1.6	-	74	-0.034	5.48	0.068
98	14.281	0.148	2.18	94	1.7	-	74	-0.034	5.67	0.069
99	14.429	0.148	2.19	94	1.6	-	74	-0.033	5.67	0.070
100	14.578	0.149	2.18	94	1.9	99	74	-0.035	5.71	0.066
101	14.725	0.147	2.18	94	1.5	-	74	-0.032	5.64	0.072
102	14.874	0.149	2.18	95	1.5	-	74	-0.035	5.66	0.071
103	15.022	0.148	2.19	95	1.5	-	74	-0.035	5.75	0.068
104	15.171	0.149	2.19	95	1.6	-	74	-0.033	5.75	0.069
105	15.319	0.148	2.19	95	1.5	-	74	-0.038	5.84	0.069
106	15.468	0.149	2.18	95	2.0	-	75	-0.037	5.89	0.070
107	15.616	0.148	2.18	95	1.5	-	75	-0.034	6.08	0.072
108	15.764	0.148	2.19	95	1.5	-	75	-0.036	6.04	0.070
109	15.913	0.149	2.19	95	1.9	-	74	-0.034	5.93	0.070
110	16.061	0.148	2.19	95	1.9	100	74	-0.034	5.98	0.072
111	16.209	0.148	2.19	95	2.0	-	74	-0.036	5.90	0.070
112	16.358	0.149	2.19	95	1.5	-	74	-0.035	6.24	0.070
113	16.506	0.148	2.19	96	1.5	-	75	-0.037	6.32	0.069
114	16.655	0.149	2.19	96	1.6	-	75	-0.037	6.22	0.075
115	16.803	0.148	2.19	96	1.6	-	75	-0.032	6.28	0.073
116	16.951	0.148	2.19	96	1.7	-	74	-0.038	6.29	0.069
117	17.100	0.149	2.19	96	1.5	-	75	-0.039	6.35	0.077
118	17.248	0.148	2.19	96	1.7	-	75	-0.039	6.49	0.079
119	17.397	0.149	2.19	96	1.5	-	75	-0.036	6.57	0.076
120	17.546	0.149	2.19	96	2.0	100	75	-0.039	6.43	0.076
121	17.694	0.148	2.18	96	1.6	-	75	-0.038	6.47	0.075
122	17.843	0.149	2.18	96	1.5	-	75	-0.036	6.55	0.071
123	17.992	0.149	2.18	96	1.8	-	75	-0.039	6.67	0.073
124	18.140	0.148	2.19	96	1.6	-	75	-0.041	6.80	0.079
125	18.289	0.149	2.18	96	1.5	-	75	-0.038	6.72	0.079
126	18.437	0.148	2.19	96	1.5	-	75	-0.039	6.48	0.074
127	18.586	0.149	2.18	96	1.7	-	75	-0.043	6.87	0.076

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
128	18.734	0.148	2.19	96	1.6	-	75	-0.042	6.91	0.086
129	18.883	0.149	2.18	96	1.8	-	75	-0.042	6.74	0.073
130	19.031	0.148	2.19	96	1.6	100	75	-0.041	6.85	0.079
131	19.180	0.149	2.19	96	1.5	-	75	-0.044	6.83	0.079
132	19.328	0.148	2.19	97	1.9	-	75	-0.045	7.07	0.077
133	19.478	0.150	2.19	97	1.7	-	75	-0.046	7.13	0.079
134	19.626	0.148	2.19	97	1.8	-	75	-0.046	7.32	0.087
135	19.775	0.149	2.19	97	1.9	-	75	-0.048	7.33	0.088
136	19.922	0.147	2.19	97	1.5	-	75	-0.045	7.32	0.101
137	20.072	0.150	2.18	97	1.7	-	75	-0.048	7.31	0.087
138	20.220	0.148	2.19	97	1.8	-	75	-0.049	7.52	0.090
139	20.369	0.149	2.19	97	1.5	-	75	-0.048	7.44	0.097
140	20.517	0.148	2.19	97	1.5	102	75	-0.051	7.81	0.105
141	20.666	0.149	2.19	97	1.5	-	75	-0.052	7.93	0.123
142	20.814	0.148	2.19	97	1.6	-	75	-0.053	7.92	0.139
143	20.964	0.150	2.19	97	1.7	-	75	-0.054	8.17	0.146
144	21.111	0.147	2.19	97	1.6	-	76	-0.056	8.32	0.140
145	21.261	0.150	2.19	97	1.8	-	76	-0.057	8.35	0.155
146	21.409	0.148	2.19	97	2.0	-	76	-0.057	8.36	0.140
147	21.559	0.150	2.19	97	2.0	-	76	-0.063	8.38	0.149
148	21.706	0.147	2.19	97	1.5	-	76	-0.064	8.53	0.156
149	21.856	0.150	2.19	97	1.6	-	76	-0.064	8.66	0.184
150	22.004	0.148	2.19	97	1.5	102	76	-0.064	8.58	0.171
151	22.153	0.149	2.19	97	1.5	-	76	-0.066	8.69	0.182
152	22.301	0.148	2.19	97	1.5	-	76	-0.069	8.74	0.164
153	22.450	0.149	2.19	97	2.0	-	76	-0.073	8.83	0.155
154	22.598	0.148	2.19	97	1.6	-	76	-0.074	8.79	0.165
155	22.748	0.150	2.19	98	1.6	-	76	-0.078	8.86	0.183
156	22.895	0.147	2.18	98	1.7	-	76	-0.079	9.81	1.756
157	23.045	0.150	2.18	98	2.0	-	76	-0.078	9.44	3.072
158	23.193	0.148	2.18	98	1.5	-	76	-0.082	9.28	3.269
159	23.342	0.149	2.19	98	1.9	-	76	-0.075	9.25	2.801

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
160	23.490	0.148	2.18	98	2.0	101	76	-0.078	9.19	2.511
161	23.639	0.149	2.19	98	2.0	-	77	-0.076	9.21	2.013
162	23.787	0.148	2.18	98	1.9	-	77	-0.076	9.21	1.708
163	23.937	0.150	2.18	98	1.6	-	77	-0.076	9.12	1.450
164	24.084	0.147	2.18	98	2.0	-	77	-0.075	9.18	1.281
165	24.234	0.150	2.18	98	1.8	-	77	-0.078	9.14	1.116
166	24.382	0.148	2.18	98	1.9	-	77	-0.074	9.12	0.902
167	24.531	0.149	2.18	98	1.5	-	77	-0.075	8.96	0.813
168	24.679	0.148	2.18	98	1.5	-	77	-0.074	9.03	0.788
169	24.828	0.149	2.18	98	2.0	-	77	-0.072	9.08	0.687
170	24.976	0.148	2.18	98	1.5	100	77	-0.079	8.91	0.593
171	25.126	0.150	2.18	98	1.5	-	77	-0.074	8.96	0.523
172	25.273	0.147	2.18	98	1.8	-	77	-0.075	8.80	0.464
173	25.423	0.150	2.18	98	1.7	-	77	-0.077	8.76	0.289
174	25.570	0.147	2.18	98	1.8	-	78	-0.070	8.65	0.365
175	25.720	0.150	2.18	98	1.5	-	78	-0.074	8.64	0.288
176	25.868	0.148	2.18	99	1.6	-	78	-0.072	8.57	0.238
177	26.017	0.149	2.18	99	2.0	-	78	-0.075	8.41	0.182
178	26.165	0.148	2.17	99	2.0	-	78	-0.073	8.38	0.141
179	26.315	0.150	2.18	99	1.5	-	78	-0.074	8.13	0.109
180	26.462	0.147	2.18	98	1.9	100	78	-0.075	8.17	0.081
181	26.612	0.150	2.18	98	1.8	-	78	-0.072	8.11	0.068
182	26.760	0.148	2.17	98	1.5	-	78	-0.073	7.97	0.048
183	26.909	0.149	2.18	98	1.7	-	78	-0.070	7.79	0.050
184	27.057	0.148	2.18	98	1.6	-	78	-0.071	7.41	0.044
185	27.207	0.150	2.18	98	1.5	-	78	-0.073	7.27	0.045
186	27.354	0.147	2.18	98	2.0	-	78	-0.070	7.19	0.045
187	27.504	0.150	2.18	98	1.5	-	78	-0.069	7.21	0.048
188	27.652	0.148	2.18	98	1.5	-	78	-0.071	7.22	0.043
189	27.802	0.150	2.18	98	2.0	-	78	-0.067	7.26	0.042
190	27.949	0.147	2.17	98	1.8	100	78	-0.067	7.26	0.043
191	28.099	0.150	2.18	98	1.5	-	78	-0.072	7.45	0.051

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
192	28.247	0.148	2.18	98	1.6	-	78	-0.071	7.55	0.053
193	28.397	0.150	2.18	98	2.0	-	79	-0.069	7.48	0.056
194	28.544	0.147	2.18	98	1.6	-	79	-0.073	7.46	0.052
195	28.694	0.150	2.18	98	1.8	-	79	-0.073	7.44	0.054
196	28.842	0.148	2.18	98	2.0	-	79	-0.071	7.48	0.050
197	28.992	0.150	2.18	99	1.5	-	79	-0.072	7.41	0.049
198	29.139	0.147	2.18	99	1.5	-	79	-0.072	7.45	0.056
199	29.289	0.150	2.18	99	1.7	-	79	-0.074	7.30	0.056
200	29.437	0.148	2.18	99	1.6	100	79	-0.071	7.21	0.053
201	29.587	0.150	2.18	99	1.5	-	79	-0.071	7.12	0.050
202	29.735	0.148	2.18	99	1.9	-	79	-0.070	7.13	0.048
203	29.885	0.150	2.19	99	1.5	-	79	-0.068	7.06	0.053
204	30.032	0.147	2.18	99	1.5	-	79	-0.069	7.03	0.048
205	30.182	0.150	2.19	99	1.6	-	79	-0.072	6.95	0.052
206	30.330	0.148	2.18	99	1.5	-	79	-0.069	6.93	0.054
207	30.480	0.150	2.18	99	1.9	-	79	-0.070	6.91	0.052
208	30.628	0.148	2.18	100	1.7	-	80	-0.069	6.91	0.058
209	30.777	0.149	2.18	99	2.0	-	79	-0.071	6.95	0.049
210	30.925	0.148	2.19	99	2.0	101	79	-0.066	6.93	0.053
211	31.075	0.150	2.18	99	1.9	-	79	-0.066	6.87	0.052
212	31.223	0.148	2.19	99	1.9	-	79	-0.070	6.85	0.058
213	31.373	0.150	2.18	99	1.5	-	79	-0.070	6.89	0.050
214	31.521	0.148	2.19	99	1.5	-	79	-0.066	6.94	0.052
215	31.671	0.150	2.19	99	1.9	-	79	-0.072	6.93	0.052
216	31.819	0.148	2.18	99	1.8	-	79	-0.063	6.95	0.049
217	31.969	0.150	2.19	99	1.6	-	79	-0.071	6.80	0.053
218	32.117	0.148	2.18	99	2.0	-	79	-0.067	6.52	0.051
219	32.267	0.150	2.18	99	1.5	-	79	-0.067	6.54	0.046
220	32.415	0.148	2.18	99	1.8	101	79	-0.068	6.45	0.050
221	32.564	0.149	2.18	99	1.7	-	79	-0.067	6.72	0.048
222	32.713	0.149	2.18	99	1.6	-	79	-0.071	6.81	0.058
223	32.862	0.149	2.19	99	1.5	-	80	-0.064	6.74	0.057

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
224	33.010	0.148	2.18	99	1.9	-	80	-0.067	6.74	0.051
225	33.160	0.150	2.18	99	1.6	-	80	-0.067	6.63	0.051
226	33.308	0.148	2.18	99	1.5	-	79	-0.067	6.60	0.048
227	33.457	0.149	2.18	99	1.6	-	79	-0.066	6.55	0.053
228	33.606	0.149	2.18	99	1.8	-	79	-0.064	6.49	0.052
229	33.755	0.149	2.18	99	1.5	-	79	-0.064	6.53	0.048
230	33.903	0.148	2.18	99	2.0	100	79	-0.065	6.51	0.052
231	34.053	0.150	2.18	99	1.5	-	79	-0.063	6.38	0.053
232	34.201	0.148	2.18	99	1.9	-	79	-0.065	6.41	0.049
233	34.350	0.149	2.18	99	1.5	-	79	-0.065	6.42	0.052
234	34.499	0.149	2.18	99	2.0	-	79	-0.069	6.35	0.054
235	34.648	0.149	2.18	99	1.6	-	79	-0.065	6.33	0.053
236	34.797	0.149	2.18	99	1.6	-	79	-0.066	6.32	0.052
237	34.946	0.149	2.18	99	1.5	-	79	-0.066	6.33	0.051
238	35.095	0.149	2.19	99	1.5	-	79	-0.065	6.14	0.054
239	35.244	0.149	2.19	99	1.6	-	79	-0.063	6.27	0.047
240	35.392	0.148	2.18	99	1.9	100	79	-0.062	6.13	0.045
241	35.542	0.150	2.18	99	1.4	-	79	-0.063	5.99	0.043
242	35.691	0.149	2.19	99	1.5	-	80	-0.062	5.79	0.046
243	35.839	0.148	2.19	99	1.6	-	80	-0.064	5.77	0.047
244	35.988	0.149	2.19	99	1.4	-	80	-0.063	5.61	0.041
245	36.137	0.149	2.18	100	1.9	-	80	-0.061	5.51	0.047
246	36.287	0.150	2.19	99	2.0	-	79	-0.062	5.49	0.040
247	36.435	0.148	2.19	99	1.7	-	79	-0.059	5.47	0.046
248	36.585	0.150	2.19	100	2.0	-	80	-0.061	5.40	0.051
249	36.733	0.148	2.19	99	1.9	-	79	-0.061	5.32	0.044
250	36.883	0.150	2.18	99	1.8	100	79	-0.061	5.32	0.046
251	37.031	0.148	2.18	99	1.9	-	79	-0.060	5.32	0.043
252	37.181	0.150	2.18	99	1.7	-	79	-0.060	5.33	0.041
253	37.329	0.148	2.18	99	1.5	-	79	-0.061	5.28	0.052
254	37.479	0.150	2.18	99	1.9	-	79	-0.061	5.25	0.043
255	37.628	0.149	2.19	99	1.6	-	79	-0.058	5.34	0.045

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
256	37.777	0.149	2.19	99	1.5	-	79	-0.061	5.22	0.048
257	37.926	0.149	2.19	99	1.9	-	79	-0.056	5.25	0.049
258	38.076	0.150	2.19	99	1.5	-	79	-0.057	5.12	0.045
259	38.224	0.148	2.20	100	1.7	-	79	-0.056	5.14	0.050
260	38.374	0.150	2.19	100	2.0	101	79	-0.060	5.15	0.048
261	38.522	0.148	2.19	100	1.9	-	79	-0.057	5.06	0.047
262	38.672	0.150	2.19	100	2.0	-	79	-0.058	4.97	0.049
263	38.820	0.148	2.19	100	1.5	-	79	-0.055	4.98	0.045
264	38.970	0.150	2.19	100	1.7	-	79	-0.056	4.92	0.045
265	39.118	0.148	2.19	100	2.0	-	79	-0.056	4.96	0.049
266	39.268	0.150	2.19	100	2.0	-	79	-0.056	4.93	0.044
267	39.416	0.148	2.19	100	1.7	-	79	-0.054	4.85	0.049
268	39.566	0.150	2.19	100	1.5	-	79	-0.057	4.96	0.042
269	39.714	0.148	2.20	99	1.9	-	79	-0.057	4.90	0.047
270	39.864	0.150	2.19	100	1.7	101	79	-0.053	4.92	0.047
271	40.012	0.148	2.18	99	1.9	-	79	-0.054	4.93	0.042
272	40.162	0.150	2.18	99	1.6	-	79	-0.056	4.91	0.048
273	40.310	0.148	2.19	100	2.0	-	79	-0.054	4.85	0.049
274	40.460	0.150	2.19	100	1.7	-	79	-0.054	4.86	0.048
275	40.608	0.148	2.19	100	1.4	-	79	-0.055	4.89	0.046
276	40.759	0.151	2.19	100	1.5	-	79	-0.052	4.82	0.044
277	40.906	0.147	2.19	100	1.5	-	79	-0.054	4.79	0.043
278	41.057	0.151	2.19	100	1.5	-	79	-0.051	4.82	0.040
279	41.205	0.148	2.19	100	2.0	-	79	-0.052	4.84	0.043
280	41.356	0.151	2.19	100	2.0	99	79	-0.052	4.87	0.046
281	41.503	0.147	2.19	100	1.5	-	79	-0.051	4.85	0.048
282	41.654	0.151	2.19	100	1.8	-	79	-0.052	4.85	0.044
283	41.801	0.147	2.19	100	1.5	-	79	-0.050	4.86	0.041
284	41.952	0.151	2.19	100	1.9	-	79	-0.050	4.84	0.043
285	42.099	0.147	2.19	100	1.8	-	79	-0.051	4.82	0.044
286	42.250	0.151	2.19	100	1.9	-	79	-0.053	4.87	0.046
287	42.397	0.147	2.18	100	1.6	-	79	-0.051	4.82	0.043

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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 (%)
288	42.548	0.151	2.18	100	1.8	-	79	-0.053	4.81	0.044
289	42.695	0.147	2.18	100	1.6	-	79	-0.050	4.82	0.045
290	42.846	0.151	2.18	100	1.7	99	79	-0.052	4.94	0.046
291	42.993	0.147	2.19	100	1.6	-	79	-0.048	4.92	0.039
292	43.145	0.152	2.18	100	1.9	-	79	-0.051	4.99	0.041
293	43.292	0.147	2.19	100	1.5	-	79	-0.049	4.91	0.045
294	43.443	0.151	2.19	100	1.6	-	79	-0.048	4.92	0.042
295	43.590	0.147	2.19	100	2.0	-	79	-0.050	5.00	0.048
296	43.742	0.152	2.19	100	1.6	-	79	-0.049	4.83	0.040
297	43.889	0.147	2.19	100	2.0	-	79	-0.049	4.89	0.040
298	44.041	0.152	2.18	100	1.5	-	79	-0.050	4.81	0.038
299	44.188	0.147	2.18	100	1.5	-	79	-0.048	4.82	0.040
300	44.339	0.151	2.18	100	1.5	99	79	-0.049	4.86	0.044
301	44.486	0.147	2.19	100	1.7	-	79	-0.049	4.81	0.044
302	44.637	0.151	2.19	100	1.8	-	79	-0.051	4.89	0.046
303	44.784	0.147	2.19	101	1.9	-	79	-0.046	4.82	0.040
304	44.936	0.152	2.19	101	1.5	-	79	-0.047	4.71	0.043
305	45.083	0.147	2.18	101	1.5	-	79	-0.052	4.75	0.043
306	45.234	0.151	2.19	100	1.8	-	79	-0.051	4.77	0.045
307	45.381	0.147	2.18	100	1.5	-	79	-0.047	4.79	0.043
308	45.533	0.152	2.19	100	1.5	-	79	-0.049	4.81	0.046
309	45.679	0.146	2.18	100	1.6	-	79	-0.048	4.74	0.043
310	45.831	0.152	2.18	100	2.0	99	79	-0.047	4.70	0.045
311	45.978	0.147	2.18	100	1.5	-	79	-0.049	4.80	0.046
312	46.129	0.151	2.18	100	1.7	-	79	-0.046	4.81	0.042
313	46.276	0.147	2.18	100	1.7	-	79	-0.048	4.68	0.038
314	46.428	0.152	2.19	100	1.5	-	79	-0.049	4.78	0.046
315	46.575	0.147	2.19	100	1.7	-	79	-0.047	4.88	0.039
316	46.727	0.152	2.20	100	1.6	-	79	-0.046	4.70	0.044
317	46.874	0.147	2.19	100	1.5	-	79	-0.045	4.74	0.039
318	47.025	0.151	2.19	100	1.8	-	79	-0.048	4.70	0.044
319	47.172	0.147	2.19	100	1.5	-	79	-0.047	4.65	0.042

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

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	47.324	0.152	2.20	100	2.0	99	79	-0.046	4.62	0.038
321	47.471	0.147	2.20	100	1.9	-	79	-0.047	4.68	0.039
322	47.622	0.151	2.20	101	2.0	-	79	-0.047	4.69	0.046
323	47.769	0.147	2.19	101	1.9	-	79	-0.048	4.65	0.043
324	47.920	0.151	2.19	101	1.7	-	79	-0.047	4.72	0.044
325	48.067	0.147	2.19	101	1.7	-	79	-0.045	4.76	0.044
326	48.218	0.151	2.19	101	1.5	-	79	-0.045	4.81	0.048
327	48.366	0.148	2.19	101	1.5	-	79	-0.044	4.81	0.046
328	48.517	0.151	2.19	100	2.0	-	79	-0.047	4.87	0.049
329	48.665	0.148	2.19	100	1.5	-	79	-0.049	4.83	0.047
330	48.816	0.151	2.19	100	1.6	101	79	-0.045	4.83	0.042
331	48.964	0.148	2.19	100	2.0	-	79	-0.047	4.83	0.048
332	49.114	0.150	2.19	100	1.8	-	79	-0.046	4.90	0.043
333	49.262	0.148	2.19	100	1.6	-	79	-0.044	5.04	0.050
334	49.413	0.151	2.19	100	1.5	-	79	-0.046	4.95	0.047
335	49.561	0.148	2.18	100	1.6	-	79	-0.047	4.91	0.047
336	49.711	0.150	2.19	100	1.8	-	79	-0.046	4.80	0.047
337	49.859	0.148	2.18	100	1.8	-	79	-0.044	4.91	0.049
338	50.010	0.151	2.18	100	1.9	-	79	-0.047	4.83	0.049
339	50.158	0.148	2.19	100	1.4	-	79	-0.046	4.84	0.051
340	50.309	0.151	2.19	100	1.7	101	79	-0.043	4.91	0.052
341	50.458	0.149	2.19	100	1.8	-	79	-0.047	4.82	0.044
342	50.608	0.150	2.19	100	1.9	101	79	-0.048	4.86	0.049
Avg/Tot	50.608	0.148	2.17	94.6	1.7	100	76.5	-0.050	5.67	0.139

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 4

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/10/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.000		0.67	75	1.7		71
1	0.150	0.150	1.06	74	1.7	-	71
2	0.302	0.152	1.06	74	1.7	-	71
3	0.455	0.153	1.07	74	1.8	-	71
4	0.608	0.153	1.07	74	1.7	-	71
5	0.762	0.154	1.08	74	1.7	-	71
6	0.916	0.154	1.09	74	1.7	-	71
7	1.071	0.155	1.09	74	1.8	-	71
8	1.225	0.154	1.10	74	1.7	-	71
9	1.380	0.155	1.09	74	1.7	-	71
10	1.536	0.156	1.09	75	1.9	98	71
11	1.692	0.156	1.09	75	1.7	-	71
12	1.848	0.156	1.10	75	1.8	-	71
13	2.005	0.157	1.11	75	1.7	-	71
14	2.161	0.156	1.11	75	1.7	-	71
15	2.318	0.157	1.11	76	1.9	-	71
16	2.474	0.156	1.11	77	1.8	-	71
17	2.630	0.156	1.10	77	1.7	-	71
18	2.788	0.158	1.11	77	1.7	-	71
19	2.945	0.157	1.12	76	1.9	-	71
20	3.103	0.158	1.12	77	1.9	97	71
21	3.261	0.158	1.12	77	1.9	-	71
22	3.417	0.156	1.12	77	1.8	-	71
23	3.576	0.159	1.12	78	1.7	-	71
24	3.735	0.159	1.13	78	1.8	-	71
25	3.894	0.159	1.14	78	1.7	-	71
26	4.052	0.158	1.13	78	1.8	-	71
27	4.211	0.159	1.13	78	1.7	-	71
28	4.371	0.160	1.14	79	1.9	-	71
29	4.531	0.160	1.15	79	1.9	-	71
30	4.690	0.159	1.14	79	1.8	98	71
31	4.850	0.160	1.14	80	1.9	-	71

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

Elapsed Time (min)	Particulate Sampling 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)
32	5.011	0.161	1.15	80	1.8	-	71
33	5.171	0.160	1.15	80	1.7	-	71
34	5.332	0.161	1.14	80	1.9	-	71
35	5.493	0.161	1.15	80	1.7	-	71
36	5.653	0.160	1.16	81	1.8	-	71
37	5.814	0.161	1.15	81	1.9	-	71
38	5.976	0.162	1.16	81	1.8	-	71
39	6.137	0.161	1.16	81	1.7	-	71
40	6.299	0.162	1.16	81	1.9	99	71
41	6.461	0.162	1.16	81	1.7	-	71
42	6.622	0.161	1.16	82	1.9	-	71
43	6.785	0.163	1.16	82	1.9	-	71
44	6.948	0.163	1.17	82	1.7	-	71
45	7.109	0.161	1.15	82	1.8	-	71
46	7.272	0.163	1.17	82	1.9	-	71
47	7.434	0.162	1.17	83	1.8	-	71
48	7.596	0.162	1.16	83	1.7	-	71
49	7.760	0.164	1.17	83	1.9	-	71
50	7.922	0.162	1.16	83	1.8	100	71
51	8.085	0.163	1.17	83	1.9	-	71
52	8.248	0.163	1.17	84	1.7	-	71
53	8.411	0.163	1.17	84	1.9	-	71
54	8.575	0.164	1.17	83	1.8	-	71
55	8.737	0.162	1.16	83	1.8	-	71
56	8.901	0.164	1.17	83	1.8	-	71
57	9.063	0.162	1.17	83	1.9	-	71
58	9.228	0.165	1.17	83	1.7	-	72
59	9.392	0.164	1.18	83	1.8	-	72
60	9.555	0.163	1.17	83	1.8	100	71
Avg/Tot	9.555	0.159	1.13	79.0	1.8	99	71.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	328	293	233	195	239	257.7	502.8
1	327	292	234	194	241	257.7	414.4
2	326	290	234	194	242	257.2	380.0
3	324	288	235	193	243	256.5	381.4
4	321	286	235	192	243	255.4	397.4
5	318	284	235	192	243	254.3	415.9
6	316	281	235	190	243	253.0	430.9
7	312	279	235	189	243	251.6	439.3
8	310	276	235	188	243	250.3	444.2
9	307	274	235	187	243	248.9	445.9
10	304	271	235	186	243	247.7	446.4
11	301	268	235	185	242	246.3	446.5
12	298	266	234	184	243	244.9	445.9
13	295	263	234	183	243	243.5	444.8
14	293	261	234	182	243	242.4	443.0
15	290	259	234	181	243	241.1	441.0
16	287	257	233	180	242	239.8	439.3
17	284	254	233	179	242	238.5	437.7
18	282	252	233	177	242	237.2	436.7
19	279	250	232	177	242	235.9	435.3
20	276	248	232	176	242	234.8	433.3
21	274	246	232	176	241	233.7	431.4
22	272	244	231	175	241	232.7	429.2
23	270	242	231	175	241	231.6	425.7
24	267	241	231	173	241	230.4	422.8
25	265	239	230	173	240	229.4	419.7
26	263	237	230	171	240	228.2	416.7
27	261	235	229	171	240	227.2	413.9
28	259	233	229	170	240	226.1	411.5
29	257	231	228	169	239	224.9	409.2
30	255	229	228	169	239	223.9	407.0
31	253	228	227	168	239	222.9	405.4
32	251	226	227	167	239	221.9	403.3
33	250	225	226	166	238	220.9	401.7
34	248	223	226	166	238	220.1	400.9
35	246	222	226	165	237	219.2	400.0
36	245	220	225	164	237	218.1	398.9
37	243	219	224	164	236	217.1	399.0
38	241	218	224	164	236	216.5	399.5
39	240	217	224	163	235	215.6	401.0
40	239	216	223	163	234	214.9	403.8
41	238	214	223	162	233	214.1	408.1
42	237	213	222	162	232	213.4	412.8
43	236	212	222	162	232	212.6	417.1
44	234	211	221	161	231	211.8	421.2
45	233	210	221	161	230	211.1	424.9
46	232	209	220	161	230	210.4	428.4
47	231	208	220	161	229	209.8	430.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	230	207	219	160	228	209.0	432.6
49	229	206	219	160	228	208.3	433.1
50	228	206	218	160	227	207.7	433.8
51	227	205	218	160	226	207.1	434.0
52	226	204	217	160	226	206.5	434.1
53	225	203	217	160	225	205.9	434.5
54	224	203	216	160	225	205.4	434.9
55	223	202	216	160	224	205.0	435.8
56	222	202	215	160	224	204.4	436.7
57	222	201	215	160	223	204.0	436.9
58	221	200	214	160	223	203.6	437.5
59	220	200	214	160	222	203.1	437.4
60	220	199	213	160	221	202.6	437.4
61	219	199	213	160	221	202.1	437.2
62	218	198	212	160	220	201.8	436.7
63	218	198	212	160	219	201.2	436.4
64	217	197	211	160	219	200.8	436.6
65	216	197	211	160	218	200.3	436.8
66	216	196	210	160	217	199.9	437.0
67	216	195	210	160	217	199.5	437.7
68	215	195	210	160	216	199.1	438.6
69	214	195	209	160	215	198.7	440.1
70	214	194	209	160	215	198.4	442.2
71	213	194	208	160	214	197.9	444.4
72	213	193	208	160	214	197.6	446.9
73	213	193	208	160	213	197.3	449.8
74	212	193	207	161	213	197.0	451.8
75	212	193	207	161	212	196.9	454.8
76	211	192	207	161	211	196.4	457.9
77	211	192	206	161	211	196.1	461.2
78	211	192	206	161	210	195.8	464.5
79	211	191	205	161	209	195.6	468.1
80	210	191	205	161	209	195.3	471.7
81	210	191	205	162	208	195.1	475.2
82	210	191	204	162	208	194.9	479.4
83	210	191	204	162	208	194.7	482.9
84	210	191	204	163	207	194.8	487.0
85	209	190	204	163	207	194.5	490.6
86	209	190	203	163	206	194.3	493.8
87	209	190	203	164	206	194.1	496.8
88	209	190	203	164	205	194.1	498.9
89	209	190	202	164	205	194.0	501.5
90	209	190	202	165	204	194.0	503.1
91	209	190	202	165	204	193.8	504.7
92	209	190	202	166	203	193.8	506.0
93	209	190	201	166	203	193.8	506.8
94	209	190	201	167	202	193.7	508.2
95	209	190	201	167	202	193.7	509.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	209	190	201	168	202	193.7	510.5
97	209	190	201	168	201	193.8	512.1
98	209	190	200	169	201	193.8	513.7
99	209	190	200	169	200	193.7	514.8
100	209	190	200	170	200	193.8	516.0
101	209	190	200	170	200	193.9	517.6
102	209	191	200	171	199	194.0	518.7
103	209	191	200	171	199	194.0	520.2
104	210	191	200	172	199	194.1	521.4
105	210	191	200	173	198	194.1	523.8
106	210	191	199	173	198	194.3	526.0
107	210	191	200	174	198	194.5	528.0
108	211	192	199	174	197	194.5	529.5
109	211	192	199	175	197	194.6	532.0
110	211	192	199	175	196	194.6	534.1
111	211	192	199	175	196	194.7	536.4
112	212	192	199	176	196	194.9	538.7
113	212	193	199	177	196	195.1	541.3
114	212	193	199	177	196	195.3	544.1
115	212	193	199	178	196	195.5	547.4
116	213	193	199	178	195	195.6	549.7
117	213	193	199	179	195	195.9	553.0
118	214	194	199	180	195	196.2	556.6
119	214	194	199	180	195	196.3	560.7
120	215	194	199	180	194	196.6	565.8
121	215	195	199	181	194	196.8	570.7
122	215	195	199	182	194	196.9	576.1
123	216	195	199	182	194	197.1	582.0
124	216	196	199	183	193	197.4	585.8
125	217	196	199	184	193	197.8	589.8
126	217	196	200	184	193	198.1	594.0
127	218	197	200	185	193	198.5	599.0
128	219	197	200	186	192	198.8	604.0
129	219	198	200	187	192	199.1	610.5
130	220	198	200	187	192	199.4	615.9
131	220	199	200	188	192	199.8	622.6
132	221	199	200	189	192	200.2	630.5
133	222	200	200	190	192	200.6	638.6
134	223	201	200	191	192	201.1	647.8
135	224	201	200	192	191	201.6	657.0
136	225	202	200	193	191	202.1	671.0
137	226	202	200	194	191	202.6	685.1
138	226	203	200	196	191	203.1	699.0
139	227	204	199	196	191	203.4	715.5
140	228	205	199	198	190	203.9	735.6
141	230	206	198	199	190	204.6	756.2
142	231	207	198	201	190	205.2	781.9
143	232	208	198	202	190	206.0	799.9

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
144	234	209	198	203	190	206.7	815.8
145	236	210	197	205	190	207.4	829.4
146	237	211	197	207	190	208.3	854.3
147	239	212	196	209	189	209.2	880.6
148	241	213	196	211	189	210.0	903.5
149	243	214	196	214	189	211.0	919.3
150	245	215	195	216	189	212.1	939.9
151	247	217	195	218	189	213.2	955.8
152	249	219	195	220	189	214.3	973.4
153	251	220	195	222	189	215.4	991.4
154	254	222	195	226	189	216.9	1006.7
155	256	223	194	229	189	218.2	1019.0
156	258	227	194	233	189	220.1	984.1
157	263	231	194	236	189	222.5	933.5
158	269	236	194	239	189	225.4	905.0
159	275	242	194	241	189	228.2	895.8
160	282	248	194	243	189	231.1	892.5
161	289	254	194	246	189	234.3	893.7
162	295	260	195	248	189	237.4	896.7
163	302	266	195	249	189	240.2	897.4
164	308	272	195	250	189	242.8	898.9
165	314	278	196	251	189	245.6	900.5
166	319	283	196	252	190	248.2	901.5
167	324	289	197	254	190	250.6	903.1
168	329	293	198	255	190	252.8	903.1
169	333	297	198	256	190	254.9	904.7
170	337	301	199	258	190	257.1	905.8
171	341	305	200	259	190	259.0	906.2
172	345	308	201	260	191	261.0	906.1
173	348	312	202	261	191	262.7	904.9
174	352	315	203	263	191	264.7	906.9
175	355	318	204	264	192	266.5	905.9
176	358	321	205	266	193	268.4	905.9
177	360	323	206	268	193	270.1	906.3
178	363	326	207	268	193	271.5	904.9
179	366	328	208	269	194	272.9	901.2
180	369	330	209	270	194	274.3	898.6
181	372	332	210	271	194	275.8	894.3
182	375	334	211	272	195	277.2	885.6
183	377	335	212	272	195	278.4	877.6
184	379	337	213	272	196	279.5	867.2
185	382	339	214	273	196	281.0	856.5
186	384	340	216	274	197	282.3	840.9
187	387	341	217	274	197	283.2	829.4
188	388	343	218	275	198	284.3	825.0
189	390	343	219	275	199	285.2	824.6
190	391	344	220	276	200	286.0	823.9
191	391	344	221	275	201	286.5	845.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
192	391	344	222	276	202	286.9	876.3
193	390	344	223	275	203	286.9	894.7
194	389	343	225	275	203	287.2	902.4
195	388	343	226	275	204	287.3	906.4
196	388	343	228	276	204	287.5	907.7
197	387	342	230	275	205	287.8	907.3
198	387	342	231	276	206	288.3	902.9
199	386	342	233	275	206	288.4	894.9
200	386	342	236	275	207	289.1	888.0
201	386	341	238	276	208	289.7	882.7
202	386	341	240	275	208	290.0	879.1
203	386	341	242	275	209	290.7	879.1
204	386	341	244	275	210	291.2	877.9
205	386	340	246	275	211	291.7	868.9
206	387	340	249	275	212	292.7	861.5
207	387	340	251	275	213	293.4	856.2
208	388	340	254	276	214	294.3	852.1
209	388	340	256	275	215	294.6	852.0
210	389	339	258	274	215	295.1	852.9
211	390	339	260	273	216	295.6	848.7
212	390	339	262	273	217	296.1	844.7
213	391	339	264	273	218	296.8	843.8
214	392	339	265	272	218	297.3	843.4
215	393	339	267	271	219	297.7	840.2
216	394	339	269	270	220	298.1	838.5
217	394	339	270	270	220	298.7	835.5
218	395	339	272	270	221	299.1	829.8
219	395	339	273	269	222	299.5	825.1
220	396	339	274	270	223	300.1	827.9
221	396	339	276	269	224	300.6	832.5
222	395	339	277	269	225	301.0	837.5
223	396	339	278	268	226	301.2	839.6
224	396	340	279	268	227	301.7	836.2
225	395	340	280	268	227	302.0	830.3
226	395	340	281	267	228	302.2	824.0
227	395	340	282	267	228	302.4	818.5
228	395	340	282	267	229	302.6	814.9
229	395	341	283	265	230	302.8	811.6
230	395	341	284	265	231	303.1	809.2
231	395	341	284	265	232	303.3	807.7
232	395	341	285	263	233	303.3	805.0
233	395	341	285	264	234	303.7	801.8
234	395	341	286	262	234	303.7	799.7
235	395	342	287	261	236	304.1	794.9
236	395	342	287	261	237	304.3	789.8
237	395	342	287	260	239	304.6	786.3
238	395	342	288	260	240	304.8	783.1
239	395	342	288	259	241	305.1	777.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
240	395	343	289	258	242	305.4	773.2
241	396	343	289	258	243	305.8	767.1
242	396	343	289	257	244	305.8	759.9
243	396	344	290	256	245	305.9	755.3
244	395	344	290	255	246	305.8	746.4
245	395	344	290	253	246	305.7	738.0
246	395	344	291	253	247	305.7	730.5
247	393	345	291	252	247	305.6	720.7
248	392	345	291	251	248	305.5	714.3
249	391	345	292	250	249	305.2	708.8
250	390	345	292	248	249	304.8	704.0
251	389	345	292	247	250	304.5	699.7
252	387	345	293	246	250	304.3	694.7
253	386	345	293	245	251	304.1	692.0
254	385	346	293	243	252	303.7	691.0
255	384	346	293	242	252	303.4	687.8
256	383	346	293	241	253	303.1	685.6
257	381	346	293	240	253	302.6	681.8
258	380	346	293	239	254	302.3	677.9
259	379	345	293	237	254	301.9	675.8
260	378	345	293	236	254	301.5	672.2
261	377	345	293	235	255	301.1	667.8
262	376	345	293	235	257	300.9	663.2
263	374	345	293	234	257	300.5	658.0
264	373	344	293	233	257	300.1	652.7
265	372	344	293	231	257	299.4	649.6
266	371	344	293	230	257	299.0	645.5
267	370	343	292	229	258	298.5	641.8
268	369	343	292	228	258	298.1	636.7
269	368	343	292	228	258	297.6	637.5
270	367	343	292	227	258	297.3	635.1
271	366	342	291	226	259	296.8	632.4
272	365	342	291	225	259	296.4	627.7
273	364	342	290	224	260	295.9	626.7
274	363	341	290	224	260	295.6	625.7
275	362	341	290	224	260	295.3	620.9
276	361	341	289	223	261	295.0	615.0
277	360	341	289	223	262	294.9	613.1
278	359	341	288	221	262	294.2	607.5
279	357	341	288	221	263	294.0	607.0
280	357	341	288	219	264	293.3	604.1
281	356	340	287	218	264	292.9	603.8
282	354	340	286	217	264	292.5	599.0
283	354	340	286	217	265	292.1	598.1
284	352	340	285	216	265	291.7	595.8
285	351	340	285	216	266	291.5	592.8
286	350	340	284	216	266	291.2	589.6
287	349	339	284	215	266	290.6	590.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 4

Technician: SJB

Date: 7/10/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
288	348	339	283	214	267	290.1	584.8
289	347	339	283	214	267	289.9	584.3
290	346	339	282	213	268	289.6	582.8
291	345	339	281	213	268	289.2	580.9
292	344	338	281	212	269	288.8	577.9
293	343	338	281	211	269	288.3	574.2
294	342	338	280	210	269	287.8	573.1
295	342	338	279	210	269	287.5	569.8
296	341	337	279	209	269	287.0	567.1
297	340	337	278	208	270	286.6	565.5
298	339	337	278	208	270	286.2	563.8
299	338	336	277	207	270	285.5	562.1
300	337	336	277	207	271	285.5	562.3
301	337	335	276	206	271	285.1	561.5
302	336	335	276	206	271	284.8	560.0
303	336	335	276	206	272	284.6	559.1
304	335	334	275	205	271	284.0	556.6
305	334	334	275	204	271	283.6	556.8
306	334	333	274	204	271	283.2	554.3
307	333	333	274	204	271	282.9	554.2
308	333	332	273	203	271	282.6	558.3
309	332	331	273	202	272	282.1	555.2
310	332	331	273	202	272	281.7	553.8
311	331	331	272	202	272	281.4	555.8
312	330	330	272	201	272	281.0	555.3
313	329	329	272	201	272	280.6	554.9
314	328	329	271	201	272	280.0	554.2
315	327	328	271	200	272	279.7	550.8
316	326	328	270	200	272	279.3	553.4
317	326	327	270	200	273	278.9	553.3
318	325	326	270	200	273	278.6	553.1
319	324	326	269	199	273	278.2	550.7
320	323	326	269	199	273	277.8	548.6
321	322	325	268	199	273	277.4	546.9
322	322	325	268	199	273	277.2	547.3
323	321	324	268	198	272	276.5	548.3
324	320	323	267	198	272	276.0	548.3
325	319	323	267	198	272	275.6	552.8
326	318	322	266	198	272	275.1	554.8
327	317	321	266	197	271	274.5	554.4
328	317	321	266	197	271	273.9	558.3
329	316	320	265	197	270	273.5	558.8
330	315	319	265	196	270	273.0	559.1
331	314	319	265	196	270	272.5	560.1
332	313	318	264	196	269	272.1	560.0
333	313	318	264	196	269	271.8	561.9
334	312	317	263	196	269	271.5	562.8
335	312	317	263	196	268	271.1	564.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul
 Model: F445
 Run #: 4

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/10/2023

Stove ΔT : 11

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
336	311	317	262	196	268	270.7	564.5
337	310	316	262	196	267	270.3	565.3
338	310	316	262	196	267	270.0	564.1
339	309	316	261	196	267	269.8	563.8
340	309	316	261	196	267	269.6	562.8
341	308	315	261	196	266	269.2	564.2
342	308	315	260	196	267	269.0	563.4
Average	302.5	276.5	238.3	210.3	227.4	251.0	632.3

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Model: F445

Run #: 4

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/10/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G608	243.3	243.4	0.1
	B	G609	242.3	242.7	0.4
	C - 1st Hour	G610	241.9	242.1	0.2
	Amb	G611	241.9	241.9	0.0
Probes	A	8A	116632.9	116633.2	0.3
	B	8B	116664.9	116665.1	0.2
	C - 1st Hour	8C	116662.5	116662.6	0.1
O-rings	A	8A	3552.3	3552.8	0.5
	B	8B	3358.0	3358.3	0.3
	C - 1st Hour	8C	3586.7	3586.9	0.2

Placed in Dessicator on:

7/10 - 4:30

Balance Audit (mg):

100.0

100.0

100.0

Filters	A	243.3	7/13 10:00	243.4	7/14 9:00				
	B	242.7	7/13 10:00	242.7	7/14 9:00				
	C - 1st Hour	242.1	7/13 10:00	242.1	7/14 9:00				
	Amb	241.9	7/13 10:00	241.9	7/14 9:00				
Probes	A	116633.0	7/13 10:00	116633.4	7/14 9:00	116633.2	7/17 16:00		
	B	116664.9	7/13 10:00	116665.1	7/14 9:00				
	C - 1st Hour	116662.4	7/13 10:00	116662.6	7/14 9:00				
O-Rings	A	3552.8	7/13 10:00	3552.8	7/14 9:00				
	B	3358.2	7/13 10:00	3358.3	7/14 9:00				
	C - 1st Hour	3586.8	7/13 10:00	3586.9	7/14 9:00				

Train A Aggregate, mg: 0.9

Train B Aggregate, mg: 0.9

Train C Aggregate, mg: 0.5

Ambient, mg: 0.0

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 5 Test Date: 7/11/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): Fully Open
Targeted Burn Category: High

Preburn Notes

Time	Notes
6:20	Started kindling fire with ~6 lbs of fuel, air set to fully open, fan off
6:34	With 1.7 lbs of coals left, added preburn fuel load, door closed immediately, air at test setting, fan on high
7:18	@ 4.35 lbs, stirred coals to ensure uniform charcoalization
7:34	@ 3.02 lbs leveled coal bed in preparation of fuel loading, left fan on, air control at test setting

Test Notes

Test Burn Start Time: 7:35 Test Fuel Loaded by: 25 seconds
Door Closed: 30 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
7:35	Loaded test fuel, door closed immediately, fan on high, air set to test setting
9:34	End of test

Test Burn End Time: 9:34

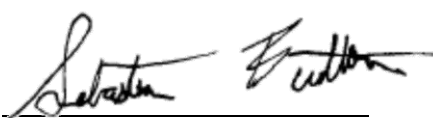
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	6:22	6:28	6:25	16:40	16:35	16:37
CO ₂	0.00	10.16	17.00	-0.04	10.13	16.97
CO	0.000	2.531	4.305	-0.002	2.495	4.288

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

Technician Signature:  Date: 7/12/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 5

Tracking #: 152
Test Date: 7/11/2023



Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: Sebastian E. Sutton

Date: 7/12/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 5 Test Date: 7/11/2023

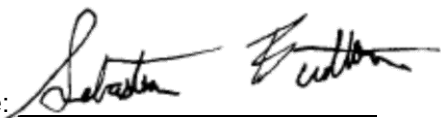
REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



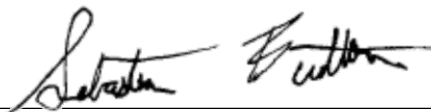
Technician Signature:  Date: 7/12/2023

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 5 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/11/2023



Technician Signature

7/17/2023

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 5

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Burn Rate (kg/hr):	2.80
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	13.882	17.996	17.336	9.459
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.4			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	21509.9			
Average Gas Meter Temperature (°F)	72.4	87.7	88.1	81.8
Total Sample Volume (dscf)	14.112	17.636	16.819	9.113
Average Tunnel Temperature (°F)	109.9			
Total Time of Test (min)	119			
Total Particulate Catch (mg)	0.0	0.9	0.8	0.7
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000510	0.0000476	0.0000768
Total PM Emissions (g)	0.00	2.18	2.03	1.65
Particulate Emission Rate (g/hr)	0.00	1.10	1.02	1.65
Emissions Factor (g/kg)	-	0.39	0.36	-
Difference from Average Total Particulate Emissions (g)	-	0.07	0.07	-
Difference from Average Total Particulate Emissions (%)	-	3.5%	3.5%	-
Difference from Average Emissions Factor (g/kg)	-	0.01	0.01	-

Final Average Results	
Total Particulate Emissions (g)	2.10
Particulate Emission Rate (g/hr)	1.06
Emissions Factor (g/kg)	0.38
HHV Efficiency (%)	68.6%
LHV Efficiency (%)	74.1%
CO Emissions (g/min)	0.98

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	82.3	OK
Face Velocity	< 30 ft/min	8.5	OK
Leakage Rate	Less than 4% of average sample rate	0.001 cfm	OK
Ambient Temp	55-90 °F	Min:71/Max:73.3	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	4.7	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/11/23
Run: 5
Control #: 23-167
Test Duration: 119
Output Category: 4

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	68.6%	74.1%
Combustion Efficiency	98.8%	98.8%
Heat Transfer Efficiency	69.4%	75.0%

Output Rate (kJ/h)	37,657	35,722	(Btu/h)
Burn Rate (kg/h)	2.77	6.11	(lb/h)
Input (kJ/h)	54,920	52,097	(Btu/h)

Test Load Weight (dry kg)	5.50	12.12	dry lb
MC wet (%)	18.78		
MC dry (%)	23.12		
Particulate (g)	2.10		
CO (g)	117		
Test Duration (h)	1.98		

Emissions	Particulate	CO
g/MJ Output	0.03	1.57
g/kg Dry Fuel	0.38	21.31
g/h	1.06	59.08
g/min	0.02	0.98
lb/MM Btu Output	0.07	3.65

Air/Fuel Ratio (A/F)	14.88
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	21.7		2x4	18.25	18.7
2x4	18.25	20.7		2x4	18.25	21.2
2x4	18.25	18.1				
2x4	18.25	21.8				
2x4	18.25	22.3				
2x4	11.00	18.9				
2x4	11.00	19.7				
2x4	11.00	23.3				
Total Fuel Weight (lbs):		13.64	Average Moisture (%DB):		20.6	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 5.42
 Total 4x4 Crib Weight, with spacers (lbs): 9.53
 Total Wet Fuel Weight, with spacers (lbs): 14.95

Coal Bed Range (20-25%):

Min (lbs): 2.99
 Max (lbs): 3.74

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.35	22.6	25.1	23.1	1.90
2x4	18.25	2.25	23.2	20.3	24.4	1.83
4x4	18.25	4.62	22.7	24.5	23.8	3.74
4x4	18.25	4.51	24.9	22.7	20.1	3.68
Total Dry Weight, no spacers (lbs):						11.15
Total Dry Weight, with spacers (lbs):						12.26

Spacer Moisture Readings (%DB)						
8.1	10.5	9.2				
10.1	8.9	10.6				
11.4	10.0	9.5				
7.0	9.8	11.3				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	30.2	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	7.36	OK
2x4 Fuel Mix	35 - 65 % of total weight	36%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 5
 Test Start Time: 7:35

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Total Sampling Time (min): 119
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.96	29.96	29.96
Relative Humidity (%)	44.9	40.3	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:		13.882	ft ³

Sample Train Leak Checks

	Pre-test	Post-test		
Induced Draft Check (in. H ₂ O):	0	(A) 0.000	0.001	cfm @ -5 in. Hg
Smoke Capture Check (%):	100%	(B) 0.000	0.001	cfm @ -5 in. Hg
Date Flue Pipe Last Cleaned:	7/3/2023	(C) 0.001	0.001	cfm @ -5 in. Hg
Test Fuel Scale Audit (lbs)	10.00	(Ambient) 0.000	0.000	cfm @ -5 in. Hg
Platform Scale Audit (lbs)	10.0			

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.012	110
2	0.016	110
3	0.018	110
4	0.020	110
5	0.018	110
6	0.010	110
7	0.012	110
8	0.018	110
9	0.018	110
10	0.016	110
11	0.014	110
12	0.008	110
Center	0.016	110

Dilution Tunnel H₂O: 2.00 percent
 Tunnel Diameter: 12 inches
 Pitot Tube Cp: 0.99 [unitless]
 Dilution Tunnel MW(dry): 29.00 lb/lb-mole
 Dilution Tunnel MW(wet): 28.78 lb/lb-mole
 Tunnel Area: 0.7854 ft²

V_{strav} : 8.37 ft/sec

V_{scent} : 8.71 ft/sec

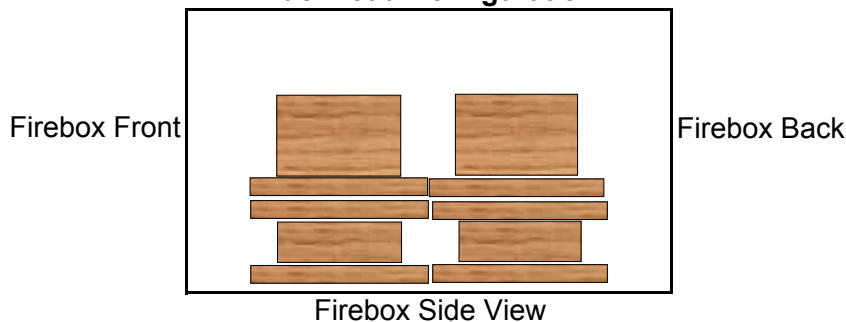
F_p : 0.961 [ratio]

Initial Tunnel Flow: 358.3 scf/min

Static Pressure: -0.095 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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): 23.1

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 5

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Recording Interval (min): 1
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	14.85	-0.082	285	266	145	173	111	195.6	464	69
1	14.76	-0.085	291	271	147	175	113	199.5	416	69
2	14.62	-0.088	295	276	149	178	116	202.5	418	69
3	14.45	-0.090	297	281	150	180	118	205.2	432	69
4	14.30	-0.093	297	286	151	182	121	207.4	447	70
5	14.13	-0.094	297	289	153	183	123	209.0	458	69
6	13.97	-0.094	298	290	154	185	126	210.6	466	70
7	13.80	-0.096	299	291	156	187	129	212.2	470	69
8	13.64	-0.094	300	291	158	189	131	213.8	471	69
9	13.48	-0.096	302	292	159	191	134	215.7	475	69
10	13.31	-0.094	303	292	161	194	138	217.6	477	69
11	13.14	-0.096	304	293	162	197	140	219.4	480	70
12	12.96	-0.096	306	294	163	201	144	221.4	487	70
13	12.75	-0.100	307	295	164	205	147	223.4	498	70
14	12.55	-0.101	308	296	165	208	151	225.7	510	70
15	12.33	-0.101	311	298	166	213	154	228.2	521	70
16	12.09	-0.102	313	301	166	217	157	230.8	533	70
17	11.84	-0.103	316	304	167	221	161	233.8	545	71
18	11.58	-0.106	320	308	168	225	165	237.0	556	71
19	11.32	-0.105	325	311	168	229	169	240.3	567	71
20	11.05	-0.106	330	315	168	234	173	244.1	574	71
21	10.57	-0.106	336	319	169	239	177	248.0	572	71
22	10.28	-0.109	343	323	169	244	182	252.0	571	71
23	9.99	-0.109	350	327	170	248	187	256.3	578	71
24	9.69	-0.110	356	332	170	253	192	260.6	586	71
25	9.39	-0.109	363	337	171	258	197	265.1	590	71
26	9.07	-0.110	370	341	171	264	202	269.7	589	71
27	9.00	-0.110	377	348	172	267	208	274.3	595	71
28	8.67	-0.108	383	354	173	272	213	279.2	602	71
29	8.36	-0.110	390	361	174	277	219	284.0	605	71
30	8.05	-0.109	397	368	175	282	226	289.3	611	72
31	7.73	-0.108	403	374	176	286	232	294.2	609	71
32	7.42	-0.112	410	380	177	291	239	299.2	606	72
33	7.13	-0.109	417	386	178	295	245	304.1	606	72
34	6.84	-0.108	424	392	179	298	252	308.9	605	72
35	6.57	-0.108	431	398	180	302	259	314.0	607	72
36	6.30	-0.109	438	403	182	305	266	318.6	607	71
37	6.04	-0.107	445	408	183	308	273	323.7	604	72
38	5.77	-0.108	453	413	185	311	280	328.5	603	72
39	5.52	-0.106	460	418	186	314	288	333.1	600	72
40	5.28	-0.106	466	423	188	317	295	337.8	600	72
41	5.04	-0.107	472	427	190	319	302	342.1	597	72
42	4.80	-0.106	478	432	192	321	309	346.5	597	72
43	4.57	-0.109	484	437	194	323	317	350.8	595	72
44	4.35	-0.107	489	442	196	326	324	355.4	592	72

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Recording Interval (min): 1
 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
45	4.12	-0.103	494	448	199	327	329	359.3	626	72
46	3.96	-0.104	498	454	201	329	332	363.0	585	72
47	3.83	-0.103	503	461	204	330	334	366.2	571	72
48	3.73	-0.100	505	467	206	331	337	369.0	557	71
49	3.64	-0.097	507	473	209	330	339	371.5	545	71
50	3.54	-0.096	507	478	212	330	340	373.3	532	71
51	3.46	-0.093	507	483	215	329	341	374.9	522	71
52	3.40	-0.095	507	486	218	327	343	376.2	515	71
53	3.34	-0.094	506	489	220	326	345	377.1	507	71
54	3.29	-0.091	504	492	223	325	346	378.0	500	72
55	3.24	-0.090	502	494	226	322	348	378.2	490	72
56	3.20	-0.088	500	495	228	320	350	378.5	485	72
57	3.16	-0.090	498	495	231	317	350	378.2	479	72
58	3.11	-0.090	495	496	233	314	351	378.0	474	72
59	3.07	-0.088	493	496	235	312	352	377.5	468	72
60	3.02	-0.087	490	496	237	309	352	376.7	463	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 5

Technician: SJB

Date: 7/11/2023

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		0.016	1.23	75	0.8		14.92		118	478	73	72
1	0.137	0.137	0.016	1.93	75	0.8	-	14.87	-0.05	122	436	75	72
2	0.279	0.142	0.016	1.95	75	0.9	-	14.73	-0.14	111	425	76	72
3	0.416	0.137	0.016	1.99	75	0.9	-	14.60	-0.13	108	450	76	72
4	0.561	0.145	0.016	2.00	75	0.9	-	14.46	-0.14	108	464	76	72
5	0.701	0.140	0.016	2.03	75	0.9	-	14.32	-0.14	108	472	76	72
6	0.845	0.144	0.016	2.05	75	0.9	-	14.19	-0.13	108	475	76	72
7	0.988	0.143	0.016	2.06	76	0.9	-	14.05	-0.14	108	474	77	72
8	1.131	0.143	0.016	2.08	76	0.9	-	13.92	-0.13	108	475	77	72
9	1.278	0.147	0.016	2.09	76	0.9	-	13.78	-0.14	108	478	77	72
10	1.420	0.142	0.016	2.11	76	0.9	96	13.63	-0.15	108	479	77	72
11	1.567	0.147	0.016	2.12	76	0.8	-	13.47	-0.16	108	483	78	72
12	1.710	0.143	0.016	2.14	76	0.9	-	13.32	-0.15	107	488	78	71
13	1.859	0.149	0.016	2.15	76	0.9	-	13.15	-0.17	109	493	78	72
14	2.003	0.144	0.016	2.16	77	0.9	-	12.98	-0.17	109	497	78	72
15	2.151	0.148	0.016	2.16	77	0.9	-	12.80	-0.18	109	502	78	72
16	2.295	0.144	0.016	2.17	77	0.9	-	12.61	-0.19	109	509	79	71
17	2.442	0.147	0.016	2.19	77	0.9	-	12.42	-0.19	110	520	79	72
18	2.589	0.147	0.016	2.19	77	0.9	-	12.22	-0.20	111	527	79	72
19	2.736	0.147	0.016	2.19	78	0.9	-	12.02	-0.20	111	532	79	72
20	2.885	0.149	0.016	2.20	78	0.9	99	11.81	-0.21	112	537	79	72
21	3.032	0.147	0.016	2.22	78	0.9	-	11.58	-0.23	113	545	79	72
22	3.182	0.150	0.016	2.22	79	0.9	-	11.37	-0.21	114	550	79	72
23	3.329	0.147	0.016	2.23	79	0.9	-	11.13	-0.24	115	554	80	72
24	3.479	0.150	0.016	2.23	79	0.9	-	10.90	-0.23	115	558	80	72
25	3.625	0.146	0.016	2.24	79	0.9	-	10.68	-0.22	116	559	80	72
26	3.776	0.151	0.016	2.22	80	0.9	-	10.44	-0.24	116	560	80	72
27	3.922	0.146	0.015	2.23	80	0.9	-	10.19	-0.25	117	564	80	72
28	4.074	0.152	0.016	2.25	80	0.9	-	9.96	-0.23	117	565	80	72
29	4.221	0.147	0.016	2.25	81	0.9	-	9.71	-0.25	118	565	81	71
30	4.373	0.152	0.015	2.24	81	0.9	102	9.48	-0.23	119	566	81	72
31	4.520	0.147	0.016	2.26	81	0.9	-	9.24	-0.24	119	568	81	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 5

Technician: SJB

Date: 7/11/2023

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
32	4.672	0.152	0.016	2.26	82	0.9	-	9.02	-0.22	119	571	81	72
33	4.819	0.147	0.015	2.26	82	0.9	-	8.77	-0.25	119	574	81	72
34	4.971	0.152	0.016	2.26	82	0.9	-	8.55	-0.22	119	577	81	72
35	5.118	0.147	0.016	2.26	83	0.9	-	8.32	-0.23	119	578	82	72
36	5.271	0.153	0.016	2.27	83	0.9	-	8.10	-0.22	119	579	82	72
37	5.418	0.147	0.016	2.27	83	0.9	-	7.88	-0.22	119	578	82	73
38	5.571	0.153	0.016	2.26	83	0.9	-	7.66	-0.22	120	577	82	73
39	5.718	0.147	0.016	2.28	84	0.9	-	7.45	-0.21	120	578	82	73
40	5.871	0.153	0.016	2.27	84	1.0	102	7.23	-0.22	119	579	82	73
41	6.019	0.148	0.016	2.27	84	0.9	-	7.02	-0.21	119	579	82	73
42	6.172	0.153	0.016	2.27	85	0.9	-	6.81	-0.21	119	578	82	73
43	6.319	0.147	0.016	2.27	85	1.0	-	6.62	-0.19	119	576	82	73
44	6.473	0.154	0.016	2.28	85	1.0	-	6.43	-0.19	118	572	82	72
45	6.620	0.147	0.016	2.28	86	1.0	-	6.25	-0.18	118	569	82	72
46	6.774	0.154	0.016	2.28	86	0.9	-	6.07	-0.18	118	565	82	73
47	6.922	0.148	0.016	2.27	86	0.9	-	5.90	-0.17	118	561	82	73
48	7.075	0.153	0.016	2.29	86	0.9	-	5.73	-0.17	118	555	82	72
49	7.224	0.149	0.016	2.30	87	1.0	-	5.57	-0.16	118	549	82	73
50	7.377	0.153	0.016	2.30	87	0.9	101	5.42	-0.15	116	544	82	73
51	7.526	0.149	0.016	2.30	87	1.0	-	5.28	-0.14	115	539	82	73
52	7.679	0.153	0.016	2.29	87	0.9	-	5.14	-0.14	116	534	82	73
53	7.828	0.149	0.016	2.29	88	1.0	-	5.00	-0.14	115	533	82	73
54	7.981	0.153	0.016	2.29	88	0.9	-	4.86	-0.14	115	529	82	73
55	8.132	0.151	0.016	2.30	88	1.0	-	4.72	-0.14	114	526	82	73
56	8.284	0.152	0.016	2.30	89	1.0	-	4.60	-0.12	113	521	82	73
57	8.435	0.151	0.015	2.30	89	1.0	-	4.46	-0.14	114	518	82	72
58	8.588	0.153	0.016	2.31	89	0.9	-	4.35	-0.11	113	516	82	73
59	8.741	0.153	0.016	2.30	89	1.0	-	4.22	-0.13	113	513	82	72
60	8.892	0.151	0.016	2.31	89	0.9	101	4.10	-0.12	112	512	82	73
61	9.046	0.154	0.016	2.32	90	1.0	-	3.96	-0.14	112	511	82	72
62	9.197	0.151	0.016	2.31	90	1.0	-	3.83	-0.13	112	511	82	73
63	9.352	0.155	0.016	2.32	90	1.0	-	3.71	-0.12	112	511	82	73

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 5

Technician: SJB

Date: 7/11/2023

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
64	9.501	0.149	0.016	2.32	90	1.0	-	3.58	-0.13	112	510	82	72
65	9.656	0.155	0.016	2.32	90	1.0	-	3.46	-0.12	112	509	82	73
66	9.806	0.150	0.016	2.32	91	1.0	-	3.35	-0.11	112	506	82	73
67	9.961	0.155	0.015	2.32	91	1.0	-	3.24	-0.11	112	502	82	73
68	10.112	0.151	0.016	2.32	91	1.0	-	3.14	-0.10	112	498	82	73
69	10.268	0.156	0.016	2.33	91	1.0	-	3.05	-0.09	110	496	82	73
70	10.419	0.151	0.016	2.32	91	1.0	101	2.96	-0.09	110	491	82	73
71	10.575	0.156	0.016	2.33	92	1.0	-	2.87	-0.09	109	487	82	73
72	10.725	0.150	0.016	2.34	92	1.0	-	2.77	-0.10	109	483	82	73
73	10.879	0.154	0.016	2.33	92	1.0	-	2.68	-0.09	108	479	82	73
74	11.032	0.153	0.016	2.33	92	1.0	-	2.58	-0.10	108	477	82	73
75	11.186	0.154	0.016	2.33	92	1.0	-	2.51	-0.07	108	474	82	73
76	11.340	0.154	0.016	2.33	93	1.0	-	2.43	-0.08	108	471	82	73
77	11.493	0.153	0.016	2.34	93	1.0	-	2.33	-0.10	108	471	82	73
78	11.649	0.156	0.016	2.34	93	1.0	-	2.25	-0.08	108	470	82	73
79	11.799	0.150	0.016	2.33	93	1.0	-	2.17	-0.08	107	469	82	73
80	11.956	0.157	0.016	2.33	93	1.0	101	2.08	-0.09	107	468	82	73
81	12.106	0.150	0.016	2.33	94	1.0	-	1.99	-0.09	106	469	82	73
82	12.265	0.159	0.017	2.34	94	1.0	-	1.90	-0.09	106	469	82	73
83	12.416	0.151	0.016	2.34	94	1.0	-	1.81	-0.09	106	469	82	73
84	12.573	0.157	0.016	2.35	94	1.0	-	1.72	-0.09	106	467	82	73
85	12.724	0.151	0.016	2.34	94	1.0	-	1.63	-0.09	106	466	82	73
86	12.880	0.156	0.016	2.35	94	1.0	-	1.55	-0.08	106	463	81	73
87	13.033	0.153	0.016	2.34	94	1.0	-	1.48	-0.07	106	462	81	73
88	13.188	0.155	0.016	2.34	94	1.0	-	1.40	-0.08	105	461	81	73
89	13.344	0.156	0.017	2.34	95	1.0	-	1.32	-0.08	104	462	81	73
90	13.497	0.153	0.016	2.35	95	1.0	100	1.24	-0.08	105	460	81	72
91	13.653	0.156	0.016	2.34	95	1.0	-	1.17	-0.07	104	460	81	72
92	13.804	0.151	0.016	2.35	95	1.0	-	1.10	-0.07	105	460	81	72
93	13.963	0.159	0.016	2.34	95	1.0	-	1.04	-0.06	106	458	81	72
94	14.115	0.152	0.016	2.35	95	0.9	-	0.99	-0.05	105	453	81	73
95	14.272	0.157	0.016	2.35	95	1.0	-	0.93	-0.06	105	450	81	72

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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
96	14.424	0.152	0.016	2.34	96	1.0	-	0.88	-0.05	104	445	81	72
97	14.580	0.156	0.017	2.35	96	1.0	-	0.83	-0.05	103	443	81	72
98	14.735	0.155	0.017	2.36	96	1.0	-	0.79	-0.04	102	440	81	72
99	14.890	0.155	0.017	2.35	96	1.0	-	0.74	-0.05	102	438	81	72
100	15.047	0.157	0.016	2.36	96	1.0	101	0.69	-0.05	102	436	81	72
101	15.198	0.151	0.016	2.35	96	1.0	-	0.62	-0.07	103	435	81	72
102	15.356	0.158	0.016	2.35	96	1.0	-	0.59	-0.03	103	431	81	72
103	15.509	0.153	0.016	2.36	96	1.0	-	0.55	-0.04	103	429	81	72
104	15.667	0.158	0.016	2.35	96	1.0	-	0.52	-0.03	102	427	81	72
105	15.820	0.153	0.016	2.36	96	1.0	-	0.47	-0.05	102	423	81	72
106	15.976	0.156	0.016	2.36	97	1.0	-	0.43	-0.04	102	420	81	72
107	16.130	0.154	0.017	2.35	97	1.0	-	0.40	-0.03	101	420	81	72
108	16.286	0.156	0.016	2.36	97	1.0	-	0.37	-0.03	101	417	81	73
109	16.443	0.157	0.016	2.35	97	1.0	-	0.33	-0.04	101	415	80	72
110	16.596	0.153	0.016	2.36	97	1.0	100	0.30	-0.03	101	413	80	73
111	16.754	0.158	0.016	2.36	97	1.0	-	0.26	-0.04	101	411	80	73
112	16.907	0.153	0.016	2.35	97	1.0	-	0.23	-0.03	102	410	80	73
113	17.066	0.159	0.015	2.37	97	1.0	-	0.18	-0.05	102	410	80	72
114	17.219	0.153	0.016	2.37	97	1.0	-	0.16	-0.02	101	409	80	73
115	17.376	0.157	0.016	2.36	97	1.0	-	0.12	-0.04	100	406	80	73
116	17.530	0.154	0.017	2.36	97	1.0	-	0.10	-0.02	100	407	80	73
117	17.687	0.157	0.017	2.36	98	1.0	-	0.06	-0.04	100	406	80	73
118	17.844	0.157	0.016	2.36	98	1.0	-	0.02	-0.04	100	405	80	73
119	17.996	0.152	0.016	2.36	98	1.0	100	0.00	-0.02	101	404	80	73
Avg/Tot	17.996	0.151	0.016	2.27	87.7	0.9	100			109.9	493.7	80.6	72.4

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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		1.48	76	1.8		76	-0.082	4.26	0.051
1	0.138	0.138	2.10	76	1.8	-	76	-0.078	2.59	0.070
2	0.282	0.144	2.10	76	1.7	-	77	-0.087	5.55	0.026
3	0.424	0.142	2.10	76	1.9	-	77	-0.091	6.51	0.022
4	0.569	0.145	2.11	76	1.8	-	77	-0.091	6.43	0.022
5	0.708	0.139	2.11	76	1.9	-	77	-0.090	6.61	0.025
6	0.854	0.146	2.11	76	1.8	-	77	-0.091	6.58	0.022
7	0.996	0.142	2.12	77	1.6	-	78	-0.092	6.69	0.023
8	1.139	0.143	2.12	77	1.9	-	78	-0.091	6.79	0.026
9	1.281	0.142	2.12	77	2.0	-	78	-0.093	6.85	0.021
10	1.423	0.142	2.11	77	2.0	100	78	-0.093	7.16	0.024
11	1.568	0.145	2.12	77	1.9	-	78	-0.093	7.44	0.023
12	1.710	0.142	2.12	77	1.4	-	78	-0.095	7.77	0.019
13	1.855	0.145	2.12	78	1.5	-	78	-0.095	8.02	0.026
14	1.995	0.140	2.11	78	1.5	-	79	-0.097	8.23	0.025
15	2.141	0.146	2.12	78	1.7	-	79	-0.097	8.38	0.026
16	2.284	0.143	2.12	78	2.0	-	79	-0.097	8.70	0.033
17	2.428	0.144	2.12	78	1.5	-	79	-0.097	9.51	0.097
18	2.571	0.143	2.13	79	1.5	-	79	-0.098	9.53	0.134
19	2.713	0.142	2.12	79	1.4	-	79	-0.100	9.70	0.125
20	2.859	0.146	2.13	79	2.0	100	79	-0.099	9.85	0.143
21	3.002	0.143	2.13	79	1.9	-	79	-0.102	10.39	0.160
22	3.148	0.146	2.13	80	2.0	-	79	-0.101	10.47	0.231
23	3.289	0.141	2.13	80	1.9	-	80	-0.102	10.49	0.410
24	3.435	0.146	2.13	80	1.6	-	79	-0.100	10.58	0.536
25	3.577	0.142	2.13	80	1.9	-	79	-0.102	10.76	0.533
26	3.724	0.147	2.13	81	1.6	-	80	-0.103	10.57	0.742
27	3.867	0.143	2.13	81	1.6	-	80	-0.104	10.98	0.872
28	4.011	0.144	2.13	81	1.5	-	80	-0.102	10.77	0.924
29	4.155	0.144	2.13	81	1.9	-	80	-0.102	10.69	0.767
30	4.299	0.144	2.13	81	1.6	102	80	-0.101	10.90	0.736
31	4.445	0.146	2.13	82	1.9	-	80	-0.102	10.84	0.685

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
32	4.588	0.143	2.14	82	1.5	-	80	-0.103	10.88	0.592
33	4.734	0.146	2.13	82	1.9	-	80	-0.102	11.04	0.570
34	4.876	0.142	2.13	82	1.7	-	80	-0.106	11.07	0.644
35	5.023	0.147	2.12	83	2.0	-	80	-0.104	10.97	0.500
36	5.166	0.143	2.13	84	1.6	-	81	-0.105	10.92	0.540
37	5.312	0.146	2.12	84	2.0	-	81	-0.105	11.01	0.492
38	5.456	0.144	2.13	84	2.0	-	81	-0.104	11.01	0.493
39	5.602	0.146	2.13	85	1.7	-	81	-0.105	10.99	0.437
40	5.746	0.144	2.13	85	1.5	103	81	-0.103	11.00	0.423
41	5.890	0.144	2.13	86	2.0	-	81	-0.105	11.00	0.361
42	6.036	0.146	2.12	86	1.8	-	81	-0.103	10.89	0.267
43	6.179	0.143	2.13	86	1.5	-	81	-0.105	10.75	0.153
44	6.327	0.148	2.13	86	2.0	-	81	-0.103	10.52	0.162
45	6.470	0.143	2.13	86	1.6	-	81	-0.101	10.40	0.168
46	6.617	0.147	2.13	87	1.6	-	81	-0.101	10.15	0.108
47	6.760	0.143	2.13	87	1.9	-	81	-0.100	9.97	0.063
48	6.907	0.147	2.13	87	1.5	-	81	-0.099	9.78	0.036
49	7.050	0.143	2.13	88	1.8	-	82	-0.098	9.54	0.020
50	7.198	0.148	2.14	88	2.0	101	82	-0.099	9.25	0.024
51	7.342	0.144	2.13	88	2.0	-	82	-0.101	8.91	0.024
52	7.490	0.148	2.14	88	1.5	-	82	-0.097	8.77	0.023
53	7.634	0.144	2.13	88	2.0	-	82	-0.099	8.91	0.023
54	7.780	0.146	2.14	89	1.8	-	82	-0.095	8.63	0.027
55	7.926	0.146	2.14	89	1.5	-	82	-0.096	8.43	0.021
56	8.070	0.144	2.14	89	1.8	-	82	-0.097	8.35	0.019
57	8.217	0.147	2.14	89	1.5	-	82	-0.096	8.45	0.022
58	8.363	0.146	2.14	89	1.6	-	82	-0.094	8.63	0.021
59	8.510	0.147	2.14	89	1.7	-	82	-0.096	8.71	0.020
60	8.655	0.145	2.15	89	1.7	100	82	-0.094	8.74	0.021
61	8.804	0.149	2.15	90	2.0	-	82	-0.094	8.87	0.045
62	8.947	0.143	2.15	90	1.8	-	82	-0.092	8.91	0.054
63	9.095	0.148	2.15	90	2.0	-	82	-0.094	8.90	0.043

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
64	9.239	0.144	2.14	91	1.9	-	82	-0.095	8.81	0.025
65	9.388	0.149	2.14	91	1.5	-	82	-0.097	8.60	0.025
66	9.531	0.143	2.14	91	2.0	-	82	-0.093	8.35	0.023
67	9.679	0.148	2.15	91	1.8	-	82	-0.092	8.09	0.019
68	9.824	0.145	2.15	91	1.8	-	82	-0.093	7.89	0.018
69	9.972	0.148	2.15	91	2.0	-	82	-0.092	7.71	0.018
70	10.117	0.145	2.15	92	1.9	100	82	-0.093	7.62	0.021
71	10.266	0.149	2.15	92	2.0	-	82	-0.092	7.50	0.022
72	10.411	0.145	2.15	93	1.5	-	82	-0.093	7.38	0.022
73	10.558	0.147	2.15	93	2.0	-	82	-0.089	7.34	0.019
74	10.704	0.146	2.15	93	2.0	-	82	-0.090	7.27	0.020
75	10.850	0.146	2.15	93	2.0	-	82	-0.090	7.20	0.022
76	10.998	0.148	2.15	93	1.5	-	82	-0.089	7.24	0.020
77	11.143	0.145	2.15	93	1.5	-	82	-0.089	7.29	0.019
78	11.291	0.148	2.15	94	2.0	-	82	-0.090	7.28	0.020
79	11.437	0.146	2.15	94	1.5	-	82	-0.089	7.37	0.018
80	11.585	0.148	2.16	93	2.0	100	82	-0.089	7.43	0.025
81	11.730	0.145	2.16	94	1.8	-	82	-0.089	7.54	0.021
82	11.879	0.149	2.16	94	1.7	-	82	-0.089	7.56	0.024
83	12.025	0.146	2.16	95	2.0	-	82	-0.089	7.51	0.020
84	12.175	0.150	2.15	95	1.6	-	82	-0.087	7.67	0.016
85	12.319	0.144	2.16	95	1.6	-	82	-0.090	7.72	0.022
86	12.468	0.149	2.16	95	1.7	-	82	-0.087	7.67	0.023
87	12.613	0.145	2.15	95	1.8	-	82	-0.089	7.56	0.017
88	12.763	0.150	2.16	95	1.5	-	82	-0.088	7.33	0.018
89	12.907	0.144	2.16	95	1.5	-	82	-0.091	7.36	0.018
90	13.057	0.150	2.16	95	2.0	100	81	-0.087	7.45	0.016
91	13.201	0.144	2.16	95	1.5	-	81	-0.086	7.45	0.017
92	13.351	0.150	2.16	95	1.6	-	81	-0.087	7.29	0.021
93	13.496	0.145	2.15	95	2.0	-	81	-0.085	7.06	0.014
94	13.645	0.149	2.16	95	1.5	-	81	-0.089	6.78	0.016
95	13.791	0.146	2.16	95	1.6	-	81	-0.085	6.65	0.021

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
96	13.940	0.149	2.16	95	1.5	-	81	-0.084	6.55	0.023
97	14.086	0.146	2.16	95	1.5	-	81	-0.086	6.53	0.021
98	14.235	0.149	2.16	96	2.0	-	81	-0.083	6.57	0.020
99	14.381	0.146	2.16	96	1.7	-	81	-0.083	6.60	0.019
100	14.530	0.149	2.17	96	2.0	99	81	-0.082	6.61	0.017
101	14.677	0.147	2.16	96	1.5	-	81	-0.087	6.53	0.021
102	14.826	0.149	2.16	96	1.6	-	81	-0.083	6.44	0.020
103	14.972	0.146	2.16	96	2.0	-	81	-0.081	6.31	0.021
104	15.120	0.148	2.16	96	2.0	-	81	-0.081	6.14	0.021
105	15.267	0.147	2.16	96	2.0	-	81	-0.084	6.06	0.022
106	15.415	0.148	2.16	96	1.6	-	81	-0.083	6.01	0.021
107	15.563	0.148	2.16	96	1.9	-	81	-0.081	5.93	0.021
108	15.710	0.147	2.17	96	2.0	-	81	-0.079	5.93	0.020
109	15.858	0.148	2.16	96	1.6	-	81	-0.080	5.94	0.022
110	16.005	0.147	2.17	97	1.5	99	81	-0.082	5.98	0.019
111	16.153	0.148	2.16	97	1.5	-	81	-0.081	5.95	0.029
112	16.300	0.147	2.16	97	1.6	-	81	-0.081	5.84	0.025
113	16.449	0.149	2.17	97	1.8	-	80	-0.079	5.79	0.024
114	16.595	0.146	2.16	97	1.6	-	81	-0.082	5.76	0.022
115	16.744	0.149	2.15	97	1.9	-	80	-0.081	5.77	0.023
116	16.891	0.147	2.16	97	1.8	-	81	-0.081	5.74	0.022
117	17.040	0.149	2.16	97	2.0	-	81	-0.081	5.69	0.024
118	17.187	0.147	2.16	97	2.0	-	80	-0.079	5.71	0.023
119	17.336	0.149	2.17	97	1.7	99	81	-0.078	5.72	0.025
Avg/Tot	17.336	0.146	2.14	88.1	1.8	100	80.5	-0.092	8.10	0.126

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 5

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.001		0.67	77	1.7		74
1	0.152	0.151	1.04	76	1.7	-	74
2	0.304	0.152	1.05	76	1.7	-	75
3	0.456	0.152	1.06	76	1.8	-	75
4	0.608	0.152	1.06	77	1.7	-	75
5	0.761	0.153	1.07	77	1.9	-	76
6	0.915	0.154	1.07	77	1.8	-	75
7	1.069	0.154	1.08	77	1.8	-	76
8	1.224	0.155	1.09	77	1.9	-	76
9	1.379	0.155	1.09	77	1.9	-	76
10	1.534	0.155	1.09	78	1.9	98	76
11	1.689	0.155	1.09	77	1.8	-	76
12	1.843	0.154	1.09	78	1.9	-	77
13	1.998	0.155	1.09	78	1.8	-	77
14	2.154	0.156	1.09	79	1.9	-	77
15	2.310	0.156	1.09	79	1.8	-	78
16	2.467	0.157	1.10	79	1.8	-	77
17	2.623	0.156	1.10	79	1.9	-	78
18	2.779	0.156	1.11	80	1.8	-	78
19	2.935	0.156	1.11	80	1.8	-	78
20	3.091	0.156	1.10	80	1.9	99	78
21	3.247	0.156	1.10	80	1.7	-	78
22	3.404	0.157	1.10	81	1.9	-	79
23	3.562	0.158	1.11	81	1.8	-	79
24	3.719	0.157	1.12	81	1.7	-	79
25	3.877	0.158	1.12	81	1.9	-	78
26	4.033	0.156	1.11	81	1.8	-	79
27	4.191	0.158	1.11	81	1.9	-	79
28	4.349	0.158	1.11	81	1.9	-	79
29	4.507	0.158	1.12	81	1.8	-	79
30	4.666	0.159	1.13	81	1.7	102	78
31	4.823	0.157	1.12	81	1.8	-	79

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 5

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Elapsed Time (min)	Particulate Sampling 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)
32	4.982	0.159	1.12	81	1.8	-	79
33	5.141	0.159	1.13	82	2.0	-	79
34	5.300	0.159	1.13	82	1.8	-	79
35	5.457	0.157	1.13	83	1.8	-	79
36	5.616	0.159	1.12	83	1.8	-	80
37	5.776	0.160	1.13	84	1.9	-	80
38	5.935	0.159	1.13	84	1.8	-	80
39	6.093	0.158	1.13	84	1.8	-	81
40	6.253	0.160	1.12	85	1.8	103	81
41	6.413	0.160	1.13	85	1.9	-	81
42	6.573	0.160	1.14	85	2.0	-	81
43	6.731	0.158	1.13	85	1.9	-	81
44	6.891	0.160	1.13	85	1.8	-	81
45	7.051	0.160	1.13	85	1.9	-	81
46	7.211	0.160	1.14	85	2.0	-	81
47	7.370	0.159	1.13	86	1.9	-	81
48	7.531	0.161	1.13	85	1.8	-	81
49	7.692	0.161	1.14	86	2.0	-	81
50	7.850	0.158	1.14	87	1.8	101	81
51	8.012	0.162	1.13	86	2.0	-	81
52	8.173	0.161	1.14	87	1.9	-	81
53	8.332	0.159	1.14	86	1.8	-	81
54	8.493	0.161	1.14	87	1.9	-	81
55	8.655	0.162	1.15	87	1.9	-	81
56	8.815	0.160	1.14	87	1.8	-	81
57	8.976	0.161	1.14	87	1.8	-	81
58	9.138	0.162	1.15	87	1.9	-	80
59	9.298	0.160	1.14	87	1.9	-	80
60	9.460	0.162	1.14	87	1.9	102	80
Avg/Tot	9.459	0.158	1.11	81.8	1.8	101	78.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 5

Technician: SJB

Date: 7/11/2023

Stove ΔT: 5

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	487	494	240	306	353	375.9	770.3
1	484	492	243	303	353	374.7	626.4
2	479	487	245	300	352	372.5	733.7
3	473	481	246	297	350	369.0	851.0
4	467	474	246	294	349	365.9	894.5
5	460	467	247	291	348	362.5	906.4
6	453	461	247	288	346	359.0	908.5
7	448	456	247	285	345	356.1	909.8
8	443	451	246	283	343	353.1	911.8
9	439	445	246	281	342	350.4	916.6
10	434	441	245	279	341	347.8	925.1
11	431	437	243	277	339	345.4	939.1
12	429	434	242	275	337	343.4	958.8
13	427	431	241	274	337	342.0	978.0
14	426	429	239	273	335	340.5	990.6
15	425	427	238	272	334	339.1	1002.3
16	424	425	236	272	333	337.9	1023.4
17	424	423	234	271	332	336.9	1061.2
18	424	422	233	271	331	336.2	1079.4
19	425	422	231	272	330	335.8	1093.9
20	426	421	230	272	329	335.4	1103.6
21	427	421	228	273	328	335.3	1121.6
22	428	422	226	274	327	335.5	1130.9
23	430	423	225	277	326	336.1	1131.4
24	432	424	224	278	325	336.4	1130.3
25	434	425	223	279	324	336.8	1132.4
26	436	425	222	282	323	337.6	1133.7
27	438	427	221	284	322	338.4	1143.7
28	441	427	220	286	322	339.1	1138.1
29	444	428	220	288	321	340.2	1130.6
30	446	429	220	290	321	341.0	1132.8
31	449	431	219	292	321	342.3	1140.7
32	451	433	219	294	320	343.4	1144.6
33	454	434	219	297	320	344.8	1154.0
34	457	436	219	298	319	345.9	1159.5
35	460	439	219	300	318	347.3	1159.7
36	464	441	220	302	318	348.9	1158.8
37	467	443	220	305	318	350.4	1161.2
38	470	445	220	307	317	351.6	1161.4
39	473	447	221	309	317	353.2	1163.3
40	476	448	222	311	317	354.5	1164.1
41	479	450	223	312	316	356.0	1166.8
42	482	452	224	314	315	357.4	1165.1
43	484	454	226	316	315	359.0	1161.2
44	487	456	228	317	314	360.5	1148.8
45	489	459	230	319	314	362.1	1134.7
46	490	461	233	320	313	363.3	1122.1
47	492	463	235	321	313	364.7	1108.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 5

Technician: SJB

Date: 7/11/2023

Stove ΔT: 5

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	492	465	238	322	313	365.9	1095.9
49	493	468	241	323	314	367.7	1080.9
50	494	470	244	323	313	368.9	1063.8
51	494	473	247	323	313	369.9	1047.8
52	494	475	250	322	314	371.0	1037.3
53	493	478	254	321	314	372.0	1032.1
54	493	479	256	322	316	373.3	1025.3
55	493	480	259	321	317	373.9	1016.4
56	491	481	263	321	317	374.8	1010.4
57	491	481	266	318	318	374.9	1005.5
58	490	482	269	316	320	375.3	1005.6
59	489	482	271	315	322	375.9	1004.9
60	489	484	274	313	324	376.8	1001.2
61	489	486	277	311	326	377.8	1000.2
62	490	488	279	310	328	379.0	999.4
63	490	491	281	309	331	380.2	997.3
64	490	493	283	307	334	381.5	994.8
65	491	495	286	306	337	382.9	993.6
66	491	497	288	305	339	384.1	989.8
67	490	499	290	304	341	384.9	980.3
68	490	500	293	302	344	385.9	970.2
69	490	501	296	301	345	386.6	960.3
70	490	502	298	300	347	387.2	953.4
71	489	502	300	299	348	387.6	946.4
72	489	501	302	297	349	387.7	939.2
73	488	501	304	296	350	387.8	931.7
74	488	500	306	295	352	388.0	925.2
75	487	499	308	294	352	387.9	919.9
76	486	499	310	291	353	387.7	916.5
77	485	497	311	291	355	387.7	914.4
78	484	497	313	289	355	387.7	914.3
79	484	496	315	287	355	387.3	917.3
80	483	495	316	285	355	386.8	924.2
81	482	495	317	284	355	386.4	932.5
82	481	494	319	283	355	386.4	937.0
83	480	494	320	281	356	386.2	935.2
84	480	494	321	280	356	386.2	923.6
85	479	495	322	279	357	386.2	919.7
86	479	494	323	278	358	386.2	917.9
87	479	493	324	276	359	386.2	915.5
88	479	492	325	275	361	386.3	913.5
89	479	491	326	274	362	386.4	913.9
90	479	489	327	273	363	386.1	914.2
91	479	487	327	272	365	386.1	913.9
92	479	486	328	271	367	386.3	911.4
93	479	484	329	270	368	386.1	903.3
94	479	483	330	269	370	386.2	890.9
95	479	482	330	268	373	386.2	879.1

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 5

Technician: SJB

Date: 7/11/2023

Stove ΔT : 5

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	479	480	331	267	374	385.9	869.1
97	478	480	331	265	375	385.8	861.0
98	477	478	331	265	377	385.6	854.1
99	476	477	331	264	378	385.2	849.1
100	475	475	330	263	380	384.5	845.0
101	476	474	331	261	381	384.4	840.6
102	474	473	330	260	382	383.8	835.4
103	473	472	330	258	384	383.2	829.9
104	472	470	329	257	385	382.8	824.1
105	471	469	329	256	387	382.2	819.0
106	471	468	328	255	388	381.8	813.8
107	470	467	328	253	388	381.1	809.2
108	469	465	327	252	390	380.5	805.9
109	467	463	326	251	391	379.7	803.5
110	466	462	326	249	392	379.1	802.3
111	465	460	325	248	393	378.3	801.4
112	463	459	324	247	393	377.3	800.2
113	463	457	324	245	393	376.4	798.3
114	461	457	323	245	394	375.9	797.7
115	459	455	322	243	395	375.0	796.7
116	458	454	322	242	395	374.1	796.1
117	456	452	321	241	395	373.0	795.9
118	455	451	320	240	395	372.1	795.4
119	453	450	319	239	395	371.2	794.5
Average	469.0	466.0	275.6	285.9	345.9	368.5	969.7

LAB SAMPLE DATA - ASTM E2515

Client: Jotul

Model: F445

Run #: 5

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G612	242.5	242.8	0.3
	B	G613	243.2	243.7	0.5
	C - 1st Hour	G614	244.0	244.4	0.4
	Amb	G615	244.1	244.1	0.0
Probes	A	9A	116529.9	116530.1	0.2
	B	9B	117737.4	117737.7	0.3
	C - 1st Hour	9C	116602.6	116602.6	0.0
O-rings	A	9A	3580.9	3581.3	0.4
	B	9B	3523.8	3523.8	0.0
	C - 1st Hour	9C	3431.2	3431.5	0.3

Placed in Dessicator on:

7/11 - 9:45

Balance Audit (mg):

100.0

100.0

100.0

Filters	A	242.8	7/13 10:00	242.8	7/14 9:00				
	B	243.8	7/13 10:00	243.7	7/14 9:00				
	C - 1st Hour	244.4	7/13 10:00	244.4	7/14 9:00				
	Amb	244.1	7/13 10:00	244.1	7/14 9:00				
Probes	A	116529.9	7/13 10:00	116530.1	7/14 9:00				
	B	117737.6	7/13 10:00	117737.7	7/14 9:00				
	C - 1st Hour	116602.6	7/13 10:00	116602.6	7/14 9:00				
O-Rings	A	3581.5	7/13 10:00	3581.3	7/14 9:00				
	B	3524.2	7/13 10:00	3523.9	7/14 9:00	3523.8	7/17 16:00		
	C - 1st Hour	3431.8	7/13 10:00	3431.4	7/14 9:00	3431.5	7/17 16:00		

Train A Aggregate, mg: 0.9

Train B Aggregate, mg: 0.8

Train C Aggregate, mg: 0.7

Ambient, mg: 0.0

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 6 Test Date: 7/11/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): 3/8" open from Fully Closed
Targeted Burn Category: Medium High

Preburn Notes

Time	Notes
10:10	Started kindling fire with ~6.5 lbs of fuel, air set to fully open, fan off
10:35	With 1.7 lbs of coals left, added preburn fuel load, door closed immediately
10:50	Turned air down to halfway open
11:02	At 9.82 lbs turned air down to test setting, fan turned on to medium
12:42	@ 3.39lbs leveled coal bed in preparation of fuel loading, left fan on, air control at test setting

Test Notes

Test Burn Start Time: 12:44 Test Fuel Loaded by: 30 seconds
Door Closed: 35 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
12:44	Loaded test fuel, door closed immediately, fan on a medium, air set to test setting
16:21	End of test

Test Burn End Time: 16:21

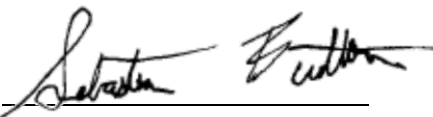
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	6:22	6:28	6:25	16:40	16:35	16:37
CO ₂	0.00	10.16	17.00	-0.04	10.13	16.97
CO	0.000	2.531	4.305	-0.002	2.495	4.288

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

Technician Signature:  Date: 7/12/2023

ASTM E2780 Wood Heater Run Sheets

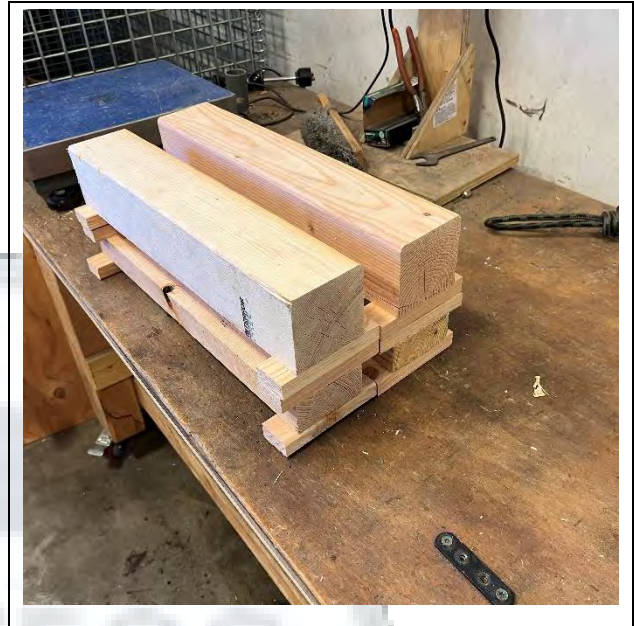
Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 6

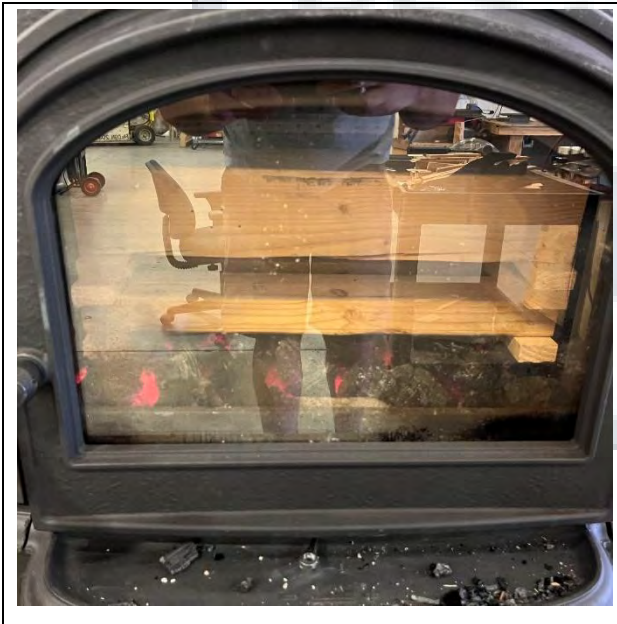
Tracking #: 152
Test Date: 7/11/2023



Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: _____

Sebastian E. Sutton

Date: 7/12/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 6 Test Date: 7/11/2023

REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



Technician Signature: 

Date: 7/12/2023

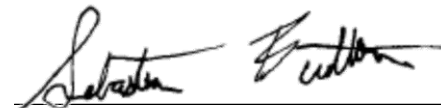
WOOD STOVE TEST DATA PACKET

ASTM E2780/E2515



Run 6 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/11/2023



Technician Signature

7/17/2023
Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 6

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Burn Rate (kg/hr):	1.51
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	24.765	34.188	32.407	9.602
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.4			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	22126.3			
Average Gas Meter Temperature (°F)	76.7	98.1	97.7	84.7
Total Sample Volume (dscf)	24.956	32.870	30.887	9.195
Average Tunnel Temperature (°F)	98.7			
Total Time of Test (min)	217			
Total Particulate Catch (mg)	0.1	0.6	0.6	0.6
Particulate Concentration, dry-standard (g/dscf)	0.0000040	0.0000183	0.0000194	0.0000653
Total PM Emissions (g)	0.32	1.14	1.23	1.36
Particulate Emission Rate (g/hr)	0.09	0.32	0.34	1.36
Emissions Factor (g/kg)	-	0.21	0.23	-
Difference from Average Total Particulate Emissions (g)	-	0.05	0.05	-
Difference from Average Total Particulate Emissions (%)	-	4.0%	4.0%	-
Difference from Average Emissions Factor (g/kg)	-	0.01	0.01	-

Final Average Results	
Total Particulate Emissions (g)	1.19
Particulate Emission Rate (g/hr)	0.33
Emissions Factor (g/kg)	0.22
HHV Efficiency (%)	72.5%
LHV Efficiency (%)	78.4%
CO Emissions (g/min)	0.06

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	84.4	OK
Face Velocity	< 30 ft/min	8.8	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min:74.2/Max:79	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	11.4	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/11/23
Run: 6
Control #: 23-167
Test Duration: 217
Output Category: 3

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	72.5%	78.4%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	72.9%	78.8%

Output Rate (kJ/h)	21,488	20,384	(Btu/h)
Burn Rate (kg/h)	1.50	3.30	(lb/h)
Input (kJ/h)	29,628	28,106	(Btu/h)

Test Load Weight (dry kg)	5.41	11.92	dry lb
MC wet (%)	17.67		
MC dry (%)	21.46		
Particulate (g)	1.19		
CO (g)	12		
Test Duration (h)	3.62		

Emissions	Particulate	CO
g/MJ Output	0.02	0.16
g/kg Dry Fuel	0.22	2.27
g/h	0.33	3.40
g/min	0.01	0.06
lb/MM Btu Output	0.04	0.37

Air/Fuel Ratio (A/F)	19.83
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	18.7		2x4	18.25	22.0
2x4	18.25	19.2		2x4	18.25	22.5
2x4	18.25	21.0				
2x4	18.25	21.8				
2x4	18.25	19.7				
2x4	11.00	21.4				
2x4	11.00	23.4				
2x4	11.00	21.5				
Total Fuel Weight (lbs):		13.67	Average Moisture (%DB):		21.1	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 5.17
 Total 4x4 Crib Weight, with spacers (lbs): 9.32
 Total Wet Fuel Weight, with spacers (lbs): 14.49

Coal Bed Range (20-25%):

Min (lbs): 2.90
 Max (lbs): 3.62

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.16	23.7	22.5	23.4	1.75
2x4	18.25	2.20	18.7	20.8	19.4	1.84
4x4	18.25	4.04	22.7	21.0	19.4	3.34
4x4	18.25	4.87	19.5	22.3	24.1	3.99
Total Dry Weight, no spacers (lbs):						10.92
Total Dry Weight, with spacers (lbs):						12.04

Spacer Moisture Readings (%DB)						
9.0	11.8	8.2				
10.2	8.8	12.8				
10.1	7.7	9.6				
8.1	10.2	8.3				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	29.5	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	7.14	OK
2x4 Fuel Mix	35 - 65 % of total weight	36%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 6
 Test Start Time: 12:44

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Total Sampling Time (min): 217
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.93	29.95	29.94
Relative Humidity (%)	34.7	29.6	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:	24.765 ft ³		

Sample Train Leak Checks

	Pre-test	Post-test		
Induced Draft Check (in. H ₂ O):	0	(A) 0.002	cfm @	-5 in. Hg
Smoke Capture Check (%):	100%	(B) 0.000	cfm @	-5 in. Hg
Date Flue Pipe Last Cleaned:	7/3/2023	(C) 0.001	cfm @	-5 in. Hg
Test Fuel Scale Audit (lbs)	10.00	(Ambient) 0.000	cfm @	-5 in. Hg
Platform Scale Audit (lbs)	10.0			

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.012	110
2	0.016	110
3	0.018	110
4	0.020	110
5	0.018	110
6	0.010	110
7	0.012	110
8	0.018	110
9	0.018	110
10	0.016	110
11	0.014	110
12	0.008	110
Center	0.016	110

Dilution Tunnel H₂O: 2.00 percent

Tunnel Diameter: 12 inches

Pitot Tube Cp: 0.99 [unitless]

Dilution Tunnel MW(dry): 29.00 lb/lb-mole

Dilution Tunnel MW(wet): 28.78 lb/lb-mole

Tunnel Area: 0.7854 ft²

V_{strav}: 8.37 ft/sec

V_{scnt}: 8.71 ft/sec

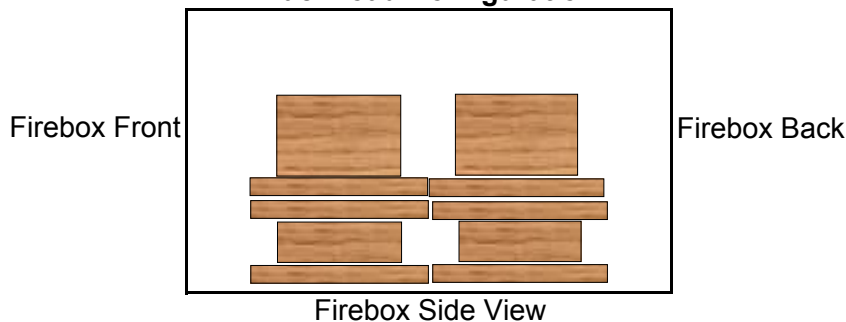
F_p: 0.961 [ratio]

Initial Tunnel Flow: 358.2 scf/min

Static Pressure: -0.095 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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)	21.5

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 6

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Recording Interval (min): 1
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	9.82	-0.094	418	401	238	320	259	327.1	519	75
1	9.66	-0.092	421	404	240	321	260	329.2	490	75
2	9.52	-0.092	423	408	240	323	261	331.0	474	75
3	9.39	-0.089	425	410	239	322	261	331.6	463	75
4	9.26	-0.089	427	411	239	323	261	332.4	456	75
5	9.13	-0.088	429	412	238	323	261	332.5	450	75
6	9.01	-0.087	431	412	238	323	260	332.8	445	75
7	8.89	-0.085	433	412	237	323	259	332.9	439	75
8	8.76	-0.085	435	413	237	324	258	333.3	435	75
9	8.64	-0.086	437	412	236	324	257	333.4	433	75
10	8.51	-0.085	439	413	236	324	255	333.5	431	75
11	8.38	-0.083	441	413	236	324	254	333.5	429	75
12	8.26	-0.084	443	413	236	324	253	333.8	428	75
13	8.13	-0.085	445	414	236	324	251	334.1	427	75
14	8.01	-0.085	446	414	236	325	250	334.2	426	75
15	7.88	-0.085	448	415	236	326	248	334.5	426	74
16	7.75	-0.083	450	415	236	325	247	334.5	426	74
17	7.63	-0.084	452	416	236	324	246	334.6	425	74
18	7.50	-0.084	454	416	236	323	245	334.8	424	74
19	7.36	-0.084	456	417	236	325	243	335.4	423	75
20	7.24	-0.083	457	417	236	323	242	335.1	422	75
21	7.11	-0.083	459	418	236	323	241	335.4	422	75
22	6.98	-0.083	461	419	237	324	240	336.0	420	74
23	6.86	-0.084	463	419	237	325	239	336.6	420	74
24	6.73	-0.084	465	420	237	326	238	337.2	418	74
25	6.61	-0.083	467	421	238	324	237	337.4	417	75
26	6.49	-0.083	468	422	238	323	236	337.4	416	75
27	6.38	-0.081	470	423	238	322	235	337.8	414	75
28	6.27	-0.082	472	423	238	321	234	337.7	412	75
29	6.15	-0.080	473	424	239	321	234	337.9	412	75
30	6.05	-0.082	474	424	239	320	233	338.0	409	75
31	5.95	-0.080	475	425	239	321	232	338.3	407	75
32	5.85	-0.081	475	425	239	319	232	338.2	405	75
33	5.75	-0.081	476	425	240	319	231	338.3	404	75
34	5.64	-0.080	476	425	240	319	231	338.2	403	75
35	5.56	-0.080	477	426	241	321	230	338.8	403	75
36	5.45	-0.080	478	426	241	319	229	338.6	402	75
37	5.36	-0.079	478	426	241	319	229	338.4	401	75
38	5.26	-0.079	478	426	241	318	229	338.3	399	75
39	5.18	-0.079	478	426	241	317	228	338.1	396	75
40	5.10	-0.079	478	426	241	316	228	337.9	394	75
41	5.02	-0.075	478	425	241	316	228	337.7	390	75
42	4.95	-0.077	477	426	242	316	229	337.9	387	75
43	4.87	-0.074	476	426	243	315	229	337.8	383	75
44	4.81	-0.074	476	426	243	314	230	337.8	378	75

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 6

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Recording Interval (min): 1
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
45	4.77	-0.072	474	427	243	315	230	337.9	372	75
46	4.71	-0.071	473	426	243	314	231	337.4	365	75
47	4.68	-0.072	472	426	243	312	231	336.9	360	75
48	4.63	-0.068	471	425	244	312	232	336.7	355	75
49	4.59	-0.069	470	425	244	312	231	336.3	350	75
50	4.56	-0.071	468	424	244	308	232	335.0	346	75
51	4.52	-0.069	465	422	244	306	232	333.9	342	75
52	4.49	-0.069	463	421	244	303	233	332.8	340	75
53	4.45	-0.068	460	420	244	301	234	331.8	337	75
54	4.42	-0.066	457	418	244	298	234	330.4	334	75
55	4.37	-0.066	455	417	245	297	234	329.4	332	75
56	4.35	-0.067	451	416	245	296	235	328.2	330	75
57	4.31	-0.068	447	414	245	293	236	326.9	328	75
58	4.28	-0.068	444	413	245	291	237	325.9	326	75
59	4.24	-0.065	441	412	245	287	238	324.7	322	75
60	4.21	-0.065	438	411	245	285	239	323.5	320	75
61	4.19	-0.064	435	410	245	283	240	322.4	317	75
62	4.16	-0.064	432	409	245	280	240	321.0	315	75
63	4.13	-0.063	429	408	245	278	241	320.0	313	75
64	4.11	-0.061	426	406	245	277	242	319.0	311	75
65	4.08	-0.064	424	405	245	273	243	317.8	308	75
66	4.06	-0.063	421	404	245	271	243	316.8	306	75
67	4.03	-0.061	418	403	245	269	244	315.8	303	75
68	4.01	-0.060	415	402	245	266	245	314.6	301	75
69	3.98	-0.061	412	400	245	266	246	313.7	299	75
70	3.96	-0.061	410	399	245	263	247	312.6	296	75
71	3.95	-0.060	408	397	244	260	247	311.4	295	75
72	3.92	-0.060	405	396	245	259	248	310.7	293	75
73	3.90	-0.059	403	395	245	257	249	309.6	291	75
74	3.88	-0.057	400	393	245	256	250	308.8	290	75
75	3.86	-0.058	398	392	245	254	251	307.8	288	75
76	3.84	-0.057	396	390	244	252	251	306.6	286	75
77	3.82	-0.057	394	389	244	250	252	305.9	284	75
78	3.81	-0.057	391	388	244	248	253	304.8	284	75
79	3.78	-0.057	389	387	244	247	254	304.0	282	75
80	3.76	-0.057	387	386	244	246	254	303.3	280	75
81	3.75	-0.056	385	385	244	243	255	302.3	280	75
82	3.73	-0.058	383	383	244	242	256	301.7	278	75
83	3.70	-0.057	382	382	244	240	257	301.0	277	75
84	3.69	-0.054	380	381	244	239	258	300.2	275	75
85	3.67	-0.054	378	380	243	237	259	299.4	274	75
86	3.65	-0.055	377	379	243	237	259	299.0	272	75
87	3.63	-0.053	376	377	243	235	260	298.3	270	75
88	3.61	-0.055	375	376	244	235	261	298.0	269	75
89	3.59	-0.053	373	375	244	234	261	297.5	268	75

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Recording Interval (min): 1
 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
90	3.57	-0.054	372	374	244	232	262	296.7	267	75
91	3.56	-0.053	370	373	244	232	262	296.1	266	75
92	3.54	-0.052	369	371	244	230	263	295.4	264	75
93	3.52	-0.052	367	370	244	230	264	294.9	262	75
94	3.50	-0.050	366	368	244	228	265	294.0	262	75
95	3.48	-0.053	364	367	244	228	265	293.6	261	75
96	3.47	-0.053	363	366	244	227	266	293.0	260	75
97	3.44	-0.052	361	364	244	224	266	292.0	259	75
98	3.43	-0.053	361	364	244	224	267	291.8	258	75
99	3.41	-0.051	360	362	245	224	267	291.5	257	75
100	3.39	-0.049	359	361	245	224	267	291.1	256	75

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

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		0.017	0.38	81	0.5		14.48		101	317	77	75
1	0.144	0.144	0.016	2.05	81	0.8	-	14.48	0.00	103	300	77	75
2	0.285	0.141	0.017	2.07	81	0.9	-	14.42	-0.06	95	267	77	75
3	0.430	0.145	0.017	2.10	81	0.8	-	14.38	-0.04	92	265	78	75
4	0.575	0.145	0.017	2.12	81	0.9	-	14.32	-0.06	90	271	78	75
5	0.720	0.145	0.016	2.13	80	0.9	-	14.28	-0.04	92	276	78	75
6	0.869	0.149	0.014	2.16	81	0.8	-	14.22	-0.06	91	280	78	75
7	1.015	0.146	0.017	2.16	81	0.9	-	14.17	-0.05	91	284	78	75
8	1.164	0.149	0.016	2.18	81	0.9	-	14.13	-0.04	91	288	78	75
9	1.310	0.146	0.016	2.20	81	0.9	-	14.08	-0.05	91	291	78	75
10	1.461	0.151	0.017	2.21	81	0.8	94	14.02	-0.06	91	293	78	75
11	1.607	0.146	0.016	2.22	81	0.8	-	13.98	-0.04	92	295	78	75
12	1.759	0.152	0.016	2.23	81	0.8	-	13.92	-0.06	91	297	78	74
13	1.906	0.147	0.017	2.24	81	0.9	-	13.86	-0.06	92	300	79	75
14	2.059	0.153	0.016	2.24	82	0.9	-	13.80	-0.06	93	303	79	74
15	2.206	0.147	0.017	2.25	82	0.8	-	13.74	-0.06	93	307	79	75
16	2.359	0.153	0.016	2.26	82	0.9	-	13.67	-0.07	93	311	79	74
17	2.507	0.148	0.017	2.27	82	0.9	-	13.60	-0.07	93	315	79	75
18	2.661	0.154	0.017	2.28	82	0.9	-	13.53	-0.07	94	319	79	75
19	2.809	0.148	0.017	2.28	83	0.9	-	13.46	-0.07	94	323	79	75
20	2.963	0.154	0.017	2.28	83	0.9	96	13.39	-0.07	93	326	79	75
21	3.112	0.149	0.017	2.29	83	0.9	-	13.32	-0.07	93	329	79	75
22	3.266	0.154	0.016	2.30	83	0.9	-	13.24	-0.08	94	333	79	75
23	3.415	0.149	0.016	2.30	84	0.9	-	13.16	-0.08	94	335	79	75
24	3.568	0.153	0.017	2.30	84	0.9	-	13.08	-0.08	93	338	79	75
25	3.719	0.151	0.016	2.31	84	0.9	-	13.00	-0.08	94	341	80	75
26	3.873	0.154	0.016	2.31	85	0.9	-	12.91	-0.09	94	343	79	75
27	4.024	0.151	0.017	2.30	85	0.9	-	12.84	-0.07	93	345	80	76
28	4.178	0.154	0.017	2.32	85	0.9	-	12.74	-0.10	93	347	80	75
29	4.332	0.154	0.017	2.33	85	0.9	-	12.65	-0.09	94	350	80	75
30	4.484	0.152	0.016	2.33	86	0.9	99	12.55	-0.10	94	351	80	75
31	4.639	0.155	0.017	2.34	86	0.9	-	12.46	-0.09	95	355	80	75

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

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
32	4.789	0.150	0.017	2.33	86	0.9	-	12.36	-0.10	94	357	80	75
33	4.945	0.156	0.017	2.33	87	0.9	-	12.25	-0.11	95	361	80	75
34	5.095	0.150	0.017	2.33	87	0.9	-	12.14	-0.11	95	363	80	75
35	5.252	0.157	0.016	2.34	87	0.9	-	12.03	-0.11	96	366	80	75
36	5.404	0.152	0.017	2.34	88	0.9	-	11.92	-0.11	96	368	80	75
37	5.561	0.157	0.017	2.34	88	0.9	-	11.81	-0.11	97	370	80	75
38	5.713	0.152	0.017	2.35	88	0.9	-	11.69	-0.12	97	372	80	75
39	5.868	0.155	0.017	2.35	89	0.9	-	11.57	-0.12	98	374	80	75
40	6.021	0.153	0.017	2.34	89	0.9	100	11.44	-0.13	99	378	80	75
41	6.176	0.155	0.016	2.36	89	0.9	-	11.31	-0.13	99	383	80	75
42	6.332	0.156	0.016	2.36	89	0.9	-	11.18	-0.13	99	390	80	75
43	6.486	0.154	0.016	2.36	90	0.9	-	11.03	-0.15	100	397	81	75
44	6.642	0.156	0.016	2.36	90	0.9	-	10.89	-0.14	101	404	81	75
45	6.793	0.151	0.016	2.36	90	0.9	-	10.76	-0.13	99	404	81	75
46	6.952	0.159	0.017	2.36	91	0.9	-	10.62	-0.14	99	406	81	75
47	7.105	0.153	0.017	2.38	91	0.9	-	10.50	-0.12	101	408	81	75
48	7.263	0.158	0.017	2.38	91	0.9	-	10.37	-0.13	100	407	81	75
49	7.415	0.152	0.017	2.37	91	0.9	-	10.24	-0.13	101	407	81	75
50	7.572	0.157	0.016	2.37	92	0.9	100	10.11	-0.13	102	408	81	75
51	7.728	0.156	0.016	2.37	92	0.9	-	9.99	-0.12	102	409	81	75
52	7.883	0.155	0.017	2.37	92	0.9	-	9.86	-0.13	102	412	81	76
53	8.040	0.157	0.017	2.38	92	0.9	-	9.73	-0.13	103	414	81	76
54	8.193	0.153	0.016	2.38	93	0.9	-	9.61	-0.12	102	414	81	76
55	8.353	0.160	0.015	2.38	93	0.9	-	9.48	-0.13	103	415	82	75
56	8.506	0.153	0.017	2.38	93	0.9	-	9.35	-0.13	102	415	82	76
57	8.664	0.158	0.017	2.39	93	0.9	-	9.21	-0.14	102	417	82	76
58	8.819	0.155	0.016	2.38	94	0.9	-	9.08	-0.13	102	419	82	75
59	8.976	0.157	0.016	2.38	94	0.9	-	8.96	-0.12	103	420	82	75
60	9.135	0.159	0.017	2.38	94	0.9	101	8.82	-0.14	103	421	82	75
61	9.288	0.153	0.016	2.39	94	0.9	-	8.69	-0.13	104	424	82	75
62	9.447	0.159	0.017	2.38	95	0.9	-	8.55	-0.14	104	426	82	76
63	9.602	0.155	0.017	2.40	95	0.9	-	8.41	-0.14	104	429	82	76

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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
64	9.762	0.160	0.016	2.40	95	0.9	-	8.27	-0.14	104	433	82	76
65	9.916	0.154	0.016	2.39	95	0.9	-	8.13	-0.14	104	433	82	75
66	10.073	0.157	0.016	2.40	95	0.9	-	7.97	-0.16	103	434	82	75
67	10.232	0.159	0.016	2.39	96	0.9	-	7.84	-0.13	104	434	82	75
68	10.386	0.154	0.016	2.40	96	0.9	-	7.71	-0.13	104	435	82	76
69	10.545	0.159	0.017	2.40	96	0.9	-	7.58	-0.13	105	434	82	76
70	10.701	0.156	0.016	2.40	96	0.9	101	7.44	-0.14	105	434	82	76
71	10.861	0.160	0.017	2.41	96	0.9	-	7.31	-0.13	105	432	82	76
72	11.015	0.154	0.016	2.40	97	0.9	-	7.18	-0.13	106	431	82	76
73	11.173	0.158	0.017	2.41	97	0.9	-	7.06	-0.12	105	430	82	76
74	11.332	0.159	0.016	2.41	97	0.9	-	6.93	-0.13	104	427	83	76
75	11.487	0.155	0.016	2.40	97	0.9	-	6.81	-0.12	104	427	83	76
76	11.647	0.160	0.016	2.40	97	0.9	-	6.68	-0.13	106	427	83	76
77	11.803	0.156	0.016	2.41	97	0.9	-	6.54	-0.14	105	428	83	76
78	11.962	0.159	0.016	2.41	98	0.9	-	6.41	-0.13	105	428	83	76
79	12.118	0.156	0.015	2.41	98	0.9	-	6.29	-0.12	106	429	83	76
80	12.277	0.159	0.017	2.43	98	0.9	101	6.15	-0.14	104	429	83	76
81	12.437	0.160	0.015	2.42	98	0.9	-	6.04	-0.11	105	430	83	76
82	12.591	0.154	0.016	2.42	98	0.9	-	5.92	-0.12	105	428	83	76
83	12.753	0.162	0.016	2.42	98	0.9	-	5.81	-0.11	106	427	83	76
84	12.909	0.156	0.017	2.43	99	0.9	-	5.69	-0.12	104	425	83	76
85	13.067	0.158	0.017	2.42	99	0.9	-	5.59	-0.10	104	422	83	77
86	13.227	0.160	0.016	2.42	99	0.9	-	5.47	-0.12	104	420	83	77
87	13.383	0.156	0.016	2.42	99	0.9	-	5.38	-0.09	104	417	83	77
88	13.543	0.160	0.015	2.42	99	0.9	-	5.29	-0.09	105	413	83	77
89	13.700	0.157	0.016	2.42	99	1.0	-	5.21	-0.08	105	410	83	77
90	13.860	0.160	0.017	2.43	99	0.9	100	5.11	-0.10	104	408	83	77
91	14.017	0.157	0.016	2.42	99	0.9	-	5.03	-0.08	105	405	83	77
92	14.176	0.159	0.017	2.43	100	0.9	-	4.94	-0.09	105	402	83	77
93	14.336	0.160	0.016	2.42	100	0.9	-	4.86	-0.08	105	401	83	77
94	14.489	0.153	0.017	2.43	100	0.9	-	4.77	-0.09	105	399	83	77
95	14.654	0.165	0.017	2.43	100	0.9	-	4.70	-0.07	105	397	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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
96	14.810	0.156	0.017	2.42	100	0.9	-	4.61	-0.09	103	397	83	77
97	14.969	0.159	0.017	2.42	100	0.9	-	4.53	-0.08	104	395	84	77
98	15.130	0.161	0.017	2.44	100	0.9	-	4.45	-0.08	102	393	84	77
99	15.286	0.156	0.017	2.44	100	0.9	-	4.38	-0.07	103	391	84	76
100	15.448	0.162	0.016	2.44	101	0.9	101	4.30	-0.08	103	390	84	76
101	15.605	0.157	0.017	2.44	101	0.9	-	4.21	-0.09	103	388	84	77
102	15.764	0.159	0.016	2.43	101	0.9	-	4.14	-0.07	104	388	84	77
103	15.925	0.161	0.016	2.42	101	0.9	-	4.06	-0.08	102	386	84	77
104	16.082	0.157	0.017	2.44	101	0.9	-	4.00	-0.06	102	384	84	77
105	16.242	0.160	0.017	2.43	101	0.9	-	3.92	-0.08	101	383	84	76
106	16.400	0.158	0.018	2.43	101	0.9	-	3.85	-0.07	101	382	84	77
107	16.560	0.160	0.017	2.44	101	0.9	-	3.78	-0.07	101	381	84	77
108	16.720	0.160	0.017	2.43	101	0.9	-	3.70	-0.08	103	381	84	77
109	16.878	0.158	0.017	2.43	101	0.9	-	3.62	-0.08	102	382	84	77
110	17.039	0.161	0.017	2.41	102	0.9	101	3.55	-0.07	102	382	84	77
111	17.196	0.157	0.016	2.42	102	0.9	-	3.48	-0.07	102	382	84	77
112	17.358	0.162	0.017	2.41	102	0.9	-	3.42	-0.06	100	381	84	77
113	17.514	0.156	0.016	2.41	102	0.9	-	3.36	-0.06	101	380	84	77
114	17.675	0.161	0.016	2.41	102	0.9	-	3.30	-0.06	101	377	84	77
115	17.835	0.160	0.016	2.43	102	0.9	-	3.24	-0.06	101	376	84	77
116	17.992	0.157	0.017	2.42	102	0.9	-	3.18	-0.06	100	373	84	78
117	18.155	0.163	0.017	2.44	102	0.9	-	3.12	-0.06	100	372	84	78
118	18.312	0.157	0.016	2.42	102	0.9	-	3.06	-0.06	101	370	84	78
119	18.472	0.160	0.017	2.42	102	0.9	-	3.00	-0.06	100	369	84	78
120	18.633	0.161	0.016	2.43	102	0.9	101	2.95	-0.05	101	367	84	78
121	18.789	0.156	0.017	2.44	103	0.9	-	2.89	-0.06	101	366	84	78
122	18.953	0.164	0.017	2.44	103	0.9	-	2.83	-0.06	102	366	84	78
123	19.110	0.157	0.017	2.42	103	0.9	-	2.78	-0.05	101	365	84	78
124	19.270	0.160	0.017	2.43	103	0.9	-	2.72	-0.06	102	364	84	77
125	19.431	0.161	0.016	2.44	103	0.9	-	2.67	-0.05	101	363	84	77
126	19.587	0.156	0.016	2.40	103	0.9	-	2.61	-0.06	101	363	84	77
127	19.751	0.164	0.016	2.40	103	0.9	-	2.56	-0.05	101	361	84	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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
128	19.908	0.157	0.017	2.41	103	1.0	-	2.51	-0.05	100	360	84	78
129	20.068	0.160	0.017	2.43	103	0.9	-	2.46	-0.05	100	359	84	78
130	20.230	0.162	0.017	2.43	103	0.9	101	2.41	-0.05	100	358	84	77
131	20.386	0.156	0.016	2.43	103	0.9	-	2.35	-0.06	100	357	84	77
132	20.550	0.164	0.017	2.45	103	0.9	-	2.30	-0.05	100	358	84	78
133	20.706	0.156	0.017	2.45	103	0.9	-	2.24	-0.06	100	357	84	78
134	20.868	0.162	0.016	2.45	103	0.9	-	2.19	-0.05	100	356	84	78
135	21.029	0.161	0.016	2.43	104	0.9	-	2.13	-0.06	100	356	84	78
136	21.185	0.156	0.016	2.39	104	0.9	-	2.09	-0.04	100	356	84	78
137	21.349	0.164	0.016	2.42	104	0.9	-	2.04	-0.05	100	356	84	78
138	21.506	0.157	0.017	2.43	104	0.9	-	2.00	-0.04	100	356	84	78
139	21.667	0.161	0.017	2.43	104	0.9	-	1.95	-0.05	100	355	84	77
140	21.829	0.162	0.016	2.43	104	0.9	101	1.90	-0.05	99	354	84	77
141	21.985	0.156	0.017	2.43	104	0.9	-	1.86	-0.04	99	353	84	78
142	22.149	0.164	0.017	2.41	104	0.9	-	1.80	-0.06	97	353	84	78
143	22.306	0.157	0.017	2.41	104	0.9	-	1.75	-0.05	97	352	84	78
144	22.467	0.161	0.017	2.40	104	0.9	-	1.71	-0.04	98	353	84	78
145	22.629	0.162	0.017	2.41	104	0.9	-	1.65	-0.06	99	352	84	78
146	22.785	0.156	0.017	2.41	104	0.9	-	1.61	-0.04	100	353	84	78
147	22.949	0.164	0.015	2.42	104	0.9	-	1.56	-0.05	99	352	84	78
148	23.107	0.158	0.016	2.43	104	0.9	-	1.51	-0.05	99	352	84	78
149	23.268	0.161	0.017	2.45	104	0.9	-	1.49	-0.02	99	351	84	78
150	23.429	0.161	0.017	2.45	104	0.9	101	1.45	-0.04	98	347	84	78
151	23.586	0.157	0.017	2.45	104	0.9	-	1.43	-0.02	99	344	84	78
152	23.750	0.164	0.016	2.46	104	0.9	-	1.40	-0.03	98	341	84	78
153	23.907	0.157	0.017	2.45	105	0.9	-	1.37	-0.03	97	338	84	78
154	24.068	0.161	0.017	2.44	104	0.9	-	1.34	-0.03	97	336	84	78
155	24.229	0.161	0.015	2.44	105	0.9	-	1.31	-0.03	98	333	84	78
156	24.386	0.157	0.017	2.45	105	0.9	-	1.29	-0.02	99	330	84	78
157	24.551	0.165	0.017	2.45	105	0.9	-	1.26	-0.03	99	329	84	78
158	24.708	0.157	0.017	2.45	105	0.9	-	1.24	-0.02	99	327	84	78
159	24.869	0.161	0.017	2.44	105	0.9	-	1.22	-0.02	100	326	84	78

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

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
160	25.030	0.161	0.017	2.44	105	0.9	99	1.20	-0.02	99	325	84	78
161	25.188	0.158	0.017	2.44	105	0.9	-	1.17	-0.03	99	323	84	78
162	25.352	0.164	0.017	2.45	105	1.0	-	1.14	-0.03	99	321	84	77
163	25.509	0.157	0.017	2.47	105	0.9	-	1.13	-0.01	99	321	84	78
164	25.671	0.162	0.017	2.46	105	0.9	-	1.10	-0.03	99	319	84	78
165	25.832	0.161	0.017	2.47	105	0.9	-	1.08	-0.02	97	317	84	78
166	25.991	0.159	0.017	2.47	105	0.9	-	1.06	-0.02	96	315	84	78
167	26.153	0.162	0.017	2.47	105	0.9	-	1.04	-0.02	97	315	84	78
168	26.313	0.160	0.017	2.45	105	0.9	-	1.02	-0.02	96	313	84	78
169	26.473	0.160	0.017	2.46	105	0.9	-	0.99	-0.03	97	311	84	78
170	26.634	0.161	0.017	2.42	105	0.9	99	0.97	-0.02	97	310	84	78
171	26.793	0.159	0.017	2.42	105	0.9	-	0.95	-0.02	98	309	84	78
172	26.955	0.162	0.017	2.44	105	0.9	-	0.93	-0.02	97	308	84	78
173	27.116	0.161	0.017	2.44	105	0.9	-	0.91	-0.02	96	307	84	78
174	27.274	0.158	0.017	2.46	105	0.9	-	0.88	-0.03	95	306	84	78
175	27.437	0.163	0.017	2.47	105	0.9	-	0.86	-0.02	94	305	84	79
176	27.596	0.159	0.017	2.44	105	0.9	-	0.85	-0.01	96	304	84	79
177	27.757	0.161	0.017	2.43	106	0.9	-	0.82	-0.03	95	304	84	79
178	27.919	0.162	0.017	2.45	106	0.9	-	0.80	-0.02	96	302	84	79
179	28.076	0.157	0.017	2.45	106	0.9	-	0.77	-0.03	96	301	84	78
180	28.240	0.164	0.017	2.44	106	0.9	99	0.76	-0.01	96	301	84	78
181	28.398	0.158	0.017	2.46	106	0.9	-	0.73	-0.03	96	300	84	78
182	28.559	0.161	0.017	2.44	106	0.9	-	0.72	-0.01	95	299	84	78
183	28.723	0.164	0.017	2.45	106	0.9	-	0.69	-0.03	95	298	84	78
184	28.879	0.156	0.017	2.45	106	0.9	-	0.67	-0.02	96	298	84	78
185	29.044	0.165	0.017	2.44	106	0.9	-	0.65	-0.02	95	297	84	78
186	29.201	0.157	0.017	2.45	106	0.9	-	0.63	-0.02	95	296	84	78
187	29.363	0.162	0.016	2.44	106	1.0	-	0.62	-0.01	94	296	84	79
188	29.525	0.162	0.017	2.45	106	0.9	-	0.60	-0.02	96	295	84	79
189	29.682	0.157	0.017	2.45	106	0.9	-	0.57	-0.03	96	295	84	78
190	29.847	0.165	0.017	2.45	106	0.9	99	0.55	-0.02	96	295	84	78
191	30.005	0.158	0.017	2.45	106	0.9	-	0.53	-0.02	96	294	84	78

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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
192	30.166	0.161	0.017	2.46	106	0.9	-	0.51	-0.02	96	294	84	78
193	30.328	0.162	0.017	2.46	106	0.9	-	0.47	-0.04	95	294	84	78
194	30.487	0.159	0.017	2.46	106	0.9	-	0.45	-0.02	96	293	84	78
195	30.649	0.162	0.017	2.45	106	0.9	-	0.45	0.00	96	292	84	78
196	30.810	0.161	0.017	2.45	106	0.9	-	0.42	-0.03	96	292	84	78
197	30.970	0.160	0.017	2.45	106	0.9	-	0.40	-0.02	97	292	84	78
198	31.132	0.162	0.017	2.43	106	0.9	-	0.38	-0.02	96	291	84	78
199	31.291	0.159	0.017	2.44	106	0.9	-	0.36	-0.02	96	292	84	78
200	31.453	0.162	0.016	2.45	106	0.9	101	0.34	-0.02	95	292	84	78
201	31.615	0.162	0.017	2.46	106	0.9	-	0.31	-0.03	95	292	84	78
202	31.773	0.158	0.017	2.46	106	0.9	-	0.30	-0.01	96	292	84	78
203	31.937	0.164	0.017	2.46	106	0.9	-	0.28	-0.02	95	291	84	78
204	32.095	0.158	0.017	2.47	106	0.9	-	0.26	-0.02	95	291	84	78
205	32.257	0.162	0.017	2.46	106	0.9	-	0.24	-0.02	95	291	84	78
206	32.420	0.163	0.017	2.46	106	0.9	-	0.23	-0.01	95	291	84	78
207	32.577	0.157	0.017	2.46	106	0.9	-	0.19	-0.04	94	291	84	78
208	32.742	0.165	0.017	2.46	106	0.9	-	0.18	-0.01	95	291	84	78
209	32.900	0.158	0.016	2.48	106	0.9	-	0.16	-0.02	94	290	84	78
210	33.062	0.162	0.017	2.48	106	0.9	101	0.13	-0.03	94	291	84	78
211	33.224	0.162	0.017	2.47	106	1.0	-	0.12	-0.01	95	290	84	78
212	33.382	0.158	0.017	2.46	106	0.9	-	0.11	-0.01	95	290	84	78
213	33.546	0.164	0.017	2.47	107	0.9	-	0.08	-0.03	95	290	84	78
214	33.705	0.159	0.017	2.47	107	0.9	-	0.06	-0.02	95	289	84	78
215	33.867	0.162	0.017	2.48	107	1.0	-	0.05	-0.01	96	289	84	78
216	34.029	0.162	0.017	2.48	107	0.9	-	0.03	-0.02	95	289	84	78
217	34.188	0.159	0.017	2.47	107	0.9	99	0.00	-0.03	94	288	84	78
Avg/Tot	34.188	0.158	0.017	2.39	98.1	0.9	100			98.7	352.7	82.5	76.7

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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		0.43	81	1.0		78	-0.053	2.57	0.093
1	0.137	0.137	2.14	80	1.8	-	79	-0.050	1.90	0.096
2	0.285	0.148	2.15	81	1.8	-	79	-0.053	2.98	0.149
3	0.428	0.143	2.14	80	1.8	-	79	-0.056	3.04	0.015
4	0.576	0.148	2.16	80	1.5	-	79	-0.057	3.00	0.017
5	0.718	0.142	2.16	80	1.7	-	79	-0.058	3.10	0.014
6	0.865	0.147	2.15	81	1.7	-	79	-0.059	3.50	0.012
7	1.009	0.144	2.15	81	1.9	-	79	-0.060	3.64	0.014
8	1.156	0.147	2.16	81	2.0	-	79	-0.061	3.59	0.017
9	1.301	0.145	2.16	81	1.9	-	79	-0.062	3.69	0.015
10	1.447	0.146	2.16	81	2.0	99	79	-0.062	3.80	0.016
11	1.592	0.145	2.16	81	1.5	-	79	-0.063	3.97	0.012
12	1.738	0.146	2.16	81	2.0	-	79	-0.062	4.01	0.015
13	1.883	0.145	2.16	81	1.4	-	79	-0.062	4.15	0.012
14	2.028	0.145	2.15	81	1.9	-	79	-0.063	4.30	0.016
15	2.175	0.147	2.15	82	1.9	-	80	-0.063	4.48	0.018
16	2.319	0.144	2.15	82	1.7	-	80	-0.064	4.70	0.016
17	2.468	0.149	2.17	82	1.6	-	80	-0.064	5.01	0.014
18	2.612	0.144	2.17	82	1.7	-	80	-0.065	5.09	0.016
19	2.760	0.148	2.16	83	2.0	-	80	-0.067	5.26	0.020
20	2.904	0.144	2.17	83	2.0	99	80	-0.066	5.12	0.016
21	3.052	0.148	2.16	83	2.0	-	80	-0.067	5.25	0.015
22	3.195	0.143	2.17	84	1.8	-	80	-0.068	5.22	0.018
23	3.344	0.149	2.16	84	1.5	-	80	-0.068	5.45	0.016
24	3.488	0.144	2.16	85	1.6	-	80	-0.070	5.49	0.018
25	3.637	0.149	2.17	85	1.6	-	80	-0.070	5.73	0.020
26	3.782	0.145	2.17	85	1.4	-	80	-0.071	5.79	0.020
27	3.930	0.148	2.17	86	1.6	-	81	-0.072	5.89	0.018
28	4.076	0.146	2.17	86	1.8	-	81	-0.069	6.33	0.018
29	4.224	0.148	2.18	86	1.9	-	80	-0.071	6.44	0.016
30	4.370	0.146	2.17	86	1.5	100	81	-0.071	6.66	0.017
31	4.517	0.147	2.18	87	1.9	-	81	-0.070	6.77	0.015

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
32	4.664	0.147	2.17	87	1.9	-	81	-0.073	6.72	0.019
33	4.811	0.147	2.17	87	1.5	-	81	-0.073	6.65	0.013
34	4.958	0.147	2.17	87	1.6	-	81	-0.074	7.48	0.018
35	5.104	0.146	2.18	88	1.5	-	81	-0.076	7.83	0.016
36	5.252	0.148	2.17	88	1.6	-	81	-0.072	7.74	0.016
37	5.398	0.146	2.17	88	1.6	-	81	-0.074	7.52	0.011
38	5.547	0.149	2.17	88	1.8	-	81	-0.074	7.59	0.011
39	5.693	0.146	2.17	89	1.7	-	81	-0.076	7.80	0.011
40	5.843	0.150	2.18	89	2.0	101	81	-0.075	7.95	0.015
41	5.988	0.145	2.18	89	1.5	-	81	-0.078	8.51	0.013
42	6.138	0.150	2.18	90	1.6	-	81	-0.076	9.08	0.020
43	6.284	0.146	2.18	90	1.6	-	81	-0.077	9.06	0.077
44	6.434	0.150	2.18	90	1.8	-	81	-0.079	9.20	0.044
45	6.580	0.146	2.19	91	1.6	-	81	-0.080	8.92	0.023
46	6.730	0.150	2.19	91	1.7	-	81	-0.078	8.77	0.022
47	6.876	0.146	2.19	91	1.5	-	81	-0.078	8.71	0.011
48	7.027	0.151	2.18	91	1.9	-	81	-0.080	8.43	0.010
49	7.173	0.146	2.19	91	1.5	-	82	-0.081	8.27	0.008
50	7.323	0.150	2.19	92	1.5	101	82	-0.077	8.42	0.008
51	7.469	0.146	2.18	92	1.7	-	82	-0.081	8.58	0.012
52	7.619	0.150	2.18	92	1.9	-	82	-0.080	8.56	0.005
53	7.765	0.146	2.18	93	1.9	-	82	-0.082	8.44	0.007
54	7.916	0.151	2.18	93	1.9	-	82	-0.081	8.34	0.007
55	8.062	0.146	2.18	93	1.5	-	82	-0.081	8.40	0.008
56	8.213	0.151	2.18	93	1.5	-	82	-0.081	8.53	0.007
57	8.359	0.146	2.19	93	1.8	-	82	-0.082	8.40	0.010
58	8.510	0.151	2.18	93	1.6	-	82	-0.083	8.51	0.006
59	8.656	0.146	2.19	94	1.5	-	82	-0.082	8.61	0.009
60	8.807	0.151	2.18	94	1.5	101	82	-0.083	8.70	0.011
61	8.953	0.146	2.19	94	1.6	-	82	-0.082	8.64	0.013
62	9.104	0.151	2.19	95	1.5	-	82	-0.082	8.97	0.015
63	9.250	0.146	2.19	95	1.9	-	83	-0.084	9.20	0.024

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
64	9.401	0.151	2.20	95	1.5	-	83	-0.085	9.04	0.016
65	9.547	0.146	2.19	95	1.7	-	83	-0.086	9.01	0.016
66	9.698	0.151	2.19	95	1.5	-	83	-0.083	8.80	0.015
67	9.844	0.146	2.19	96	2.0	-	83	-0.083	8.96	0.018
68	9.995	0.151	2.19	96	1.6	-	83	-0.087	8.98	0.016
69	10.142	0.147	2.20	96	1.8	-	83	-0.084	8.87	0.018
70	10.293	0.151	2.19	96	1.6	101	83	-0.083	8.70	0.011
71	10.439	0.146	2.19	96	1.9	-	83	-0.084	8.53	0.013
72	10.590	0.151	2.20	96	1.7	-	83	-0.084	8.39	0.015
73	10.737	0.147	2.20	97	1.5	-	83	-0.084	8.40	0.013
74	10.888	0.151	2.20	97	1.8	-	83	-0.083	8.25	0.016
75	11.035	0.147	2.19	97	1.8	-	83	-0.082	8.27	0.011
76	11.186	0.151	2.19	97	1.6	-	83	-0.081	8.37	0.014
77	11.333	0.147	2.19	97	1.6	-	83	-0.081	8.51	0.015
78	11.485	0.152	2.20	97	2.0	-	83	-0.083	8.37	0.013
79	11.631	0.146	2.20	97	1.5	-	83	-0.083	8.61	0.016
80	11.783	0.152	2.20	98	1.7	101	83	-0.083	8.50	0.013
81	11.930	0.147	2.20	98	1.6	-	83	-0.082	8.41	0.014
82	12.082	0.152	2.21	99	1.6	-	84	-0.083	8.46	0.014
83	12.229	0.147	2.20	98	1.5	-	84	-0.083	8.50	0.011
84	12.380	0.151	2.20	99	1.8	-	84	-0.081	8.00	0.012
85	12.527	0.147	2.20	99	1.6	-	84	-0.083	7.80	0.012
86	12.679	0.152	2.21	99	1.8	-	84	-0.081	7.60	0.014
87	12.826	0.147	2.20	99	1.8	-	84	-0.082	7.81	0.015
88	12.977	0.151	2.20	99	1.5	-	84	-0.079	7.48	0.014
89	13.125	0.148	2.20	99	1.6	-	84	-0.076	7.33	0.008
90	13.276	0.151	2.20	99	1.4	99	84	-0.078	7.19	0.009
91	13.424	0.148	2.20	99	1.5	-	84	-0.079	7.05	0.012
92	13.575	0.151	2.21	100	1.7	-	84	-0.079	6.99	0.009
93	13.723	0.148	2.20	100	1.5	-	84	-0.081	7.21	0.010
94	13.872	0.149	2.21	100	1.7	-	84	-0.075	7.14	0.006
95	14.023	0.151	2.20	100	1.5	-	84	-0.077	7.27	0.012

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
96	14.173	0.150	2.20	100	1.9	-	84	-0.080	7.06	0.012
97	14.322	0.149	2.19	100	1.7	-	84	-0.080	6.90	0.009
98	14.473	0.151	2.20	100	1.6	-	84	-0.079	6.92	0.009
99	14.622	0.149	2.20	100	1.5	-	84	-0.078	7.05	0.012
100	14.773	0.151	2.20	100	1.8	101	84	-0.076	7.06	0.012
101	14.923	0.150	2.21	100	1.6	-	84	-0.076	7.01	0.012
102	15.073	0.150	2.20	101	2.0	-	84	-0.077	7.02	0.012
103	15.223	0.150	2.20	101	1.8	-	84	-0.076	7.05	0.011
104	15.373	0.150	2.20	101	1.5	-	84	-0.075	6.97	0.014
105	15.523	0.150	2.20	101	1.6	-	84	-0.076	6.94	0.012
106	15.673	0.150	2.20	101	1.5	-	84	-0.076	6.89	0.011
107	15.824	0.151	2.21	101	1.7	-	84	-0.074	6.56	0.015
108	15.973	0.149	2.21	101	1.6	-	84	-0.077	7.14	0.014
109	16.123	0.150	2.21	101	1.6	-	84	-0.075	7.21	0.013
110	16.272	0.149	2.21	101	1.7	101	84	-0.075	7.19	0.014
111	16.423	0.151	2.20	101	1.5	-	84	-0.074	7.11	0.010
112	16.571	0.148	2.21	101	1.7	-	84	-0.075	6.85	0.011
113	16.723	0.152	2.21	101	1.7	-	84	-0.073	6.53	0.013
114	16.872	0.149	2.21	101	2.0	-	84	-0.074	6.35	0.011
115	17.023	0.151	2.21	101	2.0	-	84	-0.073	6.12	0.010
116	17.171	0.148	2.19	102	1.6	-	84	-0.074	6.44	0.010
117	17.324	0.153	2.21	102	1.8	-	84	-0.074	6.17	0.012
118	17.472	0.148	2.21	102	1.9	-	84	-0.073	6.42	0.009
119	17.625	0.153	2.20	102	1.7	-	84	-0.074	6.37	0.010
120	17.773	0.148	2.21	102	1.5	100	84	-0.072	6.29	0.009
121	17.925	0.152	2.21	102	1.6	-	84	-0.071	6.27	0.008
122	18.073	0.148	2.21	102	1.9	-	84	-0.074	6.40	0.013
123	18.226	0.153	2.21	102	1.9	-	84	-0.071	6.31	0.010
124	18.374	0.148	2.21	102	1.8	-	84	-0.069	6.44	0.012
125	18.527	0.153	2.21	102	1.7	-	84	-0.074	6.29	0.008
126	18.675	0.148	2.21	102	1.6	-	84	-0.074	6.23	0.010
127	18.827	0.152	2.21	102	2.0	-	84	-0.071	6.34	0.008

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
128	18.975	0.148	2.21	102	1.6	-	84	-0.070	6.33	0.007
129	19.127	0.152	2.21	102	2.0	-	84	-0.071	6.18	0.011
130	19.276	0.149	2.21	102	1.5	100	84	-0.069	6.24	0.009
131	19.427	0.151	2.21	102	1.8	-	84	-0.070	6.23	0.011
132	19.577	0.150	2.20	102	1.5	-	84	-0.068	6.49	0.011
133	19.728	0.151	2.21	103	1.5	-	84	-0.067	6.23	0.009
134	19.879	0.151	2.21	103	1.5	-	84	-0.072	6.36	0.007
135	20.030	0.151	2.21	103	1.8	-	84	-0.071	6.60	0.014
136	20.180	0.150	2.21	103	1.7	-	84	-0.072	6.55	0.011
137	20.331	0.151	2.21	103	1.7	-	84	-0.069	6.52	0.011
138	20.482	0.151	2.21	103	2.0	-	84	-0.070	6.36	0.009
139	20.632	0.150	2.21	103	1.5	-	84	-0.071	6.27	0.006
140	20.783	0.151	2.22	103	1.6	100	84	-0.068	6.26	0.006
141	20.932	0.149	2.21	103	1.7	-	84	-0.071	6.23	0.005
142	21.084	0.152	2.21	104	1.5	-	84	-0.068	6.08	0.008
143	21.233	0.149	2.21	104	1.6	-	84	-0.071	6.38	0.008
144	21.385	0.152	2.21	104	1.9	-	84	-0.070	6.55	0.008
145	21.534	0.149	2.20	104	1.5	-	84	-0.069	6.40	0.011
146	21.687	0.153	2.21	104	2.0	-	84	-0.073	6.62	0.011
147	21.836	0.149	2.21	104	1.9	-	84	-0.068	6.47	0.009
148	21.989	0.153	2.21	103	1.8	-	84	-0.072	6.29	0.008
149	22.137	0.148	2.21	103	1.9	-	84	-0.070	6.16	0.007
150	22.290	0.153	2.21	103	1.5	100	84	-0.069	5.22	0.010
151	22.439	0.149	2.21	103	1.7	-	84	-0.069	5.07	0.010
152	22.592	0.153	2.21	104	1.8	-	84	-0.068	4.90	0.007
153	22.740	0.148	2.22	104	1.9	-	84	-0.066	5.01	0.007
154	22.892	0.152	2.21	104	1.8	-	84	-0.069	4.81	0.014
155	23.041	0.149	2.22	104	1.4	-	84	-0.068	4.95	0.008
156	23.193	0.152	2.21	104	1.5	-	84	-0.065	5.01	0.009
157	23.342	0.149	2.20	104	1.5	-	84	-0.067	4.96	0.009
158	23.494	0.152	2.21	104	1.5	-	84	-0.065	4.87	0.009
159	23.645	0.151	2.21	104	1.6	-	84	-0.062	4.96	0.009

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
160	23.796	0.151	2.21	104	1.9	99	84	-0.065	4.81	0.006
161	23.947	0.151	2.21	104	2.0	-	84	-0.066	4.85	0.010
162	24.098	0.151	2.21	104	1.5	-	84	-0.065	4.75	0.007
163	24.249	0.151	2.22	104	1.6	-	84	-0.065	4.82	0.009
164	24.399	0.150	2.21	104	1.8	-	84	-0.067	4.84	0.006
165	24.551	0.152	2.22	104	1.6	-	84	-0.064	4.61	0.007
166	24.700	0.149	2.21	104	1.5	-	84	-0.066	4.57	0.007
167	24.853	0.153	2.22	104	1.7	-	84	-0.059	4.62	0.007
168	25.002	0.149	2.22	104	1.7	-	84	-0.060	4.63	0.010
169	25.154	0.152	2.20	104	1.9	-	84	-0.064	4.80	0.009
170	25.303	0.149	2.22	104	1.5	99	84	-0.062	4.66	0.007
171	25.457	0.154	2.21	104	1.7	-	84	-0.060	4.73	0.006
172	25.606	0.149	2.21	104	1.9	-	84	-0.063	4.61	0.008
173	25.759	0.153	2.21	104	1.5	-	84	-0.062	4.49	0.009
174	25.907	0.148	2.21	104	1.7	-	84	-0.060	4.60	0.006
175	26.061	0.154	2.21	105	1.9	-	84	-0.060	4.61	0.008
176	26.209	0.148	2.22	105	1.5	-	84	-0.060	4.65	0.012
177	26.362	0.153	2.21	105	2.0	-	84	-0.063	4.57	0.006
178	26.511	0.149	2.22	105	1.5	-	84	-0.060	4.73	0.009
179	26.663	0.152	2.22	105	2.0	-	84	-0.061	4.74	0.009
180	26.812	0.149	2.21	105	1.7	99	84	-0.057	4.76	0.008
181	26.965	0.153	2.21	105	2.0	-	84	-0.061	4.70	0.009
182	27.116	0.151	2.21	105	1.5	-	84	-0.057	4.58	0.005
183	27.267	0.151	2.22	105	1.7	-	84	-0.061	4.76	0.007
184	27.418	0.151	2.21	105	1.7	-	84	-0.057	4.72	0.010
185	27.569	0.151	2.21	105	1.6	-	84	-0.056	4.76	0.008
186	27.721	0.152	2.21	105	1.8	-	84	-0.060	4.87	0.008
187	27.871	0.150	2.22	105	1.8	-	84	-0.060	4.62	0.006
188	28.022	0.151	2.21	105	1.7	-	84	-0.061	4.71	0.008
189	28.172	0.150	2.22	105	1.8	-	84	-0.056	4.85	0.007
190	28.324	0.152	2.21	105	1.5	99	84	-0.057	4.74	0.007
191	28.473	0.149	2.21	105	2.0	-	84	-0.060	4.73	0.008

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

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 (%)
192	28.627	0.154	2.21	105	1.8	-	84	-0.060	4.78	0.006
193	28.776	0.149	2.21	105	1.8	-	84	-0.059	4.58	0.009
194	28.930	0.154	2.22	105	1.7	-	84	-0.059	4.68	0.010
195	29.078	0.148	2.22	105	1.6	-	84	-0.059	4.83	0.007
196	29.232	0.154	2.22	105	1.5	-	84	-0.058	4.79	0.009
197	29.381	0.149	2.22	105	1.6	-	84	-0.059	4.76	0.009
198	29.533	0.152	2.22	105	1.9	-	84	-0.060	4.69	0.009
199	29.682	0.149	2.22	105	1.5	-	84	-0.056	4.68	0.007
200	29.835	0.153	2.22	105	1.5	100	84	-0.058	4.48	0.008
201	29.984	0.149	2.21	105	1.8	-	84	-0.058	4.29	0.008
202	30.137	0.153	2.21	105	1.5	-	84	-0.058	4.41	0.008
203	30.288	0.151	2.22	105	2.0	-	84	-0.059	4.43	0.008
204	30.440	0.152	2.21	105	1.7	-	84	-0.057	4.44	0.009
205	30.591	0.151	2.21	105	1.5	-	84	-0.059	4.28	0.009
206	30.742	0.151	2.21	105	1.6	-	84	-0.057	4.45	0.010
207	30.894	0.152	2.22	105	1.6	-	84	-0.058	4.45	0.009
208	31.043	0.149	2.22	105	1.5	-	84	-0.059	4.27	0.009
209	31.196	0.153	2.22	105	1.6	-	84	-0.060	4.29	0.008
210	31.345	0.149	2.22	105	1.5	100	84	-0.055	4.30	0.011
211	31.498	0.153	2.21	105	1.9	-	84	-0.057	4.30	0.010
212	31.647	0.149	2.22	105	1.7	-	84	-0.058	4.39	0.011
213	31.802	0.155	2.22	105	1.9	-	84	-0.058	4.44	0.009
214	31.951	0.149	2.21	105	1.9	-	84	-0.058	4.38	0.008
215	32.104	0.153	2.21	105	1.7	-	84	-0.054	4.52	0.007
216	32.253	0.149	2.22	105	1.6	-	84	-0.056	4.34	0.013
217	32.407	0.154	2.22	106	1.6	98	84	-0.060	4.25	0.009
Avg/Tot	32.407	0.149	2.19	97.7	1.7	100	83.0	-0.070	6.16	0.013

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 6

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/11/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.000		0.24	80	1.4		77
1	0.153	0.153	1.06	79	1.9	-	77
2	0.307	0.154	1.07	79	1.9	-	78
3	0.462	0.155	1.08	79	1.8	-	77
4	0.617	0.155	1.09	79	1.9	-	78
5	0.772	0.155	1.09	79	1.7	-	78
6	0.927	0.155	1.10	80	1.8	-	78
7	1.083	0.156	1.09	80	1.8	-	78
8	1.240	0.157	1.09	80	1.8	-	78
9	1.397	0.157	1.10	80	1.9	-	78
10	1.554	0.157	1.11	80	1.7	97	78
11	1.711	0.157	1.11	80	1.9	-	78
12	1.868	0.157	1.11	80	1.8	-	78
13	2.024	0.156	1.10	80	1.9	-	78
14	2.182	0.158	1.10	81	1.8	-	78
15	2.340	0.158	1.11	81	1.9	-	78
16	2.498	0.158	1.11	81	1.9	-	78
17	2.656	0.158	1.12	82	1.8	-	79
18	2.813	0.157	1.12	82	1.7	-	79
19	2.971	0.158	1.11	82	1.9	-	79
20	3.131	0.160	1.12	82	1.7	98	79
21	3.290	0.159	1.13	83	1.8	-	79
22	3.447	0.157	1.13	83	1.7	-	79
23	3.607	0.160	1.12	83	1.7	-	79
24	3.767	0.160	1.13	83	1.8	-	80
25	3.927	0.160	1.14	84	1.8	-	80
26	4.086	0.159	1.13	84	1.8	-	80
27	4.247	0.161	1.13	85	1.8	-	80
28	4.408	0.161	1.14	85	1.7	-	80
29	4.567	0.159	1.14	85	1.8	-	80
30	4.729	0.162	1.14	85	2.0	100	80
31	4.890	0.161	1.15	85	2.0	-	80

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

Elapsed Time (min)	Particulate Sampling 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)
32	5.050	0.160	1.15	86	1.8	-	80
33	5.212	0.162	1.14	86	1.8	-	80
34	5.374	0.162	1.15	86	2.0	-	80
35	5.534	0.160	1.15	86	1.8	-	80
36	5.697	0.163	1.15	86	1.8	-	80
37	5.859	0.162	1.16	86	1.8	-	80
38	6.020	0.161	1.15	87	1.8	-	80
39	6.182	0.162	1.15	87	1.8	-	80
40	6.345	0.163	1.16	87	1.8	101	80
41	6.506	0.161	1.15	88	1.9	-	81
42	6.669	0.163	1.16	88	1.8	-	81
43	6.830	0.161	1.16	88	1.9	-	81
44	6.993	0.163	1.15	88	1.8	-	81
45	7.156	0.163	1.16	89	1.8	-	81
46	7.318	0.162	1.15	88	1.9	-	81
47	7.481	0.163	1.16	89	1.9	-	81
48	7.644	0.163	1.16	89	1.9	-	81
49	7.807	0.163	1.16	89	2.0	-	81
50	7.970	0.163	1.16	89	1.8	101	81
51	8.132	0.162	1.15	89	1.9	-	81
52	8.296	0.164	1.16	90	2.0	-	82
53	8.458	0.162	1.16	90	2.0	-	82
54	8.622	0.164	1.16	90	1.9	-	82
55	8.786	0.164	1.17	90	1.8	-	82
56	8.948	0.162	1.15	91	1.9	-	82
57	9.112	0.164	1.16	90	1.9	-	82
58	9.275	0.163	1.16	90	1.8	-	82
59	9.439	0.164	1.16	90	2.0	-	82
60	9.602	0.163	1.17	90	1.9	102	82
Avg/Tot	9.602	0.160	1.12	84.7	1.8	100	79.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	357	360	246	222	269	290.7	543.1
1	356	358	247	222	271	290.6	448.5
2	353	356	247	221	271	289.5	450.4
3	350	352	247	219	271	287.6	518.8
4	346	347	246	218	270	285.4	589.7
5	342	343	246	218	269	283.5	628.7
6	337	339	247	217	267	281.1	651.5
7	335	335	246	215	266	279.4	669.7
8	332	331	246	216	265	277.8	680.1
9	330	327	245	213	265	275.9	685.0
10	328	323	244	212	264	274.1	688.9
11	326	320	243	212	263	272.8	695.1
12	324	316	242	211	263	271.3	703.7
13	322	313	241	211	263	270.1	713.6
14	321	310	240	211	262	268.9	724.9
15	319	307	238	210	262	267.4	738.5
16	318	305	237	210	262	266.4	753.1
17	317	302	236	211	261	265.4	768.3
18	316	300	234	211	261	264.4	782.0
19	315	298	233	210	261	263.2	792.4
20	314	295	231	210	260	262.2	800.2
21	314	294	230	210	260	261.3	806.8
22	313	292	228	210	260	260.4	815.2
23	313	290	227	210	259	259.8	822.7
24	312	289	225	210	259	259.1	828.0
25	313	287	224	211	259	258.8	831.3
26	313	286	223	211	258	258.1	836.2
27	313	285	222	211	258	257.7	840.2
28	313	283	220	212	257	257.2	844.3
29	314	282	219	213	256	257.0	852.3
30	316	282	218	212	256	256.9	861.3
31	318	281	217	215	255	257.3	867.8
32	321	281	216	215	255	257.4	871.1
33	324	280	215	216	254	257.8	871.5
34	327	280	214	217	254	258.4	869.2
35	330	281	213	220	253	259.5	869.0
36	333	283	213	221	253	260.4	870.8
37	336	286	211	223	252	261.7	872.1
38	339	288	211	225	252	262.9	875.2
39	343	291	210	227	251	264.2	883.6
40	346	293	209	229	251	265.8	894.6
41	351	296	209	231	250	267.1	911.6
42	355	299	208	233	249	268.8	946.0
43	360	301	207	235	249	270.4	973.7
44	365	305	206	238	248	272.3	988.3
45	370	307	205	238	248	273.6	994.4
46	374	310	205	241	247	275.4	994.4
47	378	313	205	244	247	277.3	993.2

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	382	315	204	245	247	278.5	985.1
49	386	317	204	249	246	280.5	978.0
50	390	320	204	253	245	282.3	980.8
51	393	322	203	256	245	283.8	987.3
52	396	324	203	258	244	285.1	990.1
53	398	327	203	262	243	286.5	980.8
54	399	331	203	262	243	287.5	973.3
55	400	334	203	266	242	289.0	969.0
56	401	337	203	266	241	289.7	968.1
57	402	341	203	268	241	291.0	970.4
58	404	344	203	271	240	292.6	973.8
59	405	348	204	273	240	293.8	978.9
60	407	351	204	275	239	295.3	978.8
61	409	354	204	276	239	296.5	981.7
62	411	357	204	279	239	298.1	990.4
63	413	360	205	282	238	299.5	994.7
64	414	363	205	282	238	300.6	996.5
65	416	366	205	283	238	301.6	993.5
66	418	368	206	284	238	302.5	986.1
67	419	370	207	285	237	303.5	982.0
68	421	373	207	289	237	305.3	979.7
69	423	375	208	290	236	306.4	972.3
70	425	377	209	292	236	307.7	964.3
71	427	379	209	292	236	308.7	956.4
72	429	380	210	292	235	309.3	950.5
73	430	383	211	295	235	310.8	945.6
74	431	384	212	296	234	311.3	940.4
75	434	386	213	297	234	312.7	937.7
76	435	387	214	297	234	313.4	940.7
77	437	389	215	296	234	314.1	946.7
78	439	390	216	296	235	315.0	949.9
79	440	392	217	297	235	316.0	952.7
80	442	393	217	296	235	316.8	954.0
81	443	395	218	296	235	317.4	949.7
82	445	396	220	297	235	318.6	947.9
83	446	398	220	298	235	319.5	946.7
84	447	400	221	297	236	320.1	941.1
85	448	401	223	297	236	321.0	932.6
86	450	402	224	297	236	321.7	929.8
87	451	403	225	298	236	322.5	928.2
88	452	405	226	299	235	323.2	921.5
89	452	406	227	300	235	324.0	915.5
90	453	407	228	300	236	324.7	911.4
91	453	408	229	301	236	325.2	905.7
92	453	409	230	301	236	325.7	897.0
93	453	410	231	300	236	325.9	889.4
94	453	411	232	300	235	326.3	885.2
95	453	412	233	302	236	327.1	884.0

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	454	413	233	299	236	327.0	882.2
97	454	414	234	299	237	327.4	879.8
98	454	414	235	297	237	327.4	876.9
99	454	415	236	297	237	327.7	874.1
100	454	415	237	296	238	328.0	869.0
101	454	416	238	297	238	328.6	862.5
102	454	416	239	296	239	328.7	857.9
103	454	417	240	294	239	328.7	854.1
104	454	417	240	293	239	328.6	850.4
105	454	417	241	291	240	328.5	847.9
106	452	418	242	290	241	328.5	846.1
107	451	418	243	289	242	328.7	848.3
108	450	419	243	288	243	328.6	862.2
109	449	419	244	286	244	328.5	875.7
110	448	420	245	287	245	328.9	880.7
111	446	420	246	288	246	329.1	881.3
112	446	421	247	285	247	329.1	880.6
113	445	421	248	284	248	328.9	876.2
114	443	421	248	283	248	328.7	868.7
115	442	420	249	283	249	328.7	862.4
116	443	420	250	283	250	329.0	857.6
117	442	420	251	283	251	329.4	853.2
118	442	419	252	283	251	329.4	848.0
119	442	419	253	284	252	329.9	844.2
120	442	419	253	283	253	330.0	840.1
121	442	418	254	284	254	330.3	836.6
122	441	418	255	283	254	330.3	834.3
123	441	417	256	283	255	330.3	833.8
124	440	417	256	283	256	330.5	833.1
125	439	416	257	283	257	330.5	830.3
126	439	416	257	283	259	330.8	827.1
127	438	416	258	283	260	331.0	825.1
128	437	415	259	281	262	330.7	823.7
129	437	415	260	279	263	330.4	822.8
130	436	415	260	277	264	330.5	822.7
131	436	414	261	278	265	330.9	823.4
132	435	414	262	277	267	330.8	824.8
133	434	414	263	276	268	331.0	826.6
134	434	414	263	276	269	330.9	828.8
135	433	414	264	274	269	330.7	831.4
136	432	414	264	275	270	331.1	832.8
137	431	413	265	275	270	331.0	832.7
138	430	414	266	274	271	330.9	830.5
139	429	414	266	275	273	331.3	824.9
140	428	414	267	273	274	331.2	819.8
141	427	415	268	272	276	331.4	816.6
142	426	416	269	273	277	331.9	814.9
143	425	416	270	272	278	332.1	814.4

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

Stove ΔT: 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
144	424	417	270	272	279	332.4	815.4
145	423	417	271	271	280	332.6	816.7
146	423	418	271	270	282	332.7	818.0
147	422	419	272	270	282	333.1	817.1
148	422	420	273	268	283	333.1	812.9
149	421	421	273	268	284	333.6	807.8
150	421	421	274	267	285	333.8	798.7
151	420	421	275	269	287	334.2	785.3
152	419	420	276	267	288	334.0	773.7
153	419	419	276	266	289	333.7	761.6
154	418	418	276	264	290	333.2	749.7
155	417	416	277	264	291	333.0	740.3
156	416	415	278	264	292	333.0	733.3
157	416	414	278	263	293	332.8	728.4
158	415	413	279	263	294	332.7	725.3
159	414	412	280	263	295	332.6	722.4
160	413	410	280	262	296	332.2	718.9
161	412	409	281	262	297	331.9	715.3
162	411	407	281	261	298	331.4	712.1
163	410	405	282	259	299	330.9	706.8
164	408	404	282	258	300	330.2	701.1
165	407	402	282	256	301	329.4	696.7
166	405	400	283	254	302	328.7	693.3
167	404	399	283	252	303	328.2	690.2
168	403	398	283	251	304	327.6	687.6
169	402	396	283	249	304	326.9	685.4
170	402	395	284	248	305	326.4	683.3
171	401	393	284	248	305	326.0	681.3
172	399	392	284	245	306	325.0	679.6
173	398	390	284	244	307	324.5	678.0
174	397	389	284	242	308	323.9	676.2
175	396	388	285	241	309	323.6	674.2
176	395	387	284	241	309	323.2	672.3
177	394	385	284	239	310	322.4	671.2
178	393	384	284	239	310	322.0	670.4
179	392	383	284	238	310	321.4	669.8
180	391	382	284	237	311	320.8	668.8
181	391	381	284	235	311	320.1	667.4
182	390	380	284	233	311	319.3	666.0
183	389	378	283	231	311	318.5	664.6
184	388	377	283	230	311	317.9	663.0
185	388	376	283	230	312	317.8	662.1
186	387	375	283	228	312	317.1	661.6
187	386	374	283	228	313	316.6	661.4
188	385	373	283	227	313	316.2	660.1
189	385	372	282	227	313	315.7	658.8
190	384	372	282	227	313	315.4	657.8
191	383	371	282	226	313	314.8	657.3

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 6

Technician: SJB

Date: 7/11/2023

Stove ΔT : 11

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
192	382	370	282	225	313	314.3	656.9
193	381	369	282	223	313	313.6	657.1
194	380	368	282	222	313	313.0	656.9
195	379	367	281	223	314	312.8	656.9
196	379	367	281	223	314	312.5	656.4
197	378	366	281	223	314	312.4	656.4
198	377	365	281	222	315	311.9	656.7
199	376	364	281	222	315	311.5	656.6
200	375	363	281	220	315	310.8	656.4
201	374	362	280	218	316	310.2	655.8
202	374	362	280	219	315	309.8	655.8
203	373	361	280	218	315	309.2	655.7
204	371	360	280	217	315	308.6	655.6
205	370	360	280	216	315	308.1	655.7
206	369	359	279	217	316	307.9	655.9
207	368	358	279	215	316	307.1	656.3
208	366	357	279	215	317	306.6	656.6
209	365	356	279	213	317	306.0	656.9
210	364	356	279	212	317	305.4	656.8
211	363	355	278	212	317	304.8	657.6
212	362	354	278	212	317	304.4	657.7
213	361	354	277	211	318	304.1	657.7
214	360	353	277	211	317	303.5	657.4
215	359	352	277	211	317	303.3	656.6
216	357	352	276	210	318	302.6	655.7
217	357	351	276	209	318	302.0	655.3
Average	397.3	371.7	247.4	254.3	269.0	307.9	805.1

LAB SAMPLE DATA - ASTM E2515

Client: Jotul
 Model: F445
 Run #: 6

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/11/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G616	242.7	243.1	0.4
	B	G617	243.8	243.8	0.0
	C - 1st Hour	G618	243.1	243.4	0.3
	Amb	G619	242.1	242.2	0.1
Probes	A	10A	116645.0	116645.2	0.2
	B	10B	117753.0	117753.0	0.0
	C - 1st Hour	10C	116727.7	116727.9	0.2
O-rings	A	10A	3361.9	3361.8	0.0*
	B	10B	3571.1	3571.7	0.6
	C - 1st Hour	10C	3366.6	3366.7	0.1

*Negative value corrected to zero

Placed in Dessicator on: 7/11 - 16:30

Balance Audit (mg): 100.0 100.0

Filters	A	243.1	7/13 10:00	243.1	7/14 9:00				
	B	243.8	7/13 10:00	243.8	7/14 9:00				
	C - 1st Hour	243.5	7/13 10:00	243.4	7/14 9:00				
	Amb	242.2	7/13 10:00	242.2	7/14 9:00				
Probes	A	116645.3	7/13 10:00	116645.2	7/14 9:00				
	B	117752.9	7/13 10:00	117753.0	7/14 9:00				
	C - 1st Hour	116727.8	7/13 10:00	116727.9	7/14 9:00				
O-Rings	A	3361.8	7/13 10:00	3361.8	7/14 9:00				
	B	3571.7	7/13 10:00	3571.7	7/14 9:00				
	C - 1st Hour	3366.8	7/13 10:00	3366.7	7/14 9:00				

Train A Aggregate, mg:	0.6
Train B Aggregate, mg:	0.6
Train C Aggregate, mg:	0.6
Ambient, mg:	0.1

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 7 Test Date: 7/12/2023

Wood Heater Run Notes

Test Control Settings

Primary Air Setting(s): 3/16" open from Fully Closed
Targeted Burn Category: Medium Low – FAN CONFIRMATION TEST

Preburn Notes

Time	Notes
	FAN CONFIRMATION TEST FAN NOT USED DURING THIS TEST
8:35	Started kindling fire with ~6 lbs of fuel, air set to fully open
8:55	With 1.6 lbs of coals left, added preburn fuel load, door closed immediately
9:08	Turned air down to halfway open
9:18	At 9.83 lbs turned air down to test setting
10:48	@3.59 lbs, stirred coals to ensure full charcoalization
11:08	@ 3.16lbs leveled coal bed in preparation of fuel loading, air control at test setting

Test Notes

Test Burn Start Time: 11:09 Test Fuel Loaded by: 30 seconds
Door Closed: 35 seconds Air Control Set at: 0 seconds
Other Loading Notes: N/A

Time	Notes
	FAN CONFIRMATION TEST FAN NOT USED DURING THIS TEST
11:09	Loaded test fuel, door closed immediately, air set to test setting
16:20	End of test

Test Burn End Time: 16:20

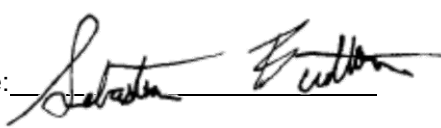
Flue Gas Concentration Measurement

Calibration Gas Values: Span Gas CO₂ (%): 17.01 CO (%): 4.306
Mid Gas CO₂ (%): 10.09 CO (%): 2.530

Calibration Results:

	Pre Test			Post Test		
	Zero	Mid	Span	Zero	Mid	Span
Time	9:30	9:34	9:32	16:32	16:30	16:28
CO ₂	0.00	10.17	17.04	0.04	10.08	16.98
CO	0.000	2.504	4.315	-0.011	2.496	4.298

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

Technician Signature:  Date: 7/13/2023

ASTM E2780 Wood Heater Run Sheets

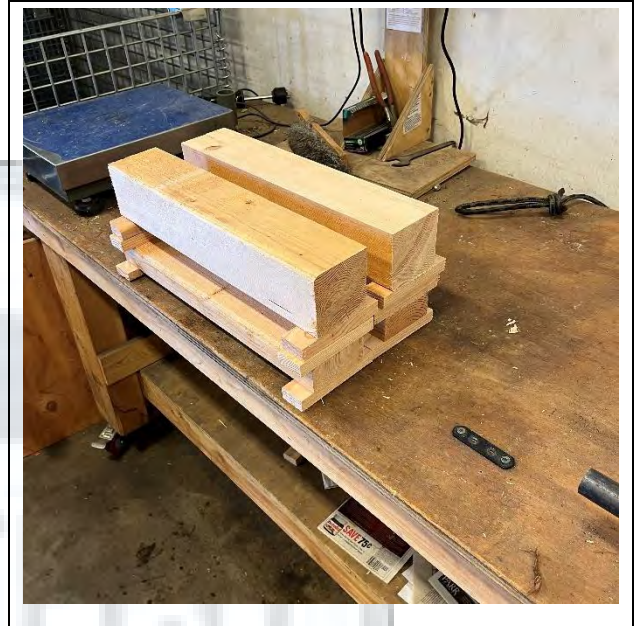
Client: Jotul
Model: F445

Job Number: 23-167
Run Number: 7

Tracking #: 152
Test Date: 7/12/2023



Test Fuel Front View



Test Fuel Iso View



Test Fuel Loaded in Stove



Air Setting

Technician Signature: _____

Sebastian E. Sutton

Date: 7/13/2023

ASTM E2780 Wood Heater Run Sheets

Client: Jotul Job Number: 23-167 Tracking #: 152
Model: F445 Run Number: 7 Test Date: 7/12/2023

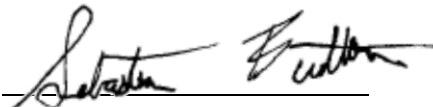
REVISION HISTORY

Version Number	Issue Date	Summary of Changes
Version 1.0	20-Sep-22	Initial release into the BMS

DOCUMENT APPROVAL

Version Number	Approval Date	Approved by
Version 1.0	20-Sep-22	John Steinert



Technician Signature:  Date: 7/13/2023

WOOD STOVE TEST DATA PACKET
ASTM E2780/E2515



Run 7 Data Summary

Client:	Jotul
Model:	F445
Job #:	23-167
Tracking #:	152
Test Date:	7/12/2023

Technician Signature

7/17/2023

Date

TEST RESULTS - ASTM E2780 / ASTM E2515

Client: Jotul

Model: F445

Run #: 7

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/12/2023

Burn Rate (kg/hr):	1.08
---------------------------	-------------

	Ambient Sample	Sample Train A	Sample Train B	1st Hour Filter
Total Sample Volume (ft ³)	35.105	49.169	46.378	9.669
Average Gas Velocity in Dilution Tunnel (ft/sec)	8.1			
Average Gas Flow Rate in Dilution Tunnel (dscf/hr)	21254.8			
Average Gas Meter Temperature (°F)	76.0	99.4	98.5	83.2
Total Sample Volume (dscf)	35.367	47.091	44.068	9.272
Average Tunnel Temperature (°F)	94.1			
Total Time of Test (min)	311			
Total Particulate Catch (mg)	0.0	0.8	1.0	0.6
Particulate Concentration, dry-standard (g/dscf)	0.0000000	0.0000170	0.0000227	0.0000647
Total PM Emissions (g)	0.00	1.87	2.50	1.38
Particulate Emission Rate (g/hr)	0.00	0.36	0.48	1.38
Emissions Factor (g/kg)	-	0.33	0.45	-
Difference from Average Total Particulate Emissions (g)	-	0.31	0.31	-
Difference from Average Total Particulate Emissions (%)	-	14.4%	14.4%	-
Difference from Average Emissions Factor (g/kg)	-	0.06	0.06	-

Final Average Results	
Total Particulate Emissions (g)	2.19
Particulate Emission Rate (g/hr)	0.42
Emissions Factor (g/kg)	0.39
HHV Efficiency (%)	74.1%
LHV Efficiency (%)	80.1%
CO Emissions (g/min)	0.13

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	84.4	OK
Face Velocity	< 30 ft/min	11.5	OK
Leakage Rate	Less than 4% of average sample rate	0.002 cfm	OK
Ambient Temp	55-90 °F	Min:73.4/Max:77.2	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	28.5	OK

B415.1 Efficiency Results

Manufacturer: Jotul
Model: F445
Date: 07/12/23
Run: 7
Control #: 23-167
Test Duration: 311
Output Category: 2

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	74.1%	80.1%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	74.5%	80.5%

Output Rate (kJ/h)	15,755	14,946	(Btu/h)
Burn Rate (kg/h)	1.07	2.36	(lb/h)
Input (kJ/h)	21,255	20,163	(Btu/h)

Test Load Weight (dry kg)	5.56	12.26	dry lb
MC wet (%)	17.24		
MC dry (%)	20.83		
Particulate (g)	2.19		
CO (g)	40		
Test Duration (h)	5.18		

Emissions	Particulate	CO
g/MJ Output	0.03	0.49
g/kg Dry Fuel	0.39	7.13
g/h	0.42	7.65
g/min	0.01	0.13
lb/MM Btu Output	0.06	1.13

Air/Fuel Ratio (A/F)	25.85
-----------------------------	-------

VERSION:

2.4

4/15/2010

WOODSTOVE FUEL DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

Preburn Fuel Information						
Size	Length (in)	Moisture Content (% DB)		Size	Length (in)	Moisture Content (% DB)
2x4	18.25	21.5		2x4	18.25	20.0
2x4	18.25	24.5		2x4	18.25	20.0
2x4	18.25	20.4				
2x4	18.25	19.5				
2x4	18.25	18.6				
2x4	11.00	22.2				
2x4	11.00	20.3				
2x4	11.00	23.6				
Total Fuel Weight (lbs):		13.23	Average Moisture (%DB):		21.1	

Firebox Volume (ft³): 2.03
 Total 2x4 Crib Weight, with spacers (lbs): 5.48
 Total 4x4 Crib Weight, with spacers (lbs): 9.36
 Total Wet Fuel Weight, with spacers (lbs): 14.84

Coal Bed Range (20-25%):

Min (lbs): 2.97
 Max (lbs): 3.71

Test Fuel Information						
Size	Length (in)	Weight (lbs)	Moisture Content (%DB)			Dry Weight (lbs)
2x4	18.25	2.23	20.0	18.7	19.3	1.87
2x4	18.25	2.34	21.2	22.7	19.7	1.93
4x4	18.25	4.51	25.2	21.3	19.3	3.70
4x4	18.25	4.41	20.4	21.6	20.5	3.65
Total Dry Weight, no spacers (lbs):						11.15
Total Dry Weight, with spacers (lbs):						12.38

Spacer Moisture Readings (%DB)						
8.6	11.5	8.9				
10.6	10.3	10.9				
9.7	10.4	8.4				
7.8	7.9	11.7				

Quality Checks	Requirement	Observed	Result
Fuel Density	25 - 36 (lbs/ft ³ , DB)	30.2	OK
Loading Density	6.3 - 7.7 (lbs/ft ³ , WB)	7.31	OK
2x4 Fuel Mix	35 - 65 % of total weight	37%	OK

DILUTION TUNNEL & MISC. DATA - ASTM E2780 / E2515

Client: Jotul
 Model: F445
 Run #: 7
 Test Start Time: 11:09

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

Total Sampling Time (min): 311
 Recording Interval (min): 1

Meter Box γ Factor: 1.010 (A)
 Meter Box γ Factor: 1.001 (B)
 Meter Box γ Factor: 0.985 (C)
 Meter Box γ Factor: 1.024 (Ambient)

Induced Draft Check (in. H₂O): 0
 Smoke Capture Check (%): 100%
 Date Flue Pipe Last Cleaned: 7/3/2023
 Test Fuel Scale Audit (lbs): 10.00
 Platform Scale Audit (lbs): 10.0

	Pre-Test	Post Test	Avg.
Barometric Pressure (in. Hg)	29.94	29.85	29.90
Relative Humidity (%)	45.9	30.5	
Room Air Velocity (ft/min)	0	0	
Pitot Tube Leak Check	0	0	
Ambient Sample Volume:		35.105	ft ³

Sample Train Leak Checks

	Pre-test	Post-test		
(A)	0.001	0.002	cfm @	-5 in. Hg
(B)	0.001	0.000	cfm @	-5 in. Hg
(C)	0.002	0.001	cfm @	-5 in. Hg
(Ambient)	0.000	0.000	cfm @	-5 in. Hg

DILUTION TUNNEL FLOW

Traverse Data

Point	dP (in H ₂ O)	Temp (°F)
1	0.010	92
2	0.014	92
3	0.018	92
4	0.018	92
5	0.016	92
6	0.008	92
7	0.012	92
8	0.016	92
9	0.018	92
10	0.018	92
11	0.014	92
12	0.010	92
Center	0.017	92

Dilution Tunnel H₂O: 2.00 percent

Tunnel Diameter: 12 inches

Pitot Tube Cp: 0.99 [unitless]

Dilution Tunnel MW(dry): 29.00 lb/lb-mole

Dilution Tunnel MW(wet): 28.78 lb/lb-mole

Tunnel Area: 0.7854 ft²

V_{strav}: 8.05 ft/sec

V_{scnt}: 8.83 ft/sec

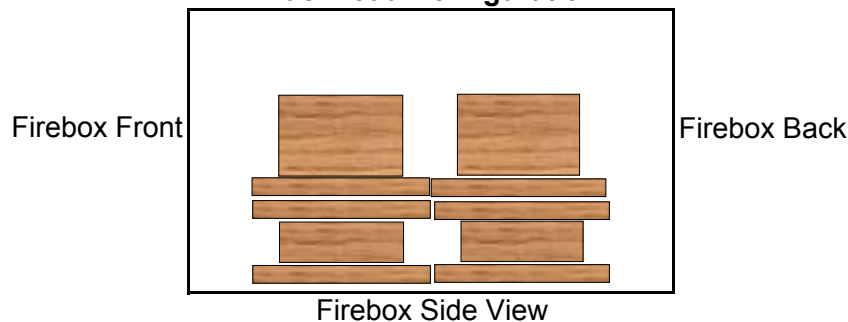
F_p: 0.911 [ratio]

Initial Tunnel Flow: 355.3 scf/min

Static Pressure: -0.096 in. H₂O

TEST FUEL PROPERTIES

Fuel Load Configuration



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)	20.8

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 7

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/12/2023

Recording Interval (min): 1
Run Time (min): 110

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	9.83	-0.094	388	343	185	287	182	277.0	502	72
1	9.66	-0.092	392	348	186	291	184	280.4	465	72
2	9.52	-0.089	396	353	188	296	185	283.5	442	73
3	9.39	-0.087	398	356	189	300	186	285.8	428	73
4	9.26	-0.086	400	358	190	304	186	287.6	417	73
5	9.15	-0.085	402	360	192	306	187	289.3	408	73
6	9.03	-0.082	404	362	193	308	187	290.7	402	73
7	8.93	-0.083	406	363	194	311	187	292.0	395	73
8	8.83	-0.082	407	364	195	312	186	293.1	388	72
9	8.73	-0.081	409	366	197	313	187	294.3	381	72
10	8.64	-0.079	411	368	198	315	186	295.5	375	72
11	8.54	-0.080	413	370	199	315	186	296.5	371	72
12	8.45	-0.079	414	372	201	315	186	297.4	365	72
13	8.37	-0.078	415	374	202	315	186	298.2	361	72
14	8.29	-0.077	416	375	203	315	185	299.0	358	72
15	8.21	-0.077	416	377	204	315	185	299.3	354	72
16	8.13	-0.076	415	379	205	313	184	299.4	350	72
17	8.05	-0.076	415	381	206	312	184	299.5	349	72
18	7.97	-0.077	414	384	207	311	184	299.9	346	72
19	7.89	-0.075	415	386	208	310	183	300.5	344	72
20	7.81	-0.074	414	389	209	308	183	300.6	342	72
21	7.73	-0.076	414	391	210	308	182	300.9	340	72
22	7.66	-0.072	414	393	211	306	182	301.0	338	72
23	7.59	-0.072	413	395	211	305	182	301.1	337	73
24	7.51	-0.071	413	396	212	303	181	301.0	334	72
25	7.44	-0.075	413	398	213	301	181	301.2	333	72
26	7.38	-0.071	414	399	214	301	181	301.5	331	73
27	7.31	-0.074	414	399	214	299	180	301.3	330	73
28	7.23	-0.071	416	397	215	298	180	300.8	328	73
29	7.17	-0.072	417	396	216	296	179	300.5	327	73
30	7.10	-0.073	417	394	216	295	178	300.0	327	72
31	7.03	-0.071	418	392	217	292	178	299.3	326	72
32	6.96	-0.070	418	390	217	292	178	298.8	324	73
33	6.89	-0.071	417	388	217	291	177	298.1	324	72
34	6.83	-0.071	417	387	218	289	177	297.7	322	72
35	6.76	-0.069	417	385	219	288	177	297.1	322	72
36	6.69	-0.070	416	385	219	288	177	296.9	321	72
37	6.62	-0.070	415	383	220	286	177	296.1	321	72
38	6.56	-0.071	414	382	220	286	177	295.8	319	73
39	6.50	-0.071	413	382	221	285	176	295.4	318	72
40	6.44	-0.069	412	382	221	284	176	295.0	316	72
41	6.37	-0.067	412	382	221	283	176	294.9	314	72
42	6.31	-0.070	412	382	222	283	177	294.8	315	73
43	6.24	-0.068	411	382	223	282	177	294.7	313	73
44	6.18	-0.067	411	382	223	281	177	294.5	312	73

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul

Model: F445

Run #: 7

Job #: 23-167

Tracking #: 152

Technician: SJB

Date: 7/12/2023

Recording Interval (min): 1
Run Time (min): 110

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
45	6.11	-0.068	410	381	223	279	177	294.1	312	73
46	6.05	-0.068	410	382	223	279	177	294.1	312	72
47	5.97	-0.068	409	381	224	278	177	293.9	314	73
48	5.89	-0.069	408	381	224	277	178	293.6	316	73
49	5.81	-0.071	406	381	224	277	178	293.2	318	72
50	5.72	-0.070	405	382	225	276	178	292.9	321	73
51	5.64	-0.072	403	383	225	275	178	292.8	323	72
52	5.57	-0.070	402	384	225	274	178	292.5	322	73
53	5.49	-0.073	402	384	225	274	179	292.6	323	73
54	5.43	-0.069	402	384	226	274	179	292.7	323	72
55	5.35	-0.070	401	383	226	274	179	292.6	322	73
56	5.28	-0.070	400	383	226	274	180	292.4	323	73
57	5.21	-0.068	399	382	226	274	180	292.3	321	72
58	5.14	-0.070	399	382	226	274	180	292.3	320	73
59	5.06	-0.072	398	382	226	275	181	292.3	320	73
60	4.98	-0.069	397	382	227	275	181	292.4	321	73
61	4.91	-0.070	396	383	227	275	182	292.4	324	73
62	4.83	-0.069	395	383	227	276	182	292.5	323	73
63	4.76	-0.068	395	383	227	276	182	292.7	323	73
64	4.68	-0.072	395	383	228	276	183	292.8	323	73
65	4.61	-0.068	394	384	228	276	184	293.1	322	73
66	4.54	-0.069	394	384	228	277	184	293.5	321	73
67	4.48	-0.069	393	385	229	278	185	293.9	320	73
68	4.42	-0.068	393	385	230	278	185	294.3	319	73
69	4.37	-0.066	394	385	230	279	186	294.7	316	73
70	4.32	-0.066	394	386	231	280	187	295.4	312	74
71	4.28	-0.066	394	385	231	279	188	295.4	310	73
72	4.23	-0.066	394	384	231	279	189	295.4	307	73
73	4.20	-0.066	395	384	231	279	190	295.7	306	73
74	4.16	-0.066	394	383	232	278	192	295.7	305	73
75	4.12	-0.064	394	382	232	277	193	295.9	303	74
76	4.07	-0.066	394	382	233	277	195	295.8	300	74
77	4.04	-0.065	393	381	233	276	196	296.0	299	73
78	3.99	-0.064	392	380	233	274	198	295.6	299	74
79	3.96	-0.064	392	380	234	274	200	295.7	297	73
80	3.92	-0.063	391	380	234	273	202	295.9	295	74
81	3.89	-0.064	390	380	235	273	204	296.1	294	73
82	3.85	-0.063	388	379	235	272	206	296.1	291	73
83	3.81	-0.060	387	380	235	271	209	296.3	290	73
84	3.78	-0.061	386	379	236	269	211	296.2	289	73
85	3.74	-0.061	385	379	236	268	214	296.4	288	74
86	3.71	-0.061	384	379	237	267	217	296.6	287	73
87	3.68	-0.060	383	378	237	266	219	296.8	286	74
88	3.65	-0.062	382	378	238	265	222	297.0	286	74
89	3.62	-0.062	382	377	238	264	225	297.0	284	74

WOODSTOVE PREBURN DATA - ASTM E2780

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

Recording Interval (min): 1
 Run Time (min): 110

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
90	3.59	-0.061	381	376	238	263	227	297.1	283	74
91	3.50	-0.071	381	375	239	262	230	297.2	354	74
92	3.47	-0.060	380	374	239	261	233	297.4	307	73
93	3.44	-0.060	382	373	239	260	235	297.8	286	74
94	3.41	-0.060	383	373	240	258	237	298.0	277	74
95	3.38	-0.058	383	372	240	257	238	297.9	274	74
96	3.36	-0.057	382	371	240	255	239	297.3	271	73
97	3.34	-0.058	380	369	240	254	241	296.8	270	73
98	3.32	-0.058	378	368	241	252	242	296.2	268	73
99	3.31	-0.057	376	367	241	251	243	295.6	265	73
100	3.30	-0.057	373	365	242	251	244	295.1	263	73
101	3.28	-0.057	371	364	242	249	246	294.4	260	73
102	3.27	-0.055	369	362	243	248	247	293.8	258	73
103	3.25	-0.055	367	361	243	246	247	292.9	256	73
104	3.24	-0.054	365	359	244	246	248	292.4	253	73
105	3.22	-0.053	364	357	244	245	249	291.8	252	73
106	3.22	-0.054	362	356	244	243	250	291.2	251	74
107	3.20	-0.053	360	354	245	242	250	290.3	250	74
108	3.19	-0.054	359	353	245	241	251	289.8	248	73
109	3.18	-0.053	357	351	246	239	252	289.2	247	74
110	3.16	-0.053	356	350	246	238	253	288.5	246	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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		0.017	0.68	77	0.7		14.81		96	292	76	74
1	0.141	0.141	0.017	1.98	77	0.9	-	14.82	0.01	98	286	76	74
2	0.279	0.138	0.018	2.03	77	0.9	-	14.79	-0.03	91	248	76	74
3	0.427	0.148	0.017	2.05	77	0.9	-	14.76	-0.03	89	234	76	74
4	0.569	0.142	0.017	2.08	77	0.9	-	14.74	-0.02	88	230	76	75
5	0.716	0.147	0.017	2.10	77	0.9	-	14.71	-0.03	88	229	76	75
6	0.860	0.144	0.017	2.13	77	0.9	-	14.69	-0.02	88	229	76	74
7	1.002	0.142	0.017	2.13	78	0.9	-	14.67	-0.02	88	229	77	74
8	1.151	0.149	0.017	2.16	78	0.8	-	14.64	-0.03	88	228	77	74
9	1.298	0.147	0.017	2.17	78	0.9	-	14.62	-0.02	87	228	77	74
10	1.446	0.148	0.017	2.17	78	0.8	95	14.58	-0.04	87	228	77	74
11	1.591	0.145	0.018	2.19	78	0.9	-	14.56	-0.02	87	227	77	74
12	1.738	0.147	0.016	2.20	78	0.9	-	14.53	-0.03	87	227	77	74
13	1.886	0.148	0.018	2.21	78	0.8	-	14.49	-0.04	86	229	77	74
14	2.037	0.151	0.017	2.21	79	0.9	-	14.46	-0.03	87	229	77	74
15	2.183	0.146	0.017	2.23	79	0.9	-	14.43	-0.03	86	230	77	74
16	2.335	0.152	0.017	2.23	79	0.8	-	14.39	-0.04	86	232	77	74
17	2.481	0.146	0.017	2.24	80	0.9	-	14.35	-0.04	86	233	77	74
18	2.634	0.153	0.017	2.26	80	0.9	-	14.31	-0.04	87	234	77	74
19	2.780	0.146	0.017	2.24	80	0.9	-	14.25	-0.06	86	237	77	74
20	2.933	0.153	0.017	2.26	80	0.9	97	14.22	-0.03	86	238	77	74
21	3.080	0.147	0.017	2.26	81	0.9	-	14.16	-0.06	87	242	77	73
22	3.234	0.154	0.017	2.26	81	0.9	-	14.09	-0.07	87	246	77	73
23	3.381	0.147	0.017	2.27	81	0.9	-	14.03	-0.06	88	249	77	74
24	3.535	0.154	0.017	2.28	81	0.9	-	13.97	-0.06	89	251	77	74
25	3.683	0.148	0.017	2.27	82	0.9	-	13.91	-0.06	88	253	77	74
26	3.837	0.154	0.017	2.29	82	0.9	-	13.86	-0.05	88	255	77	74
27	3.986	0.149	0.017	2.28	82	0.9	-	13.80	-0.06	88	257	77	74
28	4.140	0.154	0.017	2.30	83	0.9	-	13.74	-0.06	88	258	77	74
29	4.287	0.147	0.017	2.29	83	0.9	-	13.68	-0.06	89	259	77	74
30	4.443	0.156	0.017	2.30	83	0.9	98	13.62	-0.06	89	258	78	74
31	4.593	0.150	0.017	2.30	84	0.9	-	13.57	-0.05	89	258	78	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
32	4.744	0.151	0.017	2.30	84	0.9	-	13.51	-0.06	89	259	78	74
33	4.895	0.151	0.017	2.31	84	0.9	-	13.46	-0.05	89	261	78	74
34	5.048	0.153	0.017	2.31	85	0.9	-	13.40	-0.06	89	261	78	73
35	5.200	0.152	0.017	2.30	85	0.9	-	13.33	-0.07	89	263	78	73
36	5.356	0.156	0.017	2.32	85	0.9	-	13.27	-0.06	89	265	78	74
37	5.508	0.152	0.017	2.33	86	0.9	-	13.20	-0.07	89	268	78	74
38	5.659	0.151	0.017	2.32	86	0.9	-	13.13	-0.07	90	270	78	74
39	5.817	0.158	0.017	2.33	86	0.9	-	13.06	-0.07	89	272	78	74
40	5.967	0.150	0.017	2.32	87	0.9	98	12.99	-0.07	89	275	78	74
41	6.123	0.156	0.017	2.33	87	0.9	-	12.92	-0.07	89	278	78	74
42	6.273	0.150	0.017	2.32	87	0.9	-	12.84	-0.08	89	280	78	74
43	6.431	0.158	0.017	2.34	88	0.9	-	12.77	-0.07	90	283	78	74
44	6.579	0.148	0.017	2.34	88	0.9	-	12.70	-0.07	90	285	78	74
45	6.736	0.157	0.017	2.34	88	0.9	-	12.62	-0.08	90	287	78	74
46	6.890	0.154	0.017	2.35	88	0.9	-	12.53	-0.09	91	291	78	74
47	7.045	0.155	0.017	2.35	89	0.9	-	12.44	-0.09	91	294	78	74
48	7.198	0.153	0.017	2.35	89	0.9	-	12.34	-0.10	91	297	78	74
49	7.353	0.155	0.017	2.35	89	0.9	-	12.24	-0.10	91	299	78	74
50	7.509	0.156	0.017	2.36	90	0.9	99	12.13	-0.11	91	301	79	74
51	7.662	0.153	0.017	2.36	90	0.9	-	12.02	-0.11	91	303	79	74
52	7.818	0.156	0.017	2.35	90	0.9	-	11.91	-0.11	92	304	79	74
53	7.970	0.152	0.017	2.36	90	0.9	-	11.81	-0.10	92	309	79	74
54	8.129	0.159	0.016	2.37	91	0.9	-	11.69	-0.12	92	310	79	75
55	8.281	0.152	0.017	2.36	91	0.9	-	11.57	-0.12	92	313	79	74
56	8.439	0.158	0.017	2.37	91	0.9	-	11.47	-0.10	93	315	79	75
57	8.591	0.152	0.016	2.36	91	0.9	-	11.36	-0.11	94	317	79	75
58	8.745	0.154	0.017	2.37	92	1.0	-	11.25	-0.11	95	318	79	74
59	8.900	0.155	0.017	2.37	92	0.9	-	11.15	-0.10	94	319	79	74
60	9.055	0.155	0.017	2.37	92	0.9	99	11.04	-0.11	94	319	79	74
61	9.213	0.158	0.017	2.38	92	0.9	-	10.93	-0.11	95	321	79	74
62	9.367	0.154	0.017	2.37	93	0.9	-	10.81	-0.12	95	324	79	74
63	9.526	0.159	0.017	2.38	93	0.9	-	10.70	-0.11	95	326	79	74

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
64	9.680	0.154	0.017	2.39	93	0.9	-	10.58	-0.12	95	329	79	74
65	9.838	0.158	0.017	2.38	93	0.9	-	10.46	-0.12	96	331	79	75
66	9.992	0.154	0.017	2.38	94	0.9	-	10.34	-0.12	96	333	79	75
67	10.148	0.156	0.017	2.38	94	0.9	-	10.22	-0.12	97	335	80	75
68	10.303	0.155	0.017	2.38	94	0.9	-	10.10	-0.12	97	335	80	74
69	10.461	0.158	0.017	2.38	94	0.9	-	9.98	-0.12	97	337	80	74
70	10.619	0.158	0.017	2.39	94	0.9	100	9.86	-0.12	97	336	80	75
71	10.769	0.150	0.017	2.37	95	0.9	-	9.75	-0.11	97	337	80	75
72	10.930	0.161	0.018	2.39	95	0.9	-	9.63	-0.12	97	338	80	75
73	11.086	0.156	0.017	2.39	95	0.9	-	9.52	-0.11	97	338	80	75
74	11.244	0.158	0.016	2.39	95	0.9	-	9.42	-0.10	97	339	80	75
75	11.401	0.157	0.017	2.38	95	0.9	-	9.31	-0.11	98	337	80	75
76	11.557	0.156	0.016	2.39	96	0.9	-	9.20	-0.11	97	338	80	75
77	11.715	0.158	0.017	2.39	96	0.9	-	9.10	-0.10	98	338	80	75
78	11.868	0.153	0.017	2.38	96	0.9	-	9.00	-0.10	99	337	80	75
79	12.029	0.161	0.017	2.40	96	0.9	-	8.89	-0.11	99	337	80	75
80	12.184	0.155	0.017	2.39	96	0.9	100	8.78	-0.11	99	337	80	75
81	12.342	0.158	0.016	2.39	96	0.9	-	8.69	-0.09	97	337	80	75
82	12.499	0.157	0.017	2.40	96	0.9	-	8.59	-0.10	97	337	80	75
83	12.655	0.156	0.017	2.40	97	0.9	-	8.47	-0.12	98	337	80	75
84	12.814	0.159	0.016	2.40	97	0.9	-	8.36	-0.11	99	338	81	75
85	12.968	0.154	0.017	2.38	97	0.9	-	8.26	-0.10	97	339	81	76
86	13.129	0.161	0.017	2.40	97	0.9	-	8.16	-0.10	98	338	81	76
87	13.284	0.155	0.017	2.41	97	0.9	-	8.06	-0.10	97	339	81	76
88	13.442	0.158	0.017	2.41	97	0.9	-	7.95	-0.11	97	339	81	76
89	13.601	0.159	0.017	2.40	98	0.9	-	7.84	-0.11	98	340	81	76
90	13.757	0.156	0.017	2.41	98	0.9	100	7.74	-0.10	98	341	81	76
91	13.916	0.159	0.016	2.41	98	0.9	-	7.63	-0.11	97	339	81	76
92	14.071	0.155	0.017	2.41	98	0.9	-	7.53	-0.10	98	340	81	76
93	14.232	0.161	0.017	2.41	98	0.9	-	7.42	-0.11	99	341	81	76
94	14.387	0.155	0.017	2.40	98	0.9	-	7.32	-0.10	99	342	81	76
95	14.545	0.158	0.017	2.42	98	0.9	-	7.21	-0.11	98	342	81	76

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
96	14.705	0.160	0.017	2.41	98	0.9	-	7.10	-0.11	99	342	81	76
97	14.860	0.155	0.017	2.41	99	0.9	-	7.00	-0.10	100	342	81	76
98	15.021	0.161	0.017	2.41	99	1.0	-	6.89	-0.11	100	343	81	76
99	15.177	0.156	0.017	2.42	99	0.9	-	6.80	-0.09	100	342	81	76
100	15.336	0.159	0.017	2.41	99	0.9	100	6.71	-0.09	100	340	81	76
101	15.493	0.157	0.017	2.41	99	0.9	-	6.64	-0.07	100	337	82	76
102	15.652	0.159	0.016	2.42	99	0.9	-	6.55	-0.09	100	334	82	76
103	15.811	0.159	0.016	2.41	99	0.9	-	6.49	-0.06	98	332	82	76
104	15.966	0.155	0.017	2.41	100	0.9	-	6.40	-0.09	99	330	82	76
105	16.128	0.162	0.016	2.42	100	0.9	-	6.34	-0.06	98	327	82	76
106	16.284	0.156	0.017	2.41	100	0.9	-	6.27	-0.07	97	325	82	76
107	16.442	0.158	0.017	2.41	100	0.9	-	6.20	-0.07	97	322	82	76
108	16.603	0.161	0.017	2.41	100	0.9	-	6.14	-0.06	99	318	82	76
109	16.758	0.155	0.017	2.41	100	0.9	-	6.07	-0.07	99	316	82	76
110	16.919	0.161	0.017	2.42	100	0.9	100	6.02	-0.05	99	312	82	76
111	17.076	0.157	0.016	2.41	100	0.9	-	5.95	-0.07	98	309	82	76
112	17.236	0.160	0.016	2.41	100	1.0	-	5.90	-0.05	98	308	82	76
113	17.393	0.157	0.017	2.42	100	0.9	-	5.84	-0.06	98	307	82	76
114	17.552	0.159	0.016	2.42	100	0.9	-	5.79	-0.05	98	305	82	76
115	17.712	0.160	0.017	2.43	101	0.9	-	5.73	-0.06	97	306	82	76
116	17.869	0.157	0.017	2.44	101	0.9	-	5.68	-0.05	98	306	82	76
117	18.031	0.162	0.017	2.43	101	0.9	-	5.62	-0.06	97	306	82	76
118	18.187	0.156	0.017	2.42	101	1.0	-	5.57	-0.05	98	305	82	76
119	18.346	0.159	0.017	2.41	101	0.9	-	5.52	-0.05	98	304	82	76
120	18.505	0.159	0.017	2.42	101	0.9	100	5.46	-0.06	98	304	82	77
121	18.660	0.155	0.017	2.42	101	0.9	-	5.41	-0.05	97	303	82	77
122	18.825	0.165	0.016	2.43	101	1.0	-	5.36	-0.05	97	303	82	77
123	18.981	0.156	0.017	2.43	101	1.0	-	5.30	-0.06	97	302	82	77
124	19.141	0.160	0.017	2.43	101	0.9	-	5.24	-0.06	97	301	82	76
125	19.302	0.161	0.017	2.42	101	0.9	-	5.18	-0.06	97	301	82	76
126	19.458	0.156	0.017	2.40	102	1.0	-	5.13	-0.05	95	301	82	76
127	19.617	0.159	0.017	2.42	102	0.9	-	5.08	-0.05	96	301	82	76

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
128	19.778	0.161	0.017	2.40	102	0.9	-	5.03	-0.05	97	301	82	77
129	19.937	0.159	0.017	2.41	102	0.9	-	4.97	-0.06	96	300	82	76
130	20.097	0.160	0.016	2.39	102	0.9	102	4.91	-0.06	97	299	82	76
131	20.253	0.156	0.016	2.42	102	0.9	-	4.87	-0.04	97	300	82	76
132	20.415	0.162	0.016	2.41	102	0.9	-	4.80	-0.07	97	301	82	76
133	20.570	0.155	0.017	2.42	102	0.9	-	4.75	-0.05	98	303	82	76
134	20.733	0.163	0.017	2.43	102	0.9	-	4.67	-0.08	97	303	82	76
135	20.888	0.155	0.018	2.42	102	0.9	-	4.61	-0.06	97	303	82	76
136	21.048	0.160	0.017	2.43	102	0.9	-	4.56	-0.05	97	304	82	76
137	21.212	0.164	0.017	2.42	102	0.9	-	4.49	-0.07	97	305	83	76
138	21.369	0.157	0.017	2.42	103	0.9	-	4.45	-0.04	98	306	83	76
139	21.531	0.162	0.016	2.42	103	0.9	-	4.38	-0.07	97	307	82	76
140	21.685	0.154	0.017	2.43	103	0.9	102	4.30	-0.08	97	309	83	76
141	21.845	0.160	0.017	2.43	103	0.9	-	4.23	-0.07	97	308	82	76
142	22.008	0.163	0.017	2.43	103	0.9	-	4.16	-0.07	97	308	82	76
143	22.162	0.154	0.017	2.43	103	0.9	-	4.09	-0.07	97	308	83	76
144	22.328	0.166	0.017	2.42	103	0.9	-	4.01	-0.08	97	309	83	76
145	22.485	0.157	0.017	2.42	103	1.0	-	3.92	-0.09	98	309	83	77
146	22.645	0.160	0.017	2.39	103	0.9	-	3.84	-0.08	98	311	83	77
147	22.806	0.161	0.017	2.40	103	1.0	-	3.77	-0.07	97	312	82	77
148	22.962	0.156	0.017	2.39	103	0.9	-	3.69	-0.08	96	312	83	77
149	23.125	0.163	0.017	2.40	103	1.0	-	3.63	-0.06	96	313	83	77
150	23.282	0.157	0.017	2.43	103	1.0	101	3.57	-0.06	97	312	83	76
151	23.443	0.161	0.017	2.41	103	1.0	-	3.52	-0.05	97	310	83	77
152	23.604	0.161	0.017	2.44	103	1.0	-	3.46	-0.06	98	308	83	77
153	23.757	0.153	0.017	2.42	103	1.0	-	3.42	-0.04	97	306	83	77
154	23.921	0.164	0.017	2.43	103	0.9	-	3.37	-0.05	97	305	83	77
155	24.077	0.156	0.017	2.44	103	0.9	-	3.32	-0.05	97	304	83	77
156	24.241	0.164	0.017	2.42	103	0.9	-	3.27	-0.05	97	302	83	77
157	24.399	0.158	0.017	2.42	103	0.9	-	3.23	-0.04	98	301	83	77
158	24.556	0.157	0.016	2.44	104	0.9	-	3.18	-0.05	98	299	83	77
159	24.722	0.166	0.016	2.43	104	0.9	-	3.13	-0.05	97	299	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
160	24.878	0.156	0.017	2.40	104	0.9	100	3.08	-0.05	97	298	83	77
161	25.036	0.158	0.017	2.40	104	0.9	-	3.03	-0.05	98	296	83	77
162	25.198	0.162	0.016	2.41	104	1.0	-	2.99	-0.04	96	296	83	77
163	25.357	0.159	0.017	2.43	104	0.9	-	2.94	-0.05	96	295	83	77
164	25.520	0.163	0.017	2.42	104	0.9	-	2.89	-0.05	95	294	83	77
165	25.677	0.157	0.017	2.42	104	1.0	-	2.84	-0.05	95	293	83	77
166	25.838	0.161	0.017	2.42	104	1.0	-	2.79	-0.05	95	293	83	77
167	26.000	0.162	0.017	2.42	104	1.0	-	2.73	-0.06	96	293	83	77
168	26.156	0.156	0.017	2.42	104	1.0	-	2.68	-0.05	97	292	83	77
169	26.320	0.164	0.017	2.40	104	0.9	-	2.63	-0.05	97	292	83	77
170	26.477	0.157	0.017	2.40	104	1.0	101	2.58	-0.05	97	291	83	77
171	26.637	0.160	0.017	2.40	104	0.9	-	2.54	-0.04	97	291	83	77
172	26.800	0.163	0.017	2.41	104	1.0	-	2.49	-0.05	97	290	83	77
173	26.956	0.156	0.017	2.42	104	0.9	-	2.44	-0.05	97	289	83	77
174	27.119	0.163	0.017	2.43	104	0.9	-	2.41	-0.03	96	288	83	77
175	27.276	0.157	0.017	2.44	104	0.9	-	2.38	-0.03	97	286	83	77
176	27.437	0.161	0.017	2.44	104	1.0	-	2.34	-0.04	97	285	83	77
177	27.596	0.159	0.017	2.43	104	0.9	-	2.32	-0.02	96	284	83	77
178	27.755	0.159	0.017	2.44	104	0.9	-	2.28	-0.04	96	283	83	77
179	27.916	0.161	0.018	2.44	104	1.0	-	2.25	-0.03	96	282	83	77
180	28.073	0.157	0.017	2.44	104	0.9	100	2.22	-0.03	96	281	83	77
181	28.236	0.163	0.017	2.43	104	1.0	-	2.20	-0.02	96	279	83	77
182	28.395	0.159	0.017	2.44	105	0.9	-	2.17	-0.03	96	278	83	77
183	28.552	0.157	0.017	2.44	105	0.9	-	2.15	-0.02	95	276	83	77
184	28.719	0.167	0.017	2.45	105	1.0	-	2.12	-0.03	95	274	83	77
185	28.886	0.167	0.017	2.45	105	1.0	-	2.10	-0.02	95	272	83	77
186	29.034	0.148	0.017	2.43	105	1.0	-	2.08	-0.02	96	270	83	77
187	29.196	0.162	0.016	2.42	105	0.9	-	2.06	-0.02	96	270	83	77
188	29.353	0.157	0.017	2.44	105	0.9	-	2.04	-0.02	96	269	83	77
189	29.519	0.166	0.017	2.44	105	0.9	-	2.02	-0.02	96	268	83	77
190	29.676	0.157	0.017	2.45	105	0.9	101	2.00	-0.02	96	267	83	77
191	29.837	0.161	0.017	2.45	105	1.0	-	1.99	-0.01	96	265	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
192	29.999	0.162	0.017	2.46	105	0.9	-	1.96	-0.03	96	264	83	77
193	30.155	0.156	0.017	2.44	105	0.9	-	1.94	-0.02	95	263	83	77
194	30.319	0.164	0.017	2.45	105	1.0	-	1.92	-0.02	95	262	83	77
195	30.474	0.155	0.016	2.44	105	1.0	-	1.90	-0.02	95	261	83	77
196	30.635	0.161	0.017	2.46	105	0.9	-	1.89	-0.01	95	260	83	77
197	30.800	0.165	0.017	2.45	105	0.9	-	1.86	-0.03	95	260	83	77
198	30.956	0.156	0.017	2.44	105	0.9	-	1.85	-0.01	94	259	83	77
199	31.120	0.164	0.017	2.44	105	0.9	-	1.83	-0.02	94	259	83	77
200	31.278	0.158	0.017	2.44	105	0.9	100	1.80	-0.03	95	258	83	77
201	31.436	0.158	0.017	2.43	105	0.9	-	1.78	-0.02	95	258	83	77
202	31.601	0.165	0.017	2.43	105	0.9	-	1.77	-0.01	95	257	83	77
203	31.755	0.154	0.017	2.43	105	0.9	-	1.75	-0.02	95	257	83	77
204	31.922	0.167	0.017	2.43	105	0.9	-	1.73	-0.02	95	256	83	77
205	32.079	0.157	0.017	2.43	105	0.9	-	1.71	-0.02	95	254	83	77
206	32.241	0.162	0.017	2.41	105	0.9	-	1.70	-0.01	95	254	83	77
207	32.400	0.159	0.017	2.42	105	1.0	-	1.68	-0.02	95	253	83	77
208	32.560	0.160	0.017	2.42	105	1.0	-	1.66	-0.02	95	254	83	77
209	32.721	0.161	0.017	2.44	105	0.9	-	1.64	-0.02	94	254	83	77
210	32.881	0.160	0.017	2.43	105	0.9	100	1.63	-0.01	94	252	83	77
211	33.042	0.161	0.017	2.45	105	0.9	-	1.60	-0.03	94	251	83	77
212	33.201	0.159	0.017	2.46	105	0.9	-	1.59	-0.01	94	250	83	77
213	33.359	0.158	0.017	2.43	105	1.0	-	1.58	-0.01	95	251	83	77
214	33.524	0.165	0.017	2.41	106	0.9	-	1.55	-0.03	94	251	83	77
215	33.684	0.160	0.016	2.44	106	0.9	-	1.54	-0.01	94	250	83	77
216	33.841	0.157	0.017	2.44	106	0.9	-	1.52	-0.02	94	250	83	77
217	34.006	0.165	0.017	2.44	106	1.0	-	1.51	-0.01	94	250	83	77
218	34.164	0.158	0.017	2.42	106	1.0	-	1.49	-0.02	94	250	83	77
219	34.326	0.162	0.017	2.43	106	0.9	-	1.48	-0.01	94	250	83	77
220	34.487	0.161	0.017	2.42	106	0.9	100	1.46	-0.02	94	248	83	77
221	34.643	0.156	0.018	2.44	106	1.0	-	1.45	-0.01	94	248	83	77
222	34.805	0.162	0.017	2.44	106	0.9	-	1.43	-0.02	94	247	83	77
223	34.964	0.159	0.016	2.44	106	1.0	-	1.42	-0.01	94	246	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
224	35.127	0.163	0.017	2.43	106	1.0	-	1.39	-0.03	94	247	83	77
225	35.289	0.162	0.017	2.44	106	0.9	-	1.38	-0.01	94	246	83	77
226	35.445	0.156	0.016	2.44	106	1.0	-	1.36	-0.02	94	246	83	77
227	35.607	0.162	0.017	2.43	106	0.9	-	1.34	-0.02	94	246	83	77
228	35.766	0.159	0.017	2.43	106	0.9	-	1.33	-0.01	94	246	83	77
229	35.929	0.163	0.017	2.43	106	1.0	-	1.31	-0.02	94	245	83	77
230	36.092	0.163	0.017	2.43	106	0.9	100	1.30	-0.01	94	246	83	77
231	36.249	0.157	0.017	2.44	106	0.9	-	1.28	-0.02	93	245	83	77
232	36.410	0.161	0.017	2.43	106	0.9	-	1.26	-0.02	94	244	83	77
233	36.570	0.160	0.017	2.43	106	1.0	-	1.24	-0.02	93	243	83	77
234	36.729	0.159	0.017	2.44	106	0.9	-	1.23	-0.01	93	243	83	77
235	36.891	0.162	0.017	2.44	106	1.0	-	1.21	-0.02	93	243	83	77
236	37.050	0.159	0.017	2.44	106	0.9	-	1.20	-0.01	93	242	83	77
237	37.213	0.163	0.017	2.46	106	0.9	-	1.18	-0.02	93	242	83	77
238	37.370	0.157	0.017	2.44	106	1.0	-	1.17	-0.01	93	241	83	77
239	37.535	0.165	0.017	2.45	106	1.0	-	1.15	-0.02	93	241	83	77
240	37.696	0.161	0.017	2.44	106	0.9	100	1.13	-0.02	93	240	83	77
241	37.851	0.155	0.017	2.44	106	0.9	-	1.12	-0.01	92	240	83	77
242	38.016	0.165	0.017	2.44	106	1.0	-	1.10	-0.02	92	239	83	77
243	38.177	0.161	0.017	2.44	106	1.0	-	1.09	-0.01	93	238	83	77
244	38.336	0.159	0.017	2.44	106	1.0	-	1.07	-0.02	93	238	83	77
245	38.498	0.162	0.017	2.45	106	0.9	-	1.07	0.00	93	238	83	77
246	38.656	0.158	0.017	2.43	106	0.9	-	1.05	-0.02	92	237	83	77
247	38.821	0.165	0.017	2.45	106	1.0	-	1.03	-0.02	93	237	83	77
248	38.982	0.161	0.017	2.46	106	0.9	-	1.01	-0.02	92	237	83	77
249	39.141	0.159	0.017	2.46	106	0.9	-	1.00	-0.01	93	237	83	77
250	39.304	0.163	0.017	2.44	106	1.0	100	0.98	-0.02	93	236	83	77
251	39.463	0.159	0.017	2.45	106	0.9	-	0.96	-0.02	92	236	83	77
252	39.624	0.161	0.017	2.44	106	1.0	-	0.95	-0.01	93	236	83	77
253	39.786	0.162	0.017	2.44	106	0.9	-	0.93	-0.02	93	236	83	77
254	39.944	0.158	0.017	2.45	106	0.9	-	0.91	-0.02	93	235	83	77
255	40.105	0.161	0.017	2.45	106	1.0	-	0.90	-0.01	93	235	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

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
256	40.266	0.161	0.017	2.46	106	0.9	-	0.88	-0.02	92	234	83	77
257	40.425	0.159	0.018	2.44	106	0.9	-	0.86	-0.02	93	234	83	77
258	40.591	0.166	0.017	2.47	106	0.9	-	0.85	-0.01	93	233	83	77
259	40.747	0.156	0.017	2.45	106	0.9	-	0.83	-0.02	93	233	83	77
260	40.912	0.165	0.018	2.46	106	0.9	99	0.81	-0.02	93	233	83	77
261	41.070	0.158	0.017	2.47	106	1.0	-	0.80	-0.01	93	234	83	77
262	41.232	0.162	0.017	2.45	106	0.9	-	0.79	-0.01	92	233	83	77
263	41.392	0.160	0.017	2.45	106	0.9	-	0.77	-0.02	92	233	83	77
264	41.552	0.160	0.017	2.46	106	1.0	-	0.75	-0.02	92	233	83	77
265	41.713	0.161	0.018	2.47	106	0.9	-	0.73	-0.02	92	232	83	77
266	41.874	0.161	0.017	2.47	107	0.9	-	0.72	-0.01	92	232	83	77
267	42.033	0.159	0.017	2.46	107	0.9	-	0.70	-0.02	92	232	83	77
268	42.198	0.165	0.017	2.45	106	0.9	-	0.69	-0.01	92	231	83	77
269	42.356	0.158	0.017	2.45	107	0.9	-	0.67	-0.02	92	232	83	77
270	42.518	0.162	0.017	2.47	107	0.9	99	0.66	-0.01	92	231	83	77
271	42.679	0.161	0.017	2.46	107	0.9	-	0.64	-0.02	92	231	83	77
272	42.839	0.160	0.017	2.47	107	1.0	-	0.62	-0.02	92	231	83	77
273	42.999	0.160	0.017	2.46	107	0.9	-	0.61	-0.01	92	231	83	77
274	43.161	0.162	0.017	2.46	107	0.9	-	0.59	-0.02	92	231	83	77
275	43.322	0.161	0.017	2.45	107	0.9	-	0.57	-0.02	93	231	83	77
276	43.485	0.163	0.017	2.45	107	1.0	-	0.56	-0.01	93	231	83	77
277	43.640	0.155	0.017	2.46	107	0.9	-	0.54	-0.02	93	231	83	77
278	43.807	0.167	0.017	2.46	107	0.9	-	0.53	-0.01	93	232	83	77
279	43.965	0.158	0.017	2.47	107	0.9	-	0.50	-0.03	93	232	83	77
280	44.124	0.159	0.017	2.47	107	0.9	100	0.50	0.00	93	232	83	77
281	44.287	0.163	0.017	2.46	107	0.9	-	0.47	-0.03	93	232	83	77
282	44.446	0.159	0.017	2.45	107	0.9	-	0.46	-0.01	93	232	83	77
283	44.611	0.165	0.017	2.45	107	0.9	-	0.44	-0.02	93	233	83	77
284	44.766	0.155	0.018	2.46	107	0.9	-	0.43	-0.01	93	232	83	77
285	44.931	0.165	0.017	2.45	107	1.0	-	0.41	-0.02	93	232	83	77
286	45.090	0.159	0.017	2.45	107	0.9	-	0.40	-0.01	93	233	83	77
287	45.248	0.158	0.017	2.43	107	0.9	-	0.38	-0.02	93	232	83	77

BOX A TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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
288	45.414	0.166	0.018	2.44	107	0.9	-	0.37	-0.01	93	232	83	77
289	45.570	0.156	0.017	2.42	107	0.9	-	0.35	-0.02	92	232	83	77
290	45.735	0.165	0.017	2.43	107	0.9	100	0.33	-0.02	92	232	83	77
291	45.897	0.162	0.017	2.44	107	0.9	-	0.32	-0.01	92	232	83	77
292	46.056	0.159	0.017	2.43	107	1.0	-	0.30	-0.02	92	232	83	77
293	46.216	0.160	0.017	2.44	107	0.9	-	0.29	-0.01	93	231	83	77
294	46.377	0.161	0.017	2.43	107	0.9	-	0.28	-0.01	92	231	83	77
295	46.536	0.159	0.018	2.44	107	0.9	-	0.26	-0.02	92	231	83	77
296	46.703	0.167	0.017	2.43	107	0.9	-	0.24	-0.02	93	233	83	77
297	46.861	0.158	0.018	2.45	107	0.9	-	0.22	-0.02	92	233	83	77
298	47.022	0.161	0.018	2.44	107	1.0	-	0.20	-0.02	92	232	83	77
299	47.186	0.164	0.017	2.44	107	1.0	-	0.18	-0.02	92	231	83	77
300	47.343	0.157	0.017	2.44	107	0.9	100	0.18	0.00	93	231	83	77
301	47.505	0.162	0.017	2.44	107	0.9	-	0.15	-0.03	93	230	83	77
302	47.666	0.161	0.017	2.44	107	0.9	-	0.14	-0.01	93	230	83	77
303	47.828	0.162	0.017	2.44	107	0.9	-	0.13	-0.01	92	230	83	77
304	47.988	0.160	0.017	2.44	107	0.9	-	0.11	-0.02	92	229	83	77
305	48.145	0.157	0.017	2.43	107	0.9	-	0.10	-0.01	92	230	83	77
306	48.310	0.165	0.017	2.42	107	1.0	-	0.08	-0.02	93	230	83	77
307	48.468	0.158	0.018	2.42	107	1.0	-	0.06	-0.02	92	229	83	77
308	48.630	0.162	0.017	2.41	107	1.0	-	0.04	-0.02	92	229	83	77
309	48.795	0.165	0.017	2.42	107	0.9	-	0.03	-0.01	91	229	83	77
310	48.954	0.159	0.017	2.42	107	0.9	100	0.01	-0.02	92	229	83	77
311	49.169	0.215	0.016	2.43	107	0.9	105	0.00	-0.01	92	228	83	77
Avg/Tot	49.169	0.158	0.017	2.39	99.4	0.9	100			94.1	274.8	81.4	76.0

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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		0.79	77	1.9		77	-0.052	2.20	0.069
1	0.128	0.128	2.12	77	1.8	-	78	-0.048	1.25	0.093
2	0.274	0.146	2.12	77	1.8	-	78	-0.052	1.76	0.287
3	0.417	0.143	2.12	77	1.7	-	78	-0.053	1.90	0.014
4	0.562	0.145	2.12	78	1.9	-	78	-0.052	1.78	0.017
5	0.704	0.142	2.13	78	1.5	-	78	-0.053	1.73	0.015
6	0.850	0.146	2.14	78	1.9	-	78	-0.053	1.74	0.012
7	0.991	0.141	2.14	78	1.7	-	78	-0.050	1.73	0.017
8	1.138	0.147	2.13	78	2.0	-	78	-0.052	1.78	0.014
9	1.281	0.143	2.13	78	2.0	-	78	-0.053	1.81	0.017
10	1.424	0.143	2.13	78	1.9	99	78	-0.052	1.92	0.014
11	1.568	0.144	2.14	78	2.0	-	78	-0.050	2.04	0.015
12	1.708	0.140	2.14	78	1.8	-	78	-0.051	2.15	0.013
13	1.857	0.149	2.14	78	1.5	-	78	-0.051	2.23	0.022
14	1.998	0.141	2.14	79	1.9	-	79	-0.050	2.33	0.019
15	2.145	0.147	2.14	79	1.5	-	79	-0.052	2.44	0.015
16	2.288	0.143	2.14	80	1.8	-	79	-0.052	2.56	0.016
17	2.435	0.147	2.14	80	1.5	-	79	-0.051	2.71	0.015
18	2.578	0.143	2.14	80	1.4	-	79	-0.051	2.82	0.019
19	2.723	0.145	2.15	80	1.5	-	79	-0.054	2.91	0.015
20	2.868	0.145	2.15	80	1.6	100	79	-0.053	3.00	0.016
21	3.012	0.144	2.14	81	1.7	-	79	-0.055	3.22	0.019
22	3.159	0.147	2.15	81	2.0	-	79	-0.056	4.38	0.019
23	3.302	0.143	2.15	81	1.5	-	79	-0.056	3.80	0.021
24	3.451	0.149	2.15	82	2.0	-	79	-0.057	3.83	0.019
25	3.593	0.142	2.15	82	2.0	-	79	-0.058	3.75	0.016
26	3.741	0.148	2.16	82	1.9	-	79	-0.060	3.90	0.019
27	3.884	0.143	2.15	83	1.8	-	79	-0.056	3.95	0.021
28	4.031	0.147	2.14	83	1.8	-	79	-0.057	4.25	0.020
29	4.173	0.142	2.15	84	1.4	-	79	-0.057	3.94	0.016
30	4.322	0.149	2.15	84	1.9	100	79	-0.056	3.79	0.019
31	4.467	0.145	2.16	84	1.5	-	79	-0.057	3.83	0.019

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
32	4.612	0.145	2.15	84	1.5	-	79	-0.057	3.86	0.017
33	4.758	0.146	2.16	85	1.6	-	79	-0.058	3.91	0.017
34	4.904	0.146	2.16	85	1.8	-	79	-0.057	4.08	0.019
35	5.050	0.146	2.16	85	1.5	-	79	-0.059	4.18	0.021
36	5.199	0.149	2.16	85	1.7	-	79	-0.061	4.36	0.021
37	5.343	0.144	2.16	86	1.8	-	79	-0.060	4.51	0.019
38	5.488	0.145	2.16	86	1.9	-	79	-0.060	4.57	0.022
39	5.639	0.151	2.16	87	1.7	-	79	-0.061	4.51	0.015
40	5.783	0.144	2.16	87	1.5	100	79	-0.062	4.69	0.018
41	5.932	0.149	2.16	87	1.5	-	79	-0.063	4.83	0.017
42	6.077	0.145	2.17	87	1.5	-	79	-0.062	4.92	0.016
43	6.227	0.150	2.17	88	1.8	-	79	-0.066	4.92	0.014
44	6.368	0.141	2.17	88	1.9	-	79	-0.064	5.03	0.017
45	6.518	0.150	2.17	88	1.5	-	80	-0.067	5.34	0.017
46	6.665	0.147	2.17	89	1.5	-	80	-0.066	5.71	0.014
47	6.815	0.150	2.17	89	1.8	-	80	-0.065	5.89	0.015
48	6.959	0.144	2.17	89	2.0	-	80	-0.066	6.25	0.014
49	7.109	0.150	2.17	89	1.6	-	80	-0.066	6.99	0.013
50	7.253	0.144	2.17	90	1.7	100	80	-0.067	7.01	0.013
51	7.403	0.150	2.17	90	2.0	-	80	-0.066	7.04	0.016
52	7.548	0.145	2.16	90	1.7	-	80	-0.067	7.05	0.021
53	7.698	0.150	2.17	90	1.5	-	80	-0.067	7.11	0.023
54	7.844	0.146	2.17	91	1.8	-	80	-0.069	7.22	0.014
55	7.993	0.149	2.17	91	1.7	-	80	-0.071	7.27	0.021
56	8.139	0.146	2.17	91	1.9	-	80	-0.066	7.11	0.016
57	8.288	0.149	2.17	91	1.8	-	80	-0.071	6.98	0.014
58	8.433	0.145	2.17	92	1.5	-	80	-0.070	6.98	0.013
59	8.582	0.149	2.17	92	1.5	-	80	-0.070	6.84	0.012
60	8.729	0.147	2.17	92	1.5	100	80	-0.070	7.00	0.015
61	8.878	0.149	2.18	92	2.0	-	80	-0.071	7.01	0.037
62	9.027	0.149	2.18	93	1.5	-	80	-0.072	7.05	0.077
63	9.176	0.149	2.18	93	1.7	-	80	-0.072	7.22	0.129

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
64	9.323	0.147	2.18	93	1.8	-	81	-0.069	7.16	0.159
65	9.471	0.148	2.18	93	1.5	-	81	-0.073	7.62	0.245
66	9.618	0.147	2.18	93	1.6	-	81	-0.073	7.44	0.303
67	9.767	0.149	2.17	94	1.6	-	81	-0.075	7.33	0.299
68	9.912	0.145	2.18	94	1.9	-	81	-0.073	7.36	0.315
69	10.063	0.151	2.18	94	1.8	-	81	-0.071	7.23	0.383
70	10.211	0.148	2.19	94	1.5	100	81	-0.077	7.22	0.304
71	10.356	0.145	2.18	94	1.5	-	81	-0.075	7.24	0.340
72	10.504	0.148	2.18	95	1.5	-	81	-0.074	7.07	0.214
73	10.655	0.151	2.18	95	2.0	-	81	-0.073	7.11	0.210
74	10.804	0.149	2.18	95	1.5	-	81	-0.072	7.10	0.115
75	10.952	0.148	2.18	95	1.5	-	81	-0.074	6.99	0.069
76	11.100	0.148	2.18	95	2.0	-	81	-0.073	6.92	0.060
77	11.248	0.148	2.18	96	1.8	-	81	-0.072	7.07	0.028
78	11.397	0.149	2.18	96	2.0	-	82	-0.075	7.05	0.014
79	11.545	0.148	2.18	96	1.5	-	82	-0.073	6.94	0.018
80	11.694	0.149	2.18	96	1.7	100	82	-0.074	6.99	0.012
81	11.842	0.148	2.18	96	1.6	-	82	-0.076	6.99	0.016
82	11.991	0.149	2.18	96	2.0	-	82	-0.074	6.95	0.014
83	12.140	0.149	2.18	97	1.5	-	82	-0.072	6.97	0.017
84	12.289	0.149	2.19	97	1.8	-	82	-0.076	7.05	0.016
85	12.437	0.148	2.18	97	1.5	-	82	-0.073	7.02	0.028
86	12.586	0.149	2.18	97	1.7	-	82	-0.074	7.02	0.036
87	12.735	0.149	2.18	97	1.5	-	82	-0.075	7.01	0.031
88	12.884	0.149	2.18	98	1.8	-	82	-0.076	6.88	0.044
89	13.032	0.148	2.18	98	1.6	-	82	-0.075	7.08	0.054
90	13.182	0.150	2.19	98	2.0	100	82	-0.074	7.01	0.046
91	13.330	0.148	2.19	98	1.6	-	83	-0.070	7.19	0.061
92	13.480	0.150	2.18	98	1.9	-	83	-0.073	7.03	0.030
93	13.628	0.148	2.18	98	1.6	-	83	-0.072	7.05	0.031
94	13.778	0.150	2.19	98	1.8	-	83	-0.073	7.02	0.053
95	13.926	0.148	2.19	98	1.5	-	83	-0.074	7.10	0.084

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
96	14.076	0.150	2.18	98	1.5	-	83	-0.075	7.18	0.044
97	14.225	0.149	2.19	98	1.6	-	83	-0.075	7.01	0.043
98	14.374	0.149	2.19	98	1.7	-	83	-0.074	7.02	0.040
99	14.523	0.149	2.19	99	2.0	-	83	-0.074	6.88	0.023
100	14.672	0.149	2.19	99	1.6	100	83	-0.069	6.53	0.010
101	14.821	0.149	2.19	99	2.0	-	83	-0.074	6.04	0.008
102	14.970	0.149	2.19	99	1.6	-	83	-0.073	6.06	0.010
103	15.119	0.149	2.19	99	1.5	-	83	-0.071	6.01	0.011
104	15.268	0.149	2.19	99	1.6	-	83	-0.071	5.93	0.011
105	15.418	0.150	2.19	99	1.7	-	83	-0.069	5.75	0.009
106	15.567	0.149	2.19	99	1.8	-	83	-0.072	5.69	0.010
107	15.717	0.150	2.19	99	1.5	-	83	-0.070	5.46	0.010
108	15.866	0.149	2.19	99	2.0	-	83	-0.067	5.32	0.011
109	16.016	0.150	2.19	99	1.9	-	83	-0.065	5.13	0.012
110	16.164	0.148	2.19	100	1.5	100	83	-0.068	5.06	0.009
111	16.315	0.151	2.19	100	1.5	-	83	-0.067	5.08	0.010
112	16.463	0.148	2.19	100	1.9	-	83	-0.068	5.04	0.009
113	16.613	0.150	2.20	100	1.8	-	83	-0.068	5.19	0.007
114	16.761	0.148	2.19	100	1.9	-	83	-0.066	5.04	0.011
115	16.912	0.151	2.19	100	1.7	-	84	-0.070	5.13	0.010
116	17.060	0.148	2.19	100	1.5	-	84	-0.067	5.06	0.015
117	17.211	0.151	2.20	100	2.0	-	84	-0.067	4.97	0.015
118	17.359	0.148	2.19	100	1.5	-	84	-0.067	4.98	0.009
119	17.511	0.152	2.19	100	2.0	-	84	-0.065	4.98	0.013
120	17.656	0.145	2.19	101	1.5	100	84	-0.065	4.96	0.011
121	17.808	0.152	2.19	101	1.5	-	84	-0.064	5.12	0.013
122	17.957	0.149	2.19	101	1.5	-	84	-0.061	5.19	0.013
123	18.109	0.152	2.19	101	1.6	-	84	-0.067	5.08	0.015
124	18.257	0.148	2.19	101	1.5	-	84	-0.063	5.13	0.009
125	18.409	0.152	2.20	101	1.5	-	84	-0.065	5.11	0.013
126	18.557	0.148	2.19	101	1.5	-	84	-0.067	5.11	0.015
127	18.706	0.149	2.20	101	1.7	-	84	-0.066	5.25	0.011

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
128	18.856	0.150	2.19	101	1.6	-	84	-0.065	5.41	0.013
129	19.009	0.153	2.20	101	1.6	-	84	-0.067	5.30	0.011
130	19.156	0.147	2.20	101	1.5	102	84	-0.067	5.36	0.010
131	19.306	0.150	2.19	101	1.5	-	84	-0.068	5.39	0.013
132	19.455	0.149	2.19	101	1.5	-	84	-0.069	5.41	0.015
133	19.605	0.150	2.19	101	1.9	-	84	-0.063	5.43	0.012
134	19.755	0.150	2.19	101	1.6	-	84	-0.067	5.51	0.013
135	19.905	0.150	2.19	101	1.7	-	84	-0.067	5.69	0.011
136	20.052	0.147	2.19	101	2.0	-	84	-0.065	5.74	0.013
137	20.207	0.155	2.19	101	1.6	-	84	-0.069	5.73	0.013
138	20.354	0.147	2.20	102	2.0	-	84	-0.064	5.77	0.012
139	20.506	0.152	2.19	102	1.5	-	84	-0.070	5.87	0.011
140	20.652	0.146	2.20	102	2.0	101	84	-0.066	6.03	0.012
141	20.803	0.151	2.20	102	1.5	-	84	-0.066	5.90	0.010
142	20.954	0.151	2.20	102	1.9	-	84	-0.067	6.12	0.005
143	21.103	0.149	2.20	102	1.6	-	84	-0.064	6.28	0.007
144	21.253	0.150	2.19	102	1.5	-	84	-0.067	6.59	0.012
145	21.404	0.151	2.19	102	1.5	-	84	-0.068	6.67	0.005
146	21.553	0.149	2.19	102	1.9	-	84	-0.066	6.58	0.011
147	21.704	0.151	2.20	102	1.6	-	84	-0.070	6.67	0.017
148	21.854	0.150	2.20	102	1.9	-	84	-0.069	6.68	0.016
149	22.005	0.151	2.19	102	2.0	-	84	-0.065	6.30	0.008
150	22.154	0.149	2.19	102	1.8	100	84	-0.068	6.03	0.007
151	22.305	0.151	2.20	102	1.9	-	84	-0.067	5.60	0.008
152	22.455	0.150	2.19	102	1.6	-	84	-0.066	5.44	0.010
153	22.602	0.147	2.19	102	1.5	-	84	-0.066	5.19	0.012
154	22.752	0.150	2.19	102	1.8	-	84	-0.064	5.23	0.009
155	22.902	0.150	2.19	102	2.0	-	84	-0.067	5.10	0.008
156	23.056	0.154	2.20	102	1.9	-	84	-0.067	5.10	0.006
157	23.202	0.146	2.20	102	1.6	-	84	-0.063	5.03	0.012
158	23.353	0.151	2.20	102	2.0	-	84	-0.064	5.05	0.009
159	23.504	0.151	2.19	103	2.0	-	84	-0.064	5.03	0.007

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
160	23.655	0.151	2.20	103	1.6	100	84	-0.065	5.19	0.009
161	23.801	0.146	2.19	103	1.9	-	84	-0.064	5.17	0.008
162	23.953	0.152	2.20	103	1.7	-	84	-0.063	5.36	0.009
163	24.103	0.150	2.20	103	1.5	-	84	-0.066	5.37	0.005
164	24.255	0.152	2.19	103	1.5	-	84	-0.064	5.45	0.010
165	24.404	0.149	2.19	103	1.9	-	84	-0.065	5.51	0.006
166	24.556	0.152	2.20	103	2.0	-	84	-0.064	5.50	0.012
167	24.704	0.148	2.20	103	1.6	-	84	-0.064	5.60	0.007
168	24.857	0.153	2.20	103	1.5	-	84	-0.064	5.50	0.008
169	25.005	0.148	2.20	103	1.9	-	84	-0.063	5.50	0.005
170	25.157	0.152	2.20	103	2.0	100	84	-0.060	5.43	0.006
171	25.305	0.148	2.19	103	1.8	-	84	-0.064	5.36	0.009
172	25.458	0.153	2.20	103	1.5	-	84	-0.060	5.38	0.006
173	25.606	0.148	2.20	103	1.6	-	84	-0.066	5.27	0.007
174	25.758	0.152	2.20	103	1.6	-	84	-0.065	5.07	0.005
175	25.906	0.148	2.20	103	1.6	-	84	-0.064	4.90	0.008
176	26.058	0.152	2.19	103	1.5	-	84	-0.059	4.91	0.009
177	26.204	0.146	2.20	103	1.7	-	84	-0.061	4.93	0.008
178	26.358	0.154	2.20	103	1.9	-	84	-0.061	4.85	0.008
179	26.504	0.146	2.19	103	1.6	-	84	-0.060	4.80	0.008
180	26.656	0.152	2.19	103	1.5	100	84	-0.061	4.55	0.008
181	26.807	0.151	2.19	103	2.0	-	84	-0.061	4.42	0.009
182	26.956	0.149	2.19	103	1.6	-	84	-0.060	4.36	0.010
183	27.105	0.149	2.19	103	1.6	-	84	-0.057	4.31	0.011
184	27.259	0.154	2.19	104	1.9	-	84	-0.057	4.31	0.011
185	27.413	0.154	2.19	103	1.9	-	84	-0.057	4.25	0.011
186	27.557	0.144	2.20	103	1.9	-	84	-0.058	4.19	0.008
187	27.708	0.151	2.19	103	1.9	-	84	-0.060	4.20	0.007
188	27.858	0.150	2.19	103	1.5	-	84	-0.057	4.13	0.013
189	28.012	0.154	2.20	103	1.8	-	84	-0.057	4.14	0.009
190	28.161	0.149	2.20	103	1.8	100	84	-0.056	4.19	0.008
191	28.312	0.151	2.20	103	2.0	-	84	-0.057	4.21	0.008

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
192	28.461	0.149	2.20	104	1.8	-	84	-0.057	4.13	0.008
193	28.612	0.151	2.20	104	1.7	-	84	-0.058	4.13	0.009
194	28.761	0.149	2.19	104	1.5	-	84	-0.055	4.12	0.008
195	28.911	0.150	2.20	104	1.7	-	84	-0.058	4.14	0.012
196	29.059	0.148	2.19	104	1.6	-	84	-0.056	4.06	0.010
197	29.213	0.154	2.19	104	1.7	-	84	-0.056	4.10	0.008
198	29.362	0.149	2.20	104	1.5	-	84	-0.054	4.10	0.009
199	29.515	0.153	2.20	104	1.9	-	84	-0.056	4.08	0.006
200	29.663	0.148	2.20	104	1.7	100	84	-0.055	4.04	0.006
201	29.813	0.150	2.19	104	1.7	-	84	-0.054	4.11	0.008
202	29.964	0.151	2.19	104	1.6	-	84	-0.055	4.23	0.007
203	30.114	0.150	2.19	104	2.0	-	84	-0.057	4.21	0.007
204	30.265	0.151	2.20	104	2.0	-	84	-0.054	4.14	0.009
205	30.417	0.152	2.20	104	2.0	-	84	-0.056	4.15	0.007
206	30.565	0.148	2.20	104	2.0	-	84	-0.056	4.05	0.012
207	30.715	0.150	2.20	104	1.5	-	84	-0.057	4.04	0.007
208	30.865	0.150	2.20	104	1.9	-	84	-0.057	4.03	0.007
209	31.015	0.150	2.20	104	1.9	-	84	-0.053	3.87	0.010
210	31.166	0.151	2.20	104	1.7	100	84	-0.054	3.84	0.007
211	31.318	0.152	2.20	104	1.5	-	84	-0.056	3.77	0.010
212	31.465	0.147	2.19	104	1.6	-	84	-0.053	3.78	0.010
213	31.616	0.151	2.19	104	1.5	-	84	-0.053	3.80	0.010
214	31.769	0.153	2.19	104	2.0	-	84	-0.053	3.79	0.010
215	31.920	0.151	2.19	104	1.5	-	84	-0.053	3.81	0.009
216	32.067	0.147	2.19	104	1.5	-	84	-0.053	3.82	0.010
217	32.221	0.154	2.19	104	1.7	-	84	-0.057	3.78	0.013
218	32.372	0.151	2.19	104	1.5	-	84	-0.054	3.85	0.011
219	32.522	0.150	2.20	104	1.8	-	84	-0.055	3.79	0.010
220	32.673	0.151	2.20	104	1.7	100	84	-0.053	3.70	0.008
221	32.820	0.147	2.19	104	1.5	-	84	-0.052	3.78	0.008
222	32.971	0.151	2.20	104	1.5	-	84	-0.052	3.74	0.012
223	33.120	0.149	2.20	104	2.0	-	84	-0.053	3.72	0.017

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
224	33.274	0.154	2.20	104	1.9	-	84	-0.053	3.72	0.012
225	33.422	0.148	2.19	104	1.6	-	84	-0.055	3.77	0.013
226	33.572	0.150	2.20	104	1.6	-	84	-0.053	3.81	0.007
227	33.721	0.149	2.19	104	1.9	-	84	-0.052	3.77	0.010
228	33.873	0.152	2.19	104	2.0	-	84	-0.052	3.71	0.008
229	34.024	0.151	2.20	104	1.7	-	84	-0.053	3.69	0.007
230	34.177	0.153	2.19	104	1.9	100	84	-0.056	3.74	0.009
231	34.325	0.148	2.19	104	1.7	-	84	-0.052	3.75	0.009
232	34.476	0.151	2.20	104	1.5	-	84	-0.053	3.76	0.011
233	34.627	0.151	2.20	104	1.5	-	84	-0.050	3.79	0.008
234	34.777	0.150	2.19	104	2.0	-	84	-0.055	3.80	0.009
235	34.925	0.148	2.20	104	1.5	-	84	-0.053	3.78	0.010
236	35.079	0.154	2.20	104	1.5	-	84	-0.051	3.70	0.010
237	35.225	0.146	2.20	104	1.5	-	84	-0.053	3.69	0.009
238	35.377	0.152	2.20	104	1.5	-	84	-0.051	3.68	0.010
239	35.529	0.152	2.20	104	1.8	-	84	-0.050	3.71	0.009
240	35.680	0.151	2.19	104	1.9	100	84	-0.053	3.67	0.009
241	35.827	0.147	2.20	104	1.7	-	84	-0.054	3.71	0.010
242	35.979	0.152	2.20	104	1.8	-	84	-0.048	3.69	0.010
243	36.133	0.154	2.20	104	1.7	-	84	-0.049	3.70	0.009
244	36.281	0.148	2.20	104	1.9	-	84	-0.051	3.69	0.009
245	36.432	0.151	2.20	104	1.7	-	84	-0.053	3.73	0.008
246	36.582	0.150	2.20	104	1.9	-	84	-0.052	3.72	0.012
247	36.737	0.155	2.20	104	1.8	-	84	-0.051	3.80	0.008
248	36.886	0.149	2.20	104	1.5	-	84	-0.052	3.82	0.007
249	37.037	0.151	2.19	104	1.9	-	84	-0.051	3.80	0.009
250	37.186	0.149	2.20	104	1.9	100	84	-0.049	3.83	0.011
251	37.338	0.152	2.20	104	1.5	-	84	-0.049	3.79	0.009
252	37.487	0.149	2.20	104	1.7	-	84	-0.052	3.74	0.013
253	37.639	0.152	2.20	104	1.6	-	84	-0.049	3.79	0.009
254	37.788	0.149	2.20	104	1.6	-	84	-0.050	3.77	0.007
255	37.938	0.150	2.19	104	1.6	-	84	-0.051	3.77	0.010

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
256	38.090	0.152	2.20	105	1.5	-	84	-0.051	3.69	0.008
257	38.240	0.150	2.20	105	1.8	-	84	-0.054	3.72	0.006
258	38.391	0.151	2.19	105	1.6	-	84	-0.052	3.67	0.007
259	38.544	0.153	2.20	105	1.5	-	84	-0.049	3.68	0.009
260	38.693	0.149	2.20	105	1.5	98	84	-0.049	3.70	0.010
261	38.845	0.152	2.20	105	2.0	-	84	-0.050	3.69	0.013
262	38.993	0.148	2.20	105	1.9	-	84	-0.048	3.65	0.012
263	39.143	0.150	2.20	105	1.8	-	84	-0.049	3.64	0.007
264	39.295	0.152	2.20	105	1.5	-	84	-0.047	3.60	0.009
265	39.444	0.149	2.20	105	2.0	-	84	-0.051	3.57	0.007
266	39.595	0.151	2.19	105	1.6	-	84	-0.052	3.64	0.010
267	39.745	0.150	2.20	105	1.5	-	84	-0.050	3.66	0.010
268	39.898	0.153	2.20	105	1.8	-	84	-0.052	3.60	0.010
269	40.049	0.151	2.20	105	1.8	-	84	-0.051	3.63	0.006
270	40.200	0.151	2.20	105	1.6	98	84	-0.049	3.68	0.015
271	40.351	0.151	2.20	105	1.9	-	84	-0.048	3.64	0.011
272	40.502	0.151	2.20	105	1.5	-	84	-0.046	3.62	0.010
273	40.649	0.147	2.20	105	1.5	-	84	-0.049	3.66	0.008
274	40.803	0.154	2.20	105	2.0	-	84	-0.051	3.61	0.007
275	40.952	0.149	2.20	105	2.0	-	84	-0.049	3.81	0.008
276	41.105	0.153	2.20	105	2.0	-	84	-0.051	3.80	0.009
277	41.251	0.146	2.20	105	1.8	-	84	-0.051	3.79	0.010
278	41.406	0.155	2.20	105	1.5	-	84	-0.048	3.79	0.008
279	41.554	0.148	2.19	105	1.8	-	84	-0.051	3.71	0.012
280	41.704	0.150	2.20	105	1.4	99	84	-0.049	3.72	0.011
281	41.853	0.149	2.19	105	2.0	-	84	-0.053	3.70	0.008
282	42.009	0.156	2.20	105	2.0	-	84	-0.049	3.66	0.011
283	42.157	0.148	2.19	105	1.6	-	84	-0.052	3.69	0.014
284	42.308	0.151	2.19	105	1.8	-	84	-0.047	3.66	0.013
285	42.459	0.151	2.20	105	1.7	-	84	-0.053	3.61	0.009
286	42.610	0.151	2.20	105	1.9	-	84	-0.051	3.61	0.007
287	42.758	0.148	2.20	105	1.6	-	84	-0.047	3.59	0.011

BOX B TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

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 (%)
288	42.912	0.154	2.20	105	1.6	-	84	-0.047	3.60	0.010
289	43.058	0.146	2.20	105	1.8	-	84	-0.048	3.57	0.009
290	43.213	0.155	2.20	105	2.0	100	84	-0.050	3.61	0.007
291	43.362	0.149	2.20	105	1.8	-	84	-0.050	3.63	0.009
292	43.514	0.152	2.20	105	1.5	-	84	-0.050	3.57	0.012
293	43.661	0.147	2.19	105	1.7	-	84	-0.049	3.55	0.013
294	43.814	0.153	2.20	105	2.0	-	84	-0.049	3.56	0.009
295	43.964	0.150	2.20	105	1.8	-	84	-0.051	3.51	0.011
296	44.118	0.154	2.19	105	1.5	-	84	-0.047	3.67	0.011
297	44.269	0.151	2.20	105	1.8	-	84	-0.051	3.81	0.013
298	44.419	0.150	2.20	105	1.5	-	84	-0.050	3.78	0.011
299	44.571	0.152	2.20	105	1.5	-	84	-0.050	3.76	0.008
300	44.720	0.149	2.20	105	1.8	100	84	-0.052	3.72	0.007
301	44.869	0.149	2.20	105	2.0	-	84	-0.049	3.67	0.013
302	45.021	0.152	2.20	105	1.9	-	84	-0.051	3.68	0.009
303	45.173	0.152	2.20	105	1.8	-	84	-0.048	3.67	0.007
304	45.319	0.146	2.20	105	1.7	-	84	-0.048	3.70	0.007
305	45.472	0.153	2.20	105	2.0	-	84	-0.052	3.74	0.010
306	45.621	0.149	2.20	105	1.6	-	84	-0.049	3.68	0.008
307	45.774	0.153	2.20	105	1.5	-	84	-0.051	3.66	0.005
308	45.923	0.149	2.20	105	2.0	-	84	-0.049	3.62	0.007
309	46.079	0.156	2.20	105	1.5	-	84	-0.049	3.65	0.007
310	46.228	0.149	2.20	105	1.5	100	84	-0.050	3.64	0.005
311	46.378	0.150	2.20	105	1.5	101	84	-0.049	3.65	0.009
Avg/Tot	46.378	0.149	2.18	98.5	1.7	100	82.8	-0.060	4.71	0.024

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

Elapsed Time (min)	Particulate Sampling 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)
0	0.000		0.39	78	1.7		75
1	0.153	0.153	1.07	77	1.8	-	78
2	0.307	0.154	1.08	77	1.8	-	78
3	0.464	0.157	1.09	78	1.9	-	78
4	0.620	0.156	1.10	78	1.7	-	78
5	0.775	0.155	1.10	79	1.7	-	78
6	0.930	0.155	1.10	78	1.9	-	78
7	1.085	0.155	1.10	78	1.8	-	78
8	1.245	0.160	1.11	78	1.7	-	78
9	1.403	0.158	1.12	78	1.7	-	77
10	1.561	0.158	1.12	78	1.7	97	78
11	1.716	0.155	1.12	79	1.8	-	78
12	1.870	0.154	1.12	79	1.7	-	77
13	2.031	0.161	1.11	79	1.9	-	78
14	2.190	0.159	1.12	79	1.9	-	78
15	2.349	0.159	1.13	80	1.9	-	78
16	2.506	0.157	1.13	80	1.7	-	78
17	2.665	0.159	1.12	80	1.9	-	78
18	2.825	0.160	1.13	80	1.9	-	78
19	2.984	0.159	1.14	81	1.7	-	78
20	3.143	0.159	1.14	81	1.8	98	78
21	3.303	0.160	1.13	81	1.7	-	78
22	3.464	0.161	1.14	81	1.8	-	78
23	3.624	0.160	1.15	82	1.8	-	78
24	3.784	0.160	1.14	82	1.7	-	78
25	3.945	0.161	1.15	82	1.8	-	78
26	4.107	0.162	1.16	82	1.8	-	78
27	4.267	0.160	1.15	83	1.9	-	79
28	4.429	0.162	1.16	83	1.7	-	79
29	4.589	0.160	1.16	83	1.9	-	79
30	4.753	0.164	1.15	83	1.7	99	79
31	4.915	0.162	1.17	83	1.8	-	78

BOX C TEST DATA - ASTM E2780 / ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

Elapsed Time (min)	Particulate Sampling 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)
32	5.075	0.160	1.17	84	1.9	-	78
33	5.237	0.162	1.16	84	1.9	-	78
34	5.400	0.163	1.17	84	1.7	-	78
35	5.562	0.162	1.17	84	1.7	-	78
36	5.729	0.167	1.17	85	1.9	-	78
37	5.889	0.160	1.18	85	1.8	-	79
38	6.052	0.163	1.17	85	1.8	-	79
39	6.219	0.167	1.18	86	1.7	-	79
40	6.381	0.162	1.17	86	1.8	100	79
41	6.546	0.165	1.18	86	1.8	-	79
42	6.709	0.163	1.17	87	1.8	-	79
43	6.873	0.164	1.18	87	1.8	-	79
44	7.034	0.161	1.19	86	1.8	-	79
45	7.198	0.164	1.18	87	1.8	-	79
46	7.365	0.167	1.19	87	1.9	-	79
47	7.530	0.165	1.18	87	1.9	-	79
48	7.694	0.164	1.19	87	1.8	-	79
49	7.858	0.164	1.18	87	1.8	-	79
50	8.023	0.165	1.19	88	1.7	101	79
51	8.187	0.164	1.17	88	1.7	-	79
52	8.352	0.165	1.19	88	1.9	-	79
53	8.516	0.164	1.17	88	1.8	-	80
54	8.682	0.166	1.19	89	1.7	-	80
55	8.846	0.164	1.18	89	1.9	-	80
56	9.012	0.166	1.19	89	1.9	-	80
57	9.176	0.164	1.18	89	1.7	-	80
58	9.339	0.163	1.18	89	1.8	-	80
59	9.503	0.164	1.19	89	1.8	-	80
60	9.669	0.166	1.18	89	1.7	101	80
Avg/Tot	9.669	0.161	1.14	83.2	1.8	99	78.5

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT: 28

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
0	354	348	247	237	254	287.9	548.4
1	352	346	249	236	254	287.5	450.0
2	350	344	249	235	254	286.1	431.2
3	346	340	248	233	254	284.4	455.7
4	343	336	248	232	255	282.7	500.3
5	339	333	248	231	255	281.1	530.6
6	336	329	247	229	255	279.1	544.5
7	332	326	246	227	255	277.0	549.2
8	328	322	246	225	255	275.1	550.8
9	325	318	245	223	255	273.3	552.4
10	322	315	245	222	254	271.4	554.5
11	318	311	243	220	255	269.5	556.3
12	315	308	242	218	254	267.4	560.1
13	312	305	241	216	254	265.6	564.8
14	309	302	240	215	254	263.9	570.3
15	306	299	239	214	254	262.3	576.4
16	303	295	238	212	254	260.6	583.2
17	301	292	237	211	254	259.1	591.7
18	298	290	235	210	254	257.3	601.1
19	295	287	234	208	254	255.5	611.8
20	292	284	232	207	254	253.9	623.6
21	290	282	231	206	253	252.4	632.9
22	288	280	229	205	253	251.1	648.0
23	287	278	228	204	253	249.8	669.3
24	286	276	226	203	253	248.8	680.4
25	285	274	225	203	253	247.9	687.4
26	283	272	223	203	253	246.9	691.0
27	282	271	222	203	253	246.1	699.5
28	282	270	221	203	253	245.5	702.5
29	281	269	220	202	252	244.8	699.1
30	280	269	218	202	252	244.2	692.9
31	280	269	218	201	252	243.7	695.6
32	279	268	217	202	252	243.4	703.7
33	278	267	215	202	251	242.8	710.4
34	277	266	215	202	251	242.1	715.7
35	276	266	213	202	251	241.5	724.0
36	275	265	212	202	251	240.8	733.9
37	274	264	211	203	251	240.5	743.5
38	273	263	210	203	250	239.8	752.8
39	272	263	209	203	250	239.4	761.3
40	272	262	208	204	250	239.1	770.1
41	271	262	208	204	250	238.9	779.2
42	272	261	207	204	250	238.7	788.2
43	273	261	206	205	250	238.8	795.0
44	273	261	205	206	250	238.9	797.7
45	274	261	204	207	250	239.1	805.6
46	275	261	204	208	249	239.4	809.0
47	275	262	203	209	249	239.5	812.6

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT: 28

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
48	275	263	202	210	249	239.9	819.6
49	276	265	201	211	249	240.5	829.0
50	277	268	201	213	249	241.5	835.5
51	279	272	201	214	248	242.7	840.0
52	281	275	200	215	248	244.0	849.6
53	283	279	200	218	248	245.5	860.4
54	285	282	199	220	248	246.8	871.3
55	287	286	199	221	248	248.2	883.6
56	289	289	199	224	247	249.5	891.8
57	291	292	199	226	247	250.8	895.9
58	294	294	198	228	247	252.2	897.8
59	296	296	198	231	246	253.5	896.5
60	298	299	199	233	246	254.9	902.7
61	301	301	199	236	246	256.5	907.5
62	304	303	199	239	245	257.8	914.7
63	306	305	199	241	245	259.1	921.1
64	309	307	199	244	245	260.6	925.7
65	313	310	199	246	245	262.3	927.2
66	317	312	199	248	244	264.0	928.2
67	320	314	199	251	244	265.7	929.0
68	324	317	199	253	243	267.4	929.6
69	329	319	200	255	243	269.1	927.4
70	334	321	200	257	243	271.0	928.8
71	339	323	200	259	243	272.9	930.5
72	345	325	201	261	243	274.7	931.3
73	350	326	201	263	243	276.6	931.7
74	356	328	202	265	242	278.6	933.3
75	361	330	203	267	242	280.5	931.4
76	366	332	203	268	242	282.0	928.7
77	370	334	204	270	242	283.9	926.8
78	374	336	204	272	242	285.6	923.9
79	378	338	205	274	242	287.2	923.8
80	381	340	206	276	242	288.7	923.3
81	384	342	206	276	242	289.8	923.4
82	386	344	207	278	242	291.2	923.0
83	389	346	207	278	242	292.6	925.1
84	392	348	208	280	242	294.0	928.2
85	394	350	209	281	242	295.1	930.7
86	396	353	210	283	242	296.7	933.0
87	398	355	210	283	242	297.8	934.4
88	400	357	211	285	242	299.2	935.0
89	402	359	212	285	242	300.2	935.0
90	404	361	213	288	242	301.8	936.1
91	407	363	214	289	242	302.9	937.1
92	408	365	215	289	242	303.9	938.1
93	411	367	216	290	242	305.0	938.7
94	412	369	217	291	242	306.3	940.5
95	414	372	218	292	242	307.4	941.7

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT: 28

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
96	416	373	218	292	242	308.3	942.5
97	417	375	219	293	241	309.4	943.5
98	419	377	220	294	242	310.4	941.0
99	421	379	221	295	241	311.4	937.1
100	423	380	222	296	241	312.5	925.2
101	424	382	223	296	241	313.1	912.9
102	425	383	224	297	241	314.1	901.8
103	427	383	225	297	241	314.6	896.8
104	427	384	226	298	241	315.2	890.7
105	428	385	227	298	241	315.8	879.7
106	428	385	228	298	241	316.0	868.7
107	428	386	229	298	241	316.3	857.2
108	428	386	229	299	241	316.6	844.8
109	428	387	231	298	241	316.9	833.3
110	428	388	231	298	241	317.1	823.9
111	428	389	232	298	241	317.3	815.2
112	427	389	233	296	241	317.2	807.6
113	426	390	234	296	241	317.1	802.0
114	424	390	235	296	241	317.1	797.3
115	423	390	235	294	241	316.5	796.5
116	420	390	236	292	241	315.9	800.7
117	418	390	236	292	242	315.5	803.9
118	416	390	237	291	242	315.1	802.1
119	414	390	238	289	242	314.5	799.5
120	412	390	239	289	242	314.1	798.7
121	410	390	239	287	242	313.6	797.5
122	408	389	239	286	242	313.0	796.4
123	406	389	240	285	243	312.6	795.0
124	404	389	241	284	243	312.2	792.9
125	402	390	241	284	243	311.9	795.1
126	400	389	241	282	243	311.2	794.9
127	399	389	242	282	243	311.0	793.2
128	397	389	242	279	244	310.3	794.0
129	396	389	243	279	244	310.1	794.8
130	394	390	243	278	244	309.8	795.6
131	393	390	243	277	244	309.4	800.0
132	392	390	244	276	245	309.1	804.1
133	391	390	244	275	245	309.0	801.3
134	390	390	244	275	245	308.8	800.5
135	390	390	245	274	245	308.7	802.8
136	389	390	246	274	245	308.7	804.7
137	389	390	246	272	246	308.4	810.0
138	388	390	247	272	246	308.5	805.9
139	388	389	247	271	246	308.4	810.2
140	387	390	247	272	247	308.4	819.6
141	387	389	247	270	247	308.2	824.9
142	388	390	248	270	247	308.6	819.2
143	388	391	249	271	247	309.3	819.3

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT: 28

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
144	389	392	249	269	248	309.5	828.2
145	391	394	249	269	248	310.1	842.3
146	392	395	250	270	248	311.0	854.4
147	393	397	251	270	248	311.6	864.9
148	394	398	251	269	248	312.3	871.0
149	395	400	252	270	248	313.1	869.7
150	396	401	252	270	249	313.4	855.0
151	397	402	252	270	249	313.9	841.0
152	397	402	253	270	249	314.3	825.4
153	397	403	254	272	249	314.7	816.2
154	396	403	254	272	249	315.0	803.4
155	396	403	255	271	250	314.9	796.6
156	395	403	255	273	250	315.1	792.9
157	395	402	256	273	250	315.2	788.8
158	395	402	256	272	251	315.1	784.7
159	395	401	257	272	251	315.1	783.4
160	395	401	257	272	251	315.2	778.4
161	395	400	258	272	251	315.2	780.1
162	395	400	258	272	251	315.5	778.1
163	396	400	259	272	252	315.5	774.4
164	396	399	259	271	252	315.5	774.1
165	397	399	260	271	252	315.7	772.5
166	398	399	260	271	253	316.2	773.0
167	399	399	260	270	253	316.3	774.3
168	400	399	260	269	254	316.2	772.5
169	401	399	261	268	254	316.4	771.8
170	402	399	261	268	254	316.6	770.1
171	402	399	261	268	254	316.8	767.9
172	403	399	261	267	254	316.7	767.9
173	404	398	261	266	254	316.8	764.8
174	404	398	262	266	255	316.8	762.1
175	405	397	262	266	255	316.8	758.0
176	405	396	262	266	255	316.8	756.7
177	404	395	262	265	256	316.3	758.3
178	404	394	263	265	256	316.1	758.0
179	403	392	262	265	256	315.7	754.5
180	402	391	263	265	257	315.6	749.4
181	401	390	263	264	257	314.9	744.6
182	400	389	263	264	257	314.7	741.4
183	398	387	263	263	258	313.8	736.4
184	397	386	264	263	258	313.4	729.3
185	395	384	264	263	259	312.8	722.3
186	394	383	264	262	259	312.4	716.4
187	393	381	264	261	260	311.7	712.0
188	392	380	264	260	260	311.1	707.0
189	391	379	264	259	260	310.6	702.0
190	390	378	264	258	260	310.1	698.1
191	388	377	264	258	261	309.5	695.1

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT: 28

Elapsed Time (min)	Temperature Data (°F)						
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
192	387	376	264	257	261	308.9	693.1
193	386	374	264	256	261	308.3	690.8
194	385	373	265	254	261	307.7	687.6
195	384	372	265	253	261	307.0	684.9
196	383	371	264	253	262	306.4	683.5
197	382	370	264	252	262	306.1	679.8
198	381	369	264	251	261	305.2	678.0
199	380	368	264	250	261	304.4	676.3
200	379	367	264	249	260	303.8	674.6
201	378	365	264	248	260	302.9	673.4
202	377	364	264	248	260	302.6	672.7
203	376	363	264	246	260	301.7	670.1
204	375	362	264	245	260	301.1	669.2
205	374	361	264	244	260	300.5	667.7
206	373	360	263	243	260	299.7	665.9
207	372	359	263	242	260	299.2	663.9
208	372	358	263	241	260	298.6	661.4
209	371	356	263	241	260	298.1	659.9
210	370	355	263	239	260	297.3	659.4
211	368	354	263	239	260	296.7	657.9
212	367	353	262	238	260	296.1	655.9
213	366	352	263	238	260	295.6	654.6
214	365	350	262	237	260	294.8	653.2
215	364	349	262	236	260	294.1	653.1
216	363	348	262	235	260	293.5	653.3
217	361	347	262	234	260	292.8	650.9
218	360	346	262	233	260	292.1	650.2
219	359	345	262	233	260	291.6	647.7
220	357	344	262	232	261	291.0	647.5
221	356	343	261	231	261	290.5	646.9
222	355	342	261	230	261	289.9	645.0
223	354	341	261	230	262	289.5	645.3
224	352	340	261	229	262	288.9	644.3
225	351	339	261	229	262	288.4	644.5
226	350	339	260	228	262	287.9	645.0
227	349	337	261	228	262	287.3	643.3
228	348	337	260	227	262	286.7	641.1
229	347	336	260	227	262	286.3	640.4
230	346	335	260	226	262	285.8	640.3
231	345	334	260	226	262	285.2	638.2
232	344	333	260	225	262	284.7	638.3
233	343	332	259	225	262	284.2	635.3
234	342	331	259	224	261	283.6	631.3
235	341	331	259	224	262	283.1	629.9
236	340	330	259	223	262	282.7	628.3
237	340	329	258	223	261	282.1	624.8
238	339	328	258	222	261	281.5	623.7
239	338	327	258	222	261	281.1	621.8

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT: 28

Elapsed Time (min)	Temperature Data (°F)						Catalyst Exit
	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	
240	337	326	258	221	261	280.8	621.6
241	337	325	258	220	261	280.2	619.5
242	336	325	258	219	261	279.7	619.1
243	336	324	258	219	261	279.4	617.9
244	335	323	257	218	261	278.9	615.9
245	334	322	257	219	261	278.6	614.6
246	334	322	257	218	261	278.2	614.6
247	333	321	257	217	261	277.8	612.8
248	333	320	257	217	261	277.4	612.8
249	332	320	257	216	261	277.1	611.4
250	332	319	257	216	260	276.6	610.3
251	331	318	257	215	260	276.2	609.8
252	331	317	257	215	260	275.9	608.8
253	330	317	257	215	260	275.7	609.1
254	330	316	257	214	260	275.1	607.0
255	329	316	257	214	259	274.9	607.2
256	329	315	256	213	259	274.4	604.7
257	328	314	256	212	259	274.0	604.2
258	328	314	256	212	259	273.6	601.4
259	327	313	256	212	258	273.2	601.7
260	327	312	256	211	258	272.8	603.0
261	326	312	256	211	258	272.6	602.8
262	326	311	256	211	258	272.2	602.0
263	325	310	256	210	257	271.9	601.3
264	325	310	256	210	257	271.5	600.2
265	324	309	257	210	257	271.2	598.1
266	324	308	257	209	256	270.8	597.7
267	323	308	257	209	256	270.6	596.3
268	323	307	257	209	256	270.1	597.0
269	323	307	257	208	255	269.8	595.4
270	322	306	257	208	254	269.4	595.7
271	321	306	258	208	254	269.2	594.9
272	321	305	257	208	253	268.9	593.9
273	320	305	258	207	253	268.5	592.3
274	320	304	258	207	253	268.2	593.0
275	319	304	258	206	252	267.9	593.2
276	319	303	259	206	251	267.6	594.2
277	318	302	259	206	251	267.2	596.6
278	318	302	259	205	250	266.8	596.4
279	317	302	259	205	249	266.5	599.6
280	317	301	260	204	249	266.1	600.2
281	317	301	260	204	248	266.0	603.7
282	316	300	260	204	248	265.6	602.6
283	315	300	260	204	247	265.3	602.2
284	315	300	260	204	247	265.2	600.9
285	314	300	260	204	247	264.9	602.8
286	314	299	260	204	247	264.6	604.4
287	313	299	261	204	246	264.5	603.2

WOODSTOVE SURFACE TEMPERATURE DATA

Client: Jotul

Job #: 23-167

Model: F445

Tracking #: 152

Run #: 7

Technician: SJB

Date: 7/12/2023

Stove ΔT : 28

Temperature Data (°F)							
Elapsed Time (min)	FB Left	FB Right	FB Back	FB Top	FB Bottom	Stove Surface Average	Catalyst Exit
288	312	299	261	203	245	264.0	601.3
289	312	298	261	203	245	263.9	603.5
290	311	298	261	203	245	263.5	603.8
291	311	298	261	203	244	263.3	602.0
292	310	298	261	203	244	263.1	601.2
293	310	298	261	202	244	262.8	599.6
294	309	298	261	203	243	262.7	599.2
295	309	298	261	203	243	262.5	600.2
296	308	297	261	202	242	262.2	601.1
297	308	297	261	202	241	261.8	600.8
298	307	297	261	202	241	261.6	599.4
299	307	297	261	202	240	261.4	600.0
300	307	297	261	202	240	261.1	596.4
301	306	297	261	202	240	261.0	594.2
302	306	297	261	202	239	260.9	591.4
303	306	296	261	201	239	260.5	588.6
304	306	296	261	201	239	260.4	588.4
305	305	296	261	201	239	260.3	587.6
306	305	296	261	201	238	260.3	588.8
307	305	296	261	200	239	260.0	588.0
308	304	296	261	200	238	259.9	588.6
309	304	296	261	200	238	259.7	588.9
310	304	295	261	200	238	259.4	586.3
311	304	295	261	200	238	259.4	584.3
Average	352.1	338.7	242.5	241.5	250.7	285.1	727.1

LAB SAMPLE DATA - ASTM E2515

Client: Jotul
 Model: F445
 Run #: 7

Job #: 23-167
 Tracking #: 152
 Technician: SJB
 Date: 7/12/2023

		Sample ID	Tare, mg	Final, mg	Catch, mg
Filters	A	G620	242.3	242.8	0.5
	B	G621	244.3	244.6	0.3
	C - 1st Hour	G622	242.3	242.7	0.4
	Amb	G623	242.8	242.8	0.0
Probes	A	11A	116864.7	116864.9	0.2
	B	11B	117338.5	117338.7	0.2
	C - 1st Hour	11C	116184.7	116184.9	0.2
O-rings	A	11A	3423.7	3423.8	0.1
	B	11B	4233.9	4234.4	0.5
	C - 1st Hour	11C	3588.6	3588.6	0.0

Placed in Dessicator on:

7/12 - 16:25

Balance Audit (mg):

100.0

100.0

Filters	A	242.8	7/14 9:00	242.8	7/17 16:00				
	B	244.5	7/14 9:00	244.6	7/17 16:00				
	C - 1st Hour	242.6	7/14 9:00	242.7	7/17 16:00				
	Amb	242.8	7/14 9:00	242.8	7/17 16:00				
Probes	A	116864.9	7/14 9:00	116864.9	7/17 16:00				
	B	117338.6	7/14 9:00	117338.7	7/17 16:00				
	C - 1st Hour	116184.8	7/14 9:00	116184.9	7/17 16:00				
O-Rings	A	3423.8	7/14 9:00	3423.8	7/17 16:00				
	B	4234.3	7/14 9:00	4234.4	7/17 16:00				
	C - 1st Hour	3588.7	7/14 9:00	3588.6	7/17 16:00				

Train A Aggregate, mg: 0.8

Train B Aggregate, mg: 1.0

Train C Aggregate, mg: 0.6

Ambient, mg: 0.0

ASTM E2515 - Glass Filters

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00577	243.0	242.9	-	-	SB	23-153	#2
G00578	242.5	242.7	-	-	SB	23-153	#3
G00579	242.7	242.5	-	-	SB	↓	↓
G00580	242.3	242.4	-	-	SB	↓	↓
G00581	242.6	242.6	-	-	SB	↓	↓
G00582	242.7	242.7	-	-	SB	23-153	#4
G00583	242.4	242.5	-	-	SB	↓	↓
G00584	243.0	242.7	242.9	-	SB	↓	↓
G00585	242.7	242.7	-	-	SB	↓	↓
G00586	241.8	241.6	-	-	SB	23-153	#5
G00587	242.5	242.4	-	-	SB	↓	↓
G00588	242.6	242.6	-	-	SB	↓	↓
G00589	242.1	242.0	-	-	SB	↓	↓
G00590	242.6	242.6	-	-	SB	22-791	#1-HST
G00591	242.0	241.9	-	-	SB	↓	↓
G00592	241.5	241.4	-	-	SB	22-791	#2-HST
G00593	242.5	242.4	-	-	SB	↓	↓
G00594	241.8	241.8	-	-	SB	22-791	#3-HST

Weight 1 Date/Time:

6/19 - 16:00

Weight 2 Date/Time:

6/20 - 3:30

Weight 3 Date/Time:

Weight 4 Date/Time:

Sample	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00595	242.6	242.3	242.4	-	SB	22-791	#3-HST
G00596	242.8	242.9	-	-	SB	23-167	#1
G00597	242.1	242.2	-	-	SB	↓	↓
G00598	241.0	240.9	-	-	SB	↓	↓
G00599	241.8	242.0	-	-	SB	↓	↓
G00600	241.2	241.2	-	-	SB	23-167	#2
G00601	242.1	242.2	-	-	SB	↓	↓
G00602	241.6	241.6	-	-	SB	↓	↓
G00603	242.5	242.6	-	-	SB	↓	↓
G00604	242.4	242.3	-	-	SB	23-167	#3
G00605	243.0	242.9	-	-	SB	↓	↓
G00606	242.8	242.4	242.6	-	SB	↓	↓
G00607	242.2	242.0	-	-	SB	↓	↓
G00608	243.3	243.3	-	-	SB	23-167	#4
G00609	242.4	242.3	-	-	SB	↓	↓
G00610	242.1	242.2	-	-	SB	↓	↓
G00611	241.9	241.9	-	-	SB	↓	↓
G00612	242.4	242.5	-	-	SB	23-167	#5

Weight 1 Date/Time:

6/20 - 3:30

Weight 2 Date/Time:

6/21 - 3:30

Weight 3 Date/Time:

6/22 - 5:00

Weight 4 Date/Time:

ASTM E2515 - Glass Fiber Filters

Date:	7/10	7/11					
Time:	12:00	6:00					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00613	243.3	243.2	-	-	SB	23-167	#5
G00614	244.0	244.0	-	-	SB	↓	↓
G00615	243.9	244.1	-	-	SB	↓	↓
G00616	242.8	242.7	-	-	SB	26-167	#6
G00617	243.8	243.8	-	-	SB	↓	↓
G00618	243.2	243.1	-	-	SB	↓	↓
G00619	242.2	242.1	-	-	SB	↓	↓
G00620	242.3	242.3	-	-	SB	26-167	#7
G00621	244.2	244.3	-	-	SB	↓	↓
G00622	242.4	242.3	-	-	SB	↓	↓
G00623	242.9	242.8	-	-	SB	↓	↓
G00624	243.3	243.4	-	-	SB	23-169	#1
G00625	243.1	243.0	-	-	SB	↓	↓
G00626	243.8	243.7	-	-	SB	↓	↓
G00627	243.8	243.7	-	-	SB	↓	↓
G00628	244.6	244.5	-	-	SB		

Date:	7/28/23	7/31/23					
Time:	09:45	10:50					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
G00629	243.4	243.4	-	-	A	23-200	#1
G00630	244.0	244.0	-	-	A	↓	↓
G00631	243.3	243.4	-	-	A	↓	↓
G00632	244.4	244.8	-	-	A	↓	↓
G00633	244.2	244.2	-	-	A	23-200	#1
G00634	243.5	243.5	-	-	A	↓	↓
G00635	244.9	244.9	-	-	A	↓	↓
G00636	244.0	244.0	-	-	A	↓	↓
G00637	244.1	244.2	-	-	A	↓	#2
G00638	244.3	244.2	-	-	A	↓	↓
G00639	243.7	243.7	-	-	A	↓	↓
G00640	244.5	244.5	-	-	A	↓	↓
G00641	243.2	243.3	-	-	A	↓	#3
G00642	243.7	243.8	-	-	A	↓	↓
G00643	242.7	242.7	-	-	A	↓	↓
G00644	243.1	243.0	-	-	A	↓	↓

ASTM E2515 - O-Ring Samples 1-10

Date:	6/19	6/20					
Time:	10:00	3:30					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
1A	3567.6	3567.5	—	—	SB	23-153	#4
1B	3556.0	3555.8	—	—	SB		
1C	4167.3	4167.2	—	—	SB		
2A	3553.6	3553.7	—	—	SB	23-153	#15
2B	3572.9	3573.0	—	—	SB		
2C	3390.9	3390.9	—	—	SB		
3A	3580.1	3580.0	—	—	SB	22-791	#1-HST
3B	3568.8	3568.7	—	—	SB		
3C	3622.8	3622.7	—	—	SB		
4A	3375.7	3375.9	—	—	SB	22-791	#3-HST
4B	3579.9	3579.8	—	—	SB		
4C	3372.6	3372.7	—	—	SB		
5A	3536.8	3536.8	—	—	SB	23-162	#1
5B	3532.6	3532.6	—	—	SB		
5C	3376.8	3376.9	—	—	SB		

Date:	6/30	7/3					
Time:	12:00	10:00					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
6A	3614.5	3614.2	3614.3	—	SB	23-167	#2
6B	3397.0	3396.9	—	—	SB		
6C	3402.0	3401.9	—	—	SB		
7A	3572.5	3572.3	—	—	SB	23-167	#3
7B	3523.3	3523.4	—	—	SB		
7C	3407.5	3407.5	—	—	SB		
8A	3552.2	3552.3	—	—	SB	23-167	#4
8B	3358.0	3358.0 3358.0	—	—	SB		
8C	3586.7	3586.7	—	—	SB		
9A	3580.9	3580.9	—	—	SB	23-167	#5
9B	3523.6	3523.8	—	—	SB		
9C	3431.2	3431.2	—	—	SB		
10A	3361.9	3361.9	—	—	SB	23-167	#6
10B	3571.2	3571.1	—	—	SB		
10C	3366.6	3366.6	—	—	SB		

ASTM E2515 - O-Ring Samples 11-20

Date:	7/10	7/11					
Time:	12:00	6:00					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
11A	3423.7	3423.7	-	-	SB	23-167	#7
11B	4234.0	4233.9	-	-	SB		
11C	3588.6	3588.6	-	-	SB		
12A	3586.1	3586.3	-	-	SB	23-169	#1
12B	3550.7	3550.7	-	-	SB		
12C	3616.5	3616.5	-	-	SB		
13A	3596.2	3596.1	-	-	SB	23-170 23-200	#1
13B	3642.2	3642.3	-	-	SB		
13C	4409.3	4409.3	-	-	SB		
14A	3366.5	3366.4	-	-	SB	23-200	#1
14B	3341.5	3341.6	-	-	SB		
14C	3445.1	3445.3	-	-	SB		
15A	3569.8	3570.0	-	-	SB	23-200	#2
15B	3571.1	3571.1	-	-	SB		
15C	3396.8	3397.0	-	-	SB		

Date:	7/28/23	7/31/23					
Time:	030	1030					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
16A	3573.6	3572.9	-	-	A	23-200	#3
16B	3638.7	3638.6	-	-	A		
16C	3601.9	3601.9	-	-	A		
17A	3613.5	3613.6	-	-	A	23-200	#4
17B	3569.4	3569.4	-	-	A		
17C	3597.2	3597.2	-	-	A		
18A	3603.0	3602.8	-	-	A	23-200	#5
18B	3546.5	3546.4	-	-	A		
18C	3528.8	3528.7	-	-	A		
19A	3585.6	3585.7	-	-	A		
19B	3632.9	3632.9	-	-	A		
19C	3614.8	3614.8	-	-	A		
20A	3559.0	3558.9	-	-	A		
20B	3614.3	3614.3	-	-	A		
20C	3610.6	3610.6	-	-	A		

ASTM E2515 - Probe Samples 1-10

Date:	6/19	6/26	6/21				
Time:	10:00	3:30	3:30				
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
1A	115626.9	115626.9	-	-	SB	23-153	#4
1B	115902.1	115902.2	-	-	SB		
1C	116432.8	116432.8	-	-	SB		
2A	116056.8	116056.8	-	-	SB	23-153	#5
2B	116173.6	116173.5	-	-	SB		
2C	116428.9	116428.8	-	-	SB		
3A	115880.0	115879.8	-	-	SB	22-791	#1-HST
3B	116119.8	116119.6	-	-	SB	22-791	#2-HST
3C	116617.4	116616.2	116616.6	-	SB		
4A	116022.4	116022.0	116021.9	-	SB	↓	↓
4B	116181.6	116181.4	-	5	SB	22-791	#3-HST
4C	116996.7	116996.6	-	-	SB		
5A	116757.3	116757.1	-	-	SB	23-167	#1
5B	116875.5	116875.4	-	-	SB		
5C	115855.3	115855.1	-	-	SB		

Date:	6/30	7/3					
Time:	12:00	10:00					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
6A	116382.0	116381.8	-	-	SB	23-167	#2
6B	115953.0	115953.0	-	-	SB		
6C	115127.7	115127.7	-	-	SB		
7A	116557.2	116557.1	-	-	SB	23-167	#3
7B	117127.9	117127.7	-	-	SB		
7C	116550.5	116550.3	-	-	SB		
8A	116632.7	116632.9	-	-	SB	23-167	#4
8B	116665.1	116664.9	-	-	SB		
8C	116662.4	116662.5	-	-	SB		
9A	116529.7	116529.9	-	-	SB	23-167	#5
9B	117737.4	117737.4	-	-	SB		
9C	116602.5	116602.6	-	-	SB		
10A	116644.9	116645.0	-	-	SB	23-167	#6
10B	117753.0	117753.0	-	-	SB		
10C	116727.6	116727.7	-	-	SB		

ASTM E2515 - Probe Samples 11-20

Date:	7/16	7/11	7/12	7/13			
Time:	12:00	6:00	8:00	10:00			
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
11A	116864.1	116864.6	116864.7	-	SB	23-67	#7
11B	117338.0	117338.4	117338.5	-	SB		
11C	116184.5	116184.7	-	-	SB		
12A	116704.7	116704.7	-	-	SB	23-169	#1
12B	117770.5	117770.6	-	-	SB		
12C	117170.7	117170.9	-	-	SB		
13A	117313.5	117313.7	-	-	SB	23-170 23-200	#1
13B	116940.3	116940.5	-	-	SB		
13C	115649.1	115649.0	-	-	SB		
14A	116632.1	116632.2	-	-	SB	23-200	#1
14B	116617.8	116618.4	116618.2	-	SB		
14C	116529.3	116529.8	116529.6	-	SB		
15A	117238.5	117238.6	-	-	SB	23-200	#2
15B	116751.4	116751.8	116751.5	116751.4	SB		
15C	116846.1	116846.5	116846.6	-	SB		

Date:	7/28/23	7/31/23					
Time:	0045	1040					
	Weight 1	Weight 2	Weight 3	Weight 4	Initial	Project	Run
16A	116377.8	116377.8	-	-	A	23-200	#3
16B	115860.4	115860.5	-	-	A		
16C	114146.9	114147.0	-	-	A		
17A	116809.7	116809.7	-	-	A	23-200	#4
17B	117139.9	117139.8	-	-	A		
17C	113140.9	113140.9	-	-	A		
18A	117499.0	117498.9	-	-	A	23-200	#5
18B	117331.0	117330.9	-	-	A		
18C	114334.3	114334.2	-	-	C		
19A	117026.2	117026.2	-	-	A		
19B	117013.2	117013.0	-	-	A		
19C	114231.4	114231.2	-	-	A		
20A	115626.4	115626.2	-	-	A		
20B	115965.9	115965.7	-	-	A		
20C	113779.1	113779.9	-	-	A		

Sample Calculations – ASTM E2780 & E2515

Client: Jotul
 Model: F445
 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:

$$FM_S = 9.1 \%$$

$$M_{Swb} = 1.5 \text{ lbs}$$

0.4536 = Conversion factor from lbs to kg

$$M_{Sdb} = [(1.5 \times 0.4536) (100/(100 + 9.1))]$$

$$M_{Sdb} = 0.62 \text{ kg}$$

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

Sample Calculation (test fuel piece 1):

$$M_{CPnwb} = 2.12$$

$$FM_{CPn} = 20.0$$

$$= 2.1 \left(100 / (100 + 20.0) \right)$$

$$= 1.8 \text{ lbs}$$

Total dry crib weight, excluding spacers = 10.30 lbs

$$M_{Cdb} = \mathbf{4.67 \text{ kg}}$$

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:

$$V_C = 638.8 \text{ in}^3$$

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

$$D_{Cdb} = 10.30 / 638.8 * 1728$$

$$= \mathbf{27.86 \text{ lbs/ft}^3}$$

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

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

Sample calculation:

$$M_{FTAdb} = 0.62 + 4.67$$

$$= 5.30 \text{ kg}$$

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:

$$\begin{aligned} M_{Bdb} &= 5.30 \quad \text{kg} \\ \theta &= 268 \quad \text{min} \end{aligned}$$

$$BR = \frac{60 \times 5.3}{268}$$

$$BR = 1.19 \quad \text{kg/hr}$$

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:

$$F_p = \frac{8.55}{8.93} = 0.957$$

$$V_s = 0.957 \times 85.49 \times 0.99 \times 0.132 \times \left(\left(\frac{102.7}{29.72} + \frac{460}{-0.09} \right) \times \frac{28.78}{13.6} \right)^{1/2}$$

$$V_s = 8.67 \text{ ft/s}$$

*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:

$$Q_{sd} = 3600 \times (1 - 0.02) \times 8.67 \times 0.7854 \times \frac{528}{102.7 + 460} \times \frac{29.72 + \frac{-0.09}{13.6}}{29.92}$$

$$Q_{sd} = \mathbf{22384.6} \quad \text{dscf/hr}$$

$V_{m(std)}$ – 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 A:

$$V_{m(std)} = 17.64 \times 42.711 \times 1.01 \times \frac{\left(29.72 + \frac{2.38}{13.6} \right)}{\left(105.5 + 460 \right)}$$

$$V_{m(std)} = \mathbf{40.222} \text{ dscf}$$

Using equation for Train B:

$$V_{m(std)} = 17.64 \times 40.140 \times 1.001 \times \frac{\left(29.72 + \frac{2.16}{13.6} \right)}{\left(104.5 + 460 \right)}$$

$$V_{m(std)} = \mathbf{37.509} \text{ dscf}$$

Using equation for ambient train:

$$V_{m(std)} = 17.64 \times 34.54 \times 1.024 \times \frac{\left(29.715 + \frac{0.00}{13.6} \right)}{\left(82.6 + 460 \right)}$$

$$V_{m(std)} = \mathbf{34.173} \text{ dscf}$$

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:

$$m_n = 0.2 + 0.2 + 0.3$$

$$m_n = 0.7 \text{ mg}$$

Using equation for Train B:

$$m_n = 0 + 0.3 + 0.3$$

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

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

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

Where:

- K₂ = 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 A:

$$C_s = 0.001 \times \frac{0.7}{40.22}$$

$$C_s = \mathbf{0.00002} \text{ g/dscf}$$

For Train B

$$C_s = 0.001 \times \frac{0.6}{37.51}$$

$$C_s = \mathbf{0.00002} \text{ g/dscf}$$

For Ambient Train

$$C_r = 0.001 \times \frac{0.0}{34.17}$$

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

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 A

$$E_T = (0.000017 - 0.000000) \times 22384.6 \times 268 / 60$$

$$E_T = \mathbf{1.74} \text{ g}$$

For Train B

$$E_T = (0.000016 - 0.000000) \times 22384.6 \times 268 / 60$$

$$E_T = \mathbf{1.60} \text{ g}$$

Average

$$E = \mathbf{1.67} \text{ g}$$

PR - Proportional Rate Variation

ASTM E2515 equation (16)

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

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 10-min interval of Train 1):

$$PR = \left(\frac{268 \times 1.473 \times 8.67 \times (98.3 + 460) \times (105.5 + 460)}{10 \times 42.711 \times 8.78 \times (102.7 + 460) \times (83.0 + 460)} \right) \times 100$$

$$PR = 94 \%$$

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:

$$E_T \text{ (Dual train average)} = 1.67 \text{ g}$$

$$\theta = 268 \text{ min}$$

$$PM_R = 60 \times (1.67 / 268)$$

$$PM_R = 0.37 \text{ g/hr}$$

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

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

Sample Calculation:

$$E_T \text{ (Dual train average)} = 1.67 \text{ g}$$

$$M_{Bdb} = 5.30 \text{ kg}$$

$$PM_F = 1.67 / 5.30$$

$$PM_F = \mathbf{0.32} \text{ g/kg}$$

Stack Loss Efficiency and CO emissions calculations are done in accordance with CSA B415.1, using the password protected excel spreadsheet provided with the test standard. No alterations or alternative calculations are used for determining efficiency or CO emissions. The following pages are a sample of the calculations page from the B415.1 Spreadsheet (V2_4 - Dated April 15, 2010).

Manufacturer: Jotul
Model: F445
Date: 07/05/23
Run: 1
Control #: 23-167
Test Duration: 268

min

	HHV	LHV
Eff	67.44%	72.89%
Comb Eff	99.50%	99.50%
HT Eff	67.78%	73.26%
Output	15,694	kJ/h
Burn Rate	1.17	kg/h
Grams CO	53	g
Input	23,269	kJ/h
MC wet	17.05	
Averages	0.02	2.84

Note: In the "Input data", "Calc. % O₂", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a], [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3 to 13.7.5.

Overall Heating Efficiency: 67.44%
Combustion Efficiency: 99.50%
Heat Transfer Efficiency: 67.78%

Air Fuel

Dry Molecular W

Dry Moles Exhaust

Air Fuel Ratio

Heat Output: 14,887 Btu/h 15,694 kJ/h
Heat Input: 22,074 Btu/h 23,269 kJ/h

Ultimate CO₂

CO_{2-ult} 19.64

F₀

1.052

Burn Duration: 4.47 h

Burn Rate: 2.59 lb/h 1.175 kg/h

Stack Temp: 253.3 Deg. F 122.9 Deg. C

INPUT DATA				Oxygen Calculation			Input Data		Combust Eff	Heat Transfer	Net Eff	Air Fuel	Wet Wt
Elapsed Time	Weight Remaining (kg)	% CO [e]	% CO ₂ [d]	Excess Air EA	Total O ₂	Calc. % O ₂ [g]	Flue Gas (°C)	Room Temp (°C)	%	%	%	Ratio	Now Wt
0	6.32	0.05	2.41	696.9%	20.78	18.34	146.0	26.2	100.4%	59.2%	59.4%	48.3	6.32
1	6.31	0.07	1.72	993.1%	20.82	19.06	145.1	26.2	99.7%	48.1%	47.9%	66.3	6.31
2	6.29	0.09	1.21	1416.8%	20.85	19.60	121.3	26.4	98.9%	43.5%	43.0%	92.3	6.29
3	6.27	0.01	1.40	1292.1%	20.85	19.44	112.2	26.6	103.6%	53.2%	55.1%	85.3	6.27
4	6.25	0.01	1.39	1298.1%	20.85	19.45	109.7	26.5	103.4%	54.0%	55.9%	85.7	6.25
5	6.22	0.01	1.78	995.5%	20.82	19.04	110.2	26.4	102.6%	61.3%	62.8%	66.8	6.22
6	6.19	0.02	2.05	851.7%	20.80	18.75	111.2	26.2	102.1%	64.5%	65.9%	57.9	6.19
7	6.18	0.02	2.00	876.3%	20.81	18.80	112.2	26.3	102.1%	63.6%	64.9%	59.4	6.18
8	6.15	0.01	1.94	908.9%	20.81	18.87	113.4	26.3	102.4%	62.4%	63.9%	61.5	6.15
9	6.13	0.01	1.91	923.1%	20.81	18.90	114.9	26.3	102.5%	61.6%	63.1%	62.3	6.13
10	6.10	0.01	2.21	784.4%	20.79	18.58	116.1	26.4	102.1%	64.9%	66.3%	53.8	6.10
11	6.07	0.01	2.23	776.1%	20.79	18.56	116.8	26.3	102.1%	65.0%	66.3%	53.3	6.07
12	6.05	0.01	2.02	866.2%	20.81	18.78	117.3	26.2	102.3%	62.3%	63.8%	58.8	6.05
13	6.01	0.01	2.20	789.6%	20.79	18.59	117.5	26.3	102.2%	64.4%	65.9%	54.1	6.01
14	5.99	0.01	2.38	722.6%	20.78	18.40	118.3	26.1	102.0%	66.0%	67.3%	50.0	5.99
15	5.95	0.01	2.35	732.7%	20.78	18.43	119.1	26.0	101.9%	65.4%	66.7%	50.6	5.95
16	5.92	0.01	2.18	798.2%	20.80	18.61	120.3	26.2	102.1%	63.3%	64.6%	54.6	5.92
17	5.89	0.01	2.53	673.0%	20.77	18.24	121.9	26.3	101.9%	66.5%	67.8%	47.0	5.89
18	5.86	0.01	2.69	626.4%	20.76	18.06	122.9	26.3	101.6%	67.6%	68.7%	44.1	5.86
19	5.82	0.01	2.71	622.4%	20.76	18.05	124.6	26.2	101.6%	67.3%	68.4%	43.8	5.82
20	5.78	0.01	2.91	572.5%	20.75	17.83	125.9	26.2	101.5%	68.5%	69.5%	40.8	5.78
21	5.74	0.01	3.04	543.2%	20.74	17.69	127.8	26.3	101.4%	69.0%	70.0%	39.0	5.74
22	5.70	0.01	2.94	564.7%	20.74	17.80	130.2	26.2	101.4%	67.8%	68.8%	40.3	5.70
23	5.65	0.01	3.00	554.3%	20.74	17.74	132.8	26.3	101.6%	67.6%	68.7%	39.7	5.65
24	5.61	0.01	3.06	540.5%	20.74	17.67	133.2	26.3	101.5%	68.0%	69.0%	38.8	5.61
25	5.57	0.01	3.17	517.1%	20.73	17.55	136.2	26.3	101.3%	68.1%	69.0%	37.4	5.57
26	5.53	0.01	3.13	525.8%	20.73	17.60	136.7	26.7	101.4%	67.8%	68.8%	37.9	5.53
27	5.48	0.01	3.33	488.1%	20.72	17.38	137.7	26.7	101.3%	68.9%	69.8%	35.6	5.48
28	5.44	0.01	3.48	463.5%	20.71	17.23	139.4	26.7	101.2%	69.4%	70.2%	34.1	5.44
29	5.39	0.01	3.59	446.2%	20.70	17.11	139.7	26.5	101.2%	69.9%	70.7%	33.1	5.39
30	5.34	0.01	3.51	457.6%	20.71	17.19	139.5	26.6	101.2%	69.5%	70.4%	33.8	5.34
31	5.30	0.01	3.49	461.2%	20.71	17.21	139.4	26.7	101.2%	69.5%	70.3%	34.0	5.30
32	5.26	0.01	3.67	433.6%	20.70	17.02	140.4	26.6	101.1%	70.2%	71.0%	32.3	5.26
33	5.21	0.01	3.54	454.1%	20.71	17.16	141.8	26.6	101.2%	69.3%	70.1%	33.6	5.21
34	5.16	0.01	3.44	469.0%	20.71	17.27	142.7	26.7	101.2%	68.6%	69.4%	34.5	5.16
35	5.11	0.01	3.78	418.8%	20.69	16.91	142.9	26.8	101.2%	70.3%	71.1%	31.4	5.11
36	5.06	0.01	3.75	423.7%	20.69	16.94	143.4	26.7	101.2%	70.1%	70.9%	31.7	5.06
37	5.01	0.01	3.70	430.6%	20.70	17.00	144.4	26.8	101.2%	69.7%	70.5%	32.1	5.01

Ratio (A/F)	
Weight (M _g)	29.17
st Gas (N _p):	1487.01
o (A/F)	42.87

%HC
0.88

Combustion Efficiency: 99.50%
 Total Input (kJ): 103,937
 Total Output (kJ): 70,098
 Efficiency: 67.44%
 Total CO (g): 52.71

Moisture of Wood (wet basis): 17.0469
 Initial Dry Weight W_{t_{do}} (kg): 5.25
 Moisture Content Dry 20.55

Load Weight (kg): **6.32**
 Fuel Heating **HHV** **LHV**
 Value in kJ/kg - CV: **19,810** **18,329** Btu/lb **HHV 8522.5**

66.28	1.88	64.20	104065	4.06	6.87	2.74	19810.00	17.05	79.24	21.02	0.70	2.45	-0.03	0.07	40.97
% Wet Consumed	Dry Wt. Now	% Dry Consumed	Total Input	Fuel Properties				Mw Moisture Fuel Burnt	Mass Balance (moles/100 mole dry flue gas)					kg Wood per 100 mole dfp	
x	W _{t_{dn}}	y		Carbon /12= [a]	Hydrogen /1= [b]	Oxygen /16= [c]	Calorific Value		[h]	[u]	[w]	[j]	[k]	Nk	CO ₂
0.00	5.25	0.00	0	4.06	6.87	2.74	19810.00	17.05	79.20	21.01	0.60	2.11	-0.02	0.06	40.31
0.29	5.23	0.29	447	4.06	6.87	2.74	19810.00	17.05	79.14	20.99	0.44	1.54	-0.02	0.04	39.60
0.57	5.22	0.57	336	4.06	6.87	2.74	19810.00	17.05	79.10	20.98	0.31	1.12	-0.02	0.03	38.71
0.93	5.20	0.93	336	4.06	6.87	2.74	19810.00	17.05	79.15	20.99	0.34	1.23	-0.03	0.03	41.43
1.22	5.18	1.22	373	4.06	6.87	2.74	19810.00	17.05	79.15	20.99	0.34	1.22	-0.03	0.03	41.33
1.65	5.16	1.65	447	4.06	6.87	2.74	19810.00	17.05	79.17	21.00	0.43	1.55	-0.03	0.04	41.18
2.08	5.14	2.08	336	4.06	6.87	2.74	19810.00	17.05	79.19	21.00	0.50	1.78	-0.03	0.05	41.07
2.30	5.13	2.30	336	4.06	6.87	2.74	19810.00	17.05	79.18	21.00	0.49	1.73	-0.03	0.05	41.06
2.73	5.10	2.73	447	4.06	6.87	2.74	19810.00	17.05	79.18	21.00	0.47	1.68	-0.03	0.05	41.17
3.16	5.08	3.16	447	4.06	6.87	2.74	19810.00	17.05	79.18	21.00	0.47	1.66	-0.03	0.05	41.20
3.59	5.06	3.59	447	4.06	6.87	2.74	19810.00	17.05	79.20	21.01	0.54	1.91	-0.03	0.05	41.13
4.02	5.04	4.02	410	4.06	6.87	2.74	19810.00	17.05	79.20	21.01	0.55	1.93	-0.03	0.05	41.13
4.38	5.02	4.38	485	4.06	6.87	2.74	19810.00	17.05	79.19	21.00	0.49	1.75	-0.03	0.05	41.17
4.95	4.99	4.95	485	4.06	6.87	2.74	19810.00	17.05	79.20	21.01	0.54	1.90	-0.03	0.05	41.22
5.31	4.97	5.31	485	4.06	6.87	2.74	19810.00	17.05	79.21	21.01	0.58	2.05	-0.03	0.06	41.15
5.88	4.94	5.88	559	4.06	6.87	2.74	19810.00	17.05	79.21	21.01	0.57	2.03	-0.03	0.06	41.09
6.38	4.91	6.38	522	4.06	6.87	2.74	19810.00	17.05	79.20	21.01	0.53	1.88	-0.03	0.05	41.14
6.89	4.89	6.89	522	4.06	6.87	2.74	19810.00	17.05	79.22	21.01	0.62	2.18	-0.03	0.06	41.14
7.39	4.86	7.39	596	4.06	6.87	2.74	19810.00	17.05	79.23	21.02	0.66	2.32	-0.03	0.07	41.06
8.03	4.83	8.03	671	4.06	6.87	2.74	19810.00	17.05	79.23	21.02	0.66	2.33	-0.03	0.07	41.04
8.68	4.79	8.68	671	4.06	6.87	2.74	19810.00	17.05	79.25	21.02	0.71	2.50	-0.03	0.07	41.06
9.33	4.76	9.33	634	4.06	6.87	2.74	19810.00	17.05	79.26	21.02	0.75	2.61	-0.03	0.07	41.04
9.90	4.73	9.90	671	4.06	6.87	2.74	19810.00	17.05	79.25	21.02	0.72	2.53	-0.03	0.07	41.02
10.62	4.69	10.62	708	4.06	6.87	2.74	19810.00	17.05	79.25	21.02	0.73	2.57	-0.03	0.07	41.09
11.26	4.66	11.26	671	4.06	6.87	2.74	19810.00	17.05	79.26	21.02	0.75	2.63	-0.03	0.07	41.06
11.91	4.62	11.91	708	4.06	6.87	2.74	19810.00	17.05	79.26	21.02	0.78	2.72	-0.03	0.08	40.98
12.63	4.58	12.63	746	4.06	6.87	2.74	19810.00	17.05	79.26	21.02	0.77	2.69	-0.03	0.08	41.05
13.34	4.55	13.34	746	4.06	6.87	2.74	19810.00	17.05	79.28	21.03	0.82	2.86	-0.03	0.08	41.02
14.06	4.51	14.06	708	4.06	6.87	2.74	19810.00	17.05	79.28	21.03	0.85	2.98	-0.03	0.08	40.99
14.71	4.48	14.71	746	4.06	6.87	2.74	19810.00	17.05	79.29	21.03	0.88	3.07	-0.03	0.09	41.02
15.49	4.43	15.49	746	4.06	6.87	2.74	19810.00	17.05	79.29	21.03	0.86	3.01	-0.03	0.09	41.01
16.14	4.40	16.14	708	4.06	6.87	2.74	19810.00	17.05	79.29	21.03	0.86	2.99	-0.03	0.09	41.02
16.86	4.36	16.86	783	4.06	6.87	2.74	19810.00	17.05	79.30	21.03	0.90	3.14	-0.03	0.09	40.99
17.65	4.32	17.65	820	4.06	6.87	2.74	19810.00	17.05	79.29	21.03	0.87	3.03	-0.03	0.09	41.03
18.44	4.28	18.44	820	4.06	6.87	2.74	19810.00	17.05	79.28	21.03	0.84	2.95	-0.03	0.08	40.99
19.23	4.24	19.23	820	4.06	6.87	2.74	19810.00	17.05	79.31	21.04	0.93	3.23	-0.03	0.09	41.02
20.01	4.20	20.01	820	4.06	6.87	2.74	19810.00	17.05	79.30	21.04	0.92	3.20	-0.03	0.09	41.04
20.80	4.16	20.80	857	4.06	6.87	2.74	19810.00	17.05	79.30	21.03	0.91	3.16	-0.03	0.09	41.04

Moisture Content M_{Cwb} : 17.04687

Dry kg : 5.25

CA: 49

HY: 7

OX: 43.9

LHV
7885.2

272.98	0.24	-0.40	1198.67	35.33	11.42	396.17	3769.83	2842.35	2765.27	2734.35	3617.47	3309.50	301.23	41462.24	200997.89
Moles per kg of Dry Wood						Stack Temp K	Heat Content Change - Ambient to Stack Temperature Flue Gas Constituent						Room Temp K		
O ₂	CO	HC	N ₂	H ₂ O	Moisture Present		CO ₂	O ₂	CO	N ₂	CH ₄	H ₂ O		CO ₂	O ₂
306.35	0.87	-0.37	1323.01	35.26	11.42	419.15	4788.27	3596.81	3495.98	3457.58	4624.14	4182.98	299.32	193.02	1101.87
437.78	1.68	-0.46	1817.69	35.44	11.42	418.26	4751.22	3569.65	3469.75	3431.61	4586.88	4151.65	299.32	188.13	1562.71
627.03	2.72	-0.61	2530.37	35.75	11.42	394.48	3760.12	2839.32	2763.38	2732.26	3598.74	3307.58	299.54	145.54	1780.35
574.50	0.27	-0.89	2339.00	36.29	11.42	385.37	3381.57	2558.42	2491.21	2462.89	3225.62	2982.18	299.71	140.11	1469.82
577.06	0.36	-0.88	2348.43	36.28	11.42	382.87	3282.00	2484.46	2419.52	2391.96	3127.63	2896.48	299.65	135.65	1433.69
440.33	0.30	-0.66	1831.46	35.85	11.42	383.37	3306.57	2502.85	2437.38	2409.62	3151.51	2917.84	299.54	136.15	1102.09
375.79	0.30	-0.56	1587.35	35.64	11.42	384.37	3353.62	2538.00	2471.50	2443.38	3197.35	2958.65	299.37	137.74	953.76
386.78	0.33	-0.57	1628.83	35.67	11.42	385.37	3390.07	2564.97	2497.61	2469.22	3233.46	2989.86	299.48	139.19	992.08
401.46	0.26	-0.61	1684.55	35.74	11.42	386.54	3439.71	2601.91	2533.43	2504.66	3282.18	3032.69	299.43	141.60	1044.55
407.84	0.24	-0.62	1708.75	35.77	11.42	388.04	3498.75	2645.67	2575.82	2546.62	3340.46	3083.37	299.48	144.14	1079.01
345.78	0.20	-0.53	1474.15	35.58	11.42	389.26	3546.50	2681.04	2610.08	2580.53	3387.68	3124.31	299.54	145.88	927.06
342.09	0.20	-0.52	1460.17	35.56	11.42	389.93	3575.85	2702.87	2631.24	2601.47	3416.49	3149.62	299.48	147.08	924.62
382.35	0.22	-0.58	1612.40	35.69	11.42	390.43	3600.53	2721.30	2649.12	2619.16	3440.57	3171.00	299.37	148.24	1040.50
348.17	0.13	-0.54	1483.37	35.60	11.42	390.65	3607.49	2726.39	2654.04	2624.03	3447.58	3176.88	299.43	148.71	949.23
318.22	0.16	-0.49	1370.03	35.50	11.42	391.43	3647.77	2756.51	2683.28	2652.95	3486.81	3211.85	299.21	150.09	877.17
322.69	0.21	-0.49	1386.79	35.50	11.42	392.21	3681.71	2781.72	2707.71	2677.13	3520.19	3241.07	299.15	151.28	897.63
351.93	0.21	-0.54	1497.37	35.59	11.42	393.48	3727.64	2815.55	2740.42	2709.52	3566.04	3280.15	299.32	153.36	990.86
296.17	0.13	-0.46	1286.72	35.44	11.42	395.09	3787.29	2859.50	2782.94	2751.61	3625.49	3330.95	299.48	155.81	846.90
275.43	0.17	-0.42	1208.16	35.36	11.42	396.04	3828.14	2889.79	2812.28	2780.66	3665.82	3366.04	299.43	157.20	795.93
273.64	0.18	-0.41	1201.36	35.35	11.42	397.76	3900.97	2943.71	2864.49	2832.33	3737.87	3428.44	299.37	160.11	805.52
251.48	0.14	-0.38	1117.68	35.29	11.42	399.09	3955.76	2984.20	2903.68	2871.13	3792.24	3475.28	299.37	162.41	750.47
238.50	0.13	-0.36	1068.60	35.25	11.42	400.93	4029.06	3038.26	2955.98	2922.91	3865.22	3537.78	299.43	165.36	724.63
248.04	0.17	-0.37	1104.58	35.27	11.42	403.37	4134.02	3115.85	3031.09	2997.25	3969.33	3627.55	299.32	169.58	772.86
243.45	0.10	-0.38	1087.44	35.28	11.42	405.98	4237.55	3192.02	3104.73	3070.16	4072.82	3715.53	299.43	174.14	777.11
237.30	0.12	-0.36	1064.09	35.25	11.42	406.37	4253.62	3203.85	3116.17	3081.50	4088.85	3729.21	299.43	174.64	760.27
226.95	0.17	-0.34	1024.80	35.20	11.42	409.37	4375.60	3293.57	3202.91	3167.38	4210.83	3832.84	299.48	179.33	747.47
230.79	0.12	-0.35	1039.49	35.23	11.42	409.87	4383.57	3298.98	3208.02	3172.47	4219.78	3838.92	299.82	179.94	761.38
214.13	0.12	-0.33	976.44	35.18	11.42	410.82	4422.70	3327.76	3235.85	3200.01	4258.93	3872.16	299.82	181.40	712.56
203.24	0.13	-0.31	935.23	35.14	11.42	412.59	4496.45	3381.96	3288.23	3251.89	4332.75	3934.75	299.82	184.31	687.33
195.63	0.09	-0.30	906.58	35.13	11.42	412.87	4514.35	3395.35	3301.23	3264.74	4350.18	3950.29	299.65	185.19	664.23
200.63	0.11	-0.31	925.44	35.14	11.42	412.65	4503.00	3386.93	3293.08	3256.67	4338.98	3940.54	299.71	184.69	679.51
202.24	0.11	-0.31	931.56	35.14	11.42	412.54	4492.02	3378.63	3284.99	3248.68	4328.49	3930.87	299.87	184.25	683.31
190.06	0.11	-0.29	885.44	35.10	11.42	413.59	4540.09	3414.10	3319.31	3282.66	4376.32	3971.88	299.76	186.10	648.87
199.10	0.09	-0.31	919.70	35.14	11.42	414.93	4595.49	3454.78	3358.62	3321.58	4431.88	4018.84	299.76	188.54	687.85
205.69	0.13	-0.31	944.50	35.15	11.42	415.87	4632.65	3481.97	3384.87	3347.58	4469.33	4050.19	299.82	189.91	716.20
183.53	0.08	-0.28	860.86	35.09	11.42	416.09	4637.64	3485.48	3388.22	3350.91	4474.70	4054.18	299.93	190.24	639.69
185.67	0.07	-0.29	868.98	35.10	11.42	416.54	4658.26	3500.68	3402.93	3365.47	4495.23	4071.76	299.87	191.16	649.96
188.73	0.07	-0.29	880.55	35.11	11.42	417.54	4697.77	3529.58	3430.82	3393.10	4535.09	4105.07	299.93	192.80	666.13

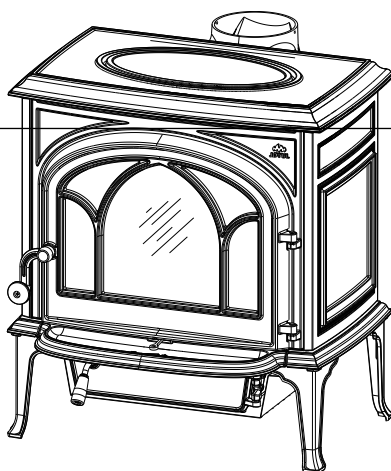
SUMS					AVERAGE	SUMS						
18855.99	853571.60	-96988.81	449275.62	145197.38	5993.95	32251.94	-1066.81	33318.75	71813.13	-1064.59	52.71	-28.75
Energy Losses (kJ/kg of Dry Fuel)					Total Loss Rate	Total Loss	Chemical Loss 1	Sensible and Latent Loss	Total Output	Chem Loss 2	Grams Produced	
Flue Gas Constituent											CO	HC
CO	N ₂	CH ₄	H ₂ O Comb	H ₂ O Fuel MC								
248.83	4574.41	-327.71	1697.60	549.74	8037.76	0.00	0	0.00	0	0	0.00	0.00
480.29	6237.58	-411.52	1705.51	549.38	10312.09	232.87	1	231.40	214	1	1.06	-0.17
776.97	6913.64	-547.40	1690.02	539.75	11298.87	191.37	4	187.57	144	4	1.29	-0.17
75.93	5760.72	-791.11	1704.03	536.03	8895.52	150.66	-12	162.74	185	-12	0.13	-0.24
101.62	5617.34	-782.98	1700.08	535.05	8740.47	164.48	-13	177.27	208	-13	0.19	-0.26
85.84	4413.14	-593.69	1680.98	535.30	7359.80	166.20	-11	177.64	281	-11	0.19	-0.24
85.83	3878.49	-500.96	1672.70	535.76	6763.32	114.55	-7	121.56	221	-7	0.14	-0.15
93.96	4021.94	-513.07	1675.08	536.12	6945.29	117.63	-7	124.71	218	-7	0.16	-0.16
72.89	4219.24	-543.81	1679.84	536.61	7150.91	161.49	-11	172.09	286	-11	0.16	-0.22
67.79	4351.53	-555.36	1682.86	537.19	7307.15	165.01	-11	175.99	282	-11	0.15	-0.22
58.47	3804.08	-470.43	1675.37	537.65	6678.10	150.81	-9	160.08	297	-9	0.13	-0.19
57.92	3798.58	-465.38	1675.74	537.94	6676.49	138.21	-8	146.62	272	-8	0.12	-0.17
63.98	4223.13	-520.53	1682.31	538.19	7175.81	175.55	-11	186.69	309	-11	0.15	-0.23
37.45	3892.41	-483.48	1678.61	538.25	6761.20	165.41	-11	176.28	319	-11	0.09	-0.21
44.47	3634.63	-437.24	1674.98	538.65	6482.75	158.60	-10	168.17	326	-10	0.11	-0.19
60.02	3712.62	-436.60	1675.94	538.99	6599.90	186.30	-11	196.90	373	-11	0.17	-0.22
59.42	4057.14	-478.93	1681.80	539.43	7003.09	184.51	-11	195.52	337	-11	0.15	-0.23
37.13	3540.56	-408.96	1676.20	540.01	6387.65	168.29	-10	178.05	354	-10	0.10	-0.19
47.94	3359.48	-374.22	1673.77	540.41	6200.49	186.70	-10	196.49	410	-10	0.14	-0.20
52.01	3402.64	-369.83	1675.50	541.13	6267.08	212.29	-11	223.02	459	-11	0.17	-0.22
40.32	3208.99	-343.31	1674.34	541.66	6034.87	204.42	-10	214.65	467	-10	0.13	-0.21
38.55	3123.42	-325.48	1674.65	542.37	5943.51	190.14	-9	199.29	444	-9	0.12	-0.19
47.84	3310.71	-335.01	1678.82	543.40	6188.19	209.62	-10	219.31	461	-10	0.16	-0.20
27.48	3338.63	-337.74	1682.21	544.40	6206.23	221.91	-11	232.96	486	-11	0.10	-0.22
34.57	3279.00	-325.66	1681.41	544.56	6148.78	208.28	-10	218.10	463	-10	0.11	-0.20
48.10	3245.93	-304.65	1682.81	545.74	6144.74	219.71	-9	228.85	489	-9	0.17	-0.19
33.78	3297.76	-316.71	1684.31	545.81	6186.27	232.84	-11	243.44	513	-11	0.12	-0.21
35.25	3124.62	-292.07	1682.85	546.19	5990.81	225.48	-10	235.11	520	-10	0.13	-0.20
37.15	3041.27	-275.56	1683.28	546.91	5904.69	211.13	-8	219.62	497	-8	0.13	-0.18
26.19	2959.74	-269.61	1683.19	547.08	5796.00	218.15	-9	227.27	527	-9	0.10	-0.18
30.07	3013.85	-275.03	1683.42	546.97	5863.48	220.69	-9	229.87	525	-9	0.11	-0.19
30.27	3026.34	-277.26	1683.32	546.86	5877.09	210.14	-9	218.93	498	-9	0.11	-0.18
31.97	2906.59	-258.96	1682.80	547.33	5744.70	227.03	-9	235.96	556	-9	0.12	-0.18
26.57	3054.87	-274.46	1686.11	547.87	5917.34	244.99	-10	255.20	575	-10	0.11	-0.20
37.53	3161.80	-278.96	1687.69	548.22	6062.39	250.99	-10	260.95	569	-10	0.15	-0.21
21.76	2884.67	-254.25	1685.18	548.27	5715.55	236.63	-10	246.21	584	-10	0.09	-0.19
18.83	2924.52	-258.67	1686.27	548.47	5760.54	238.49	-10	248.38	582	-10	0.08	-0.19
19.08	2987.79	-262.97	1687.90	548.85	5839.57	252.76	-11	263.26	605	-11	0.08	-0.20

Jøtul F 445
Holliday

Jøtul F 445 Holliday Catalytic Wood Heater

Classic and Clean Face Models

Installation and Operating Instructions
for the United States and Canada



- The Jøtul F 445 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 this wood heater.
- This wood heater contains a catalytic combustor that requires periodic inspection and maintenance 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.



Une version française de ce manuel est disponible auprès de
votre revendeur et sur le site www.jotul.ca.

Table of Contents

Combustion Specifications, Building Codes, Safety Notices	3
1. Installation	
1.1 Assembly before Installation	4
2. Chimney and Connector Requirements	
2.1 Chimney Connector	4
2.2 General Requirements.....	4
2.3 Masonry Chimneys.....	5
2.4 Prefabricated Chimneys	5
2.5 Chimney Height	5
2.6 Wall Pass-through.....	6
3. Connecting to the Chimney	
3.1 Masonry Chimney Thimbles.....	6
3.2 Hearthmount into a Masonry Fireplace	6
3.3 Prefabricated Chimneys.....	7
4. Clearances to Combustibles	
4.1 Floor Protection.....	7
4.2 Clearances to Walls and Ceilings.....	7
4.3 Using Shields to reduce Clearances	7-8
4.4 Alcove Installation.....	8
4.5 Mobile Home Installation	8
5. Operation	
5.1 Combustion Efficiency.....	9
5.2 CO Emissions	9
5.3 Wood Fuel and Performance	9-10
5.4 Stove Control - Functions and Settings	10
5.5 Catalytic Combustor Monitor	10-11
5.6 Break-in Procedure	11
5.7 Starting and Maintaining a Fire	11-12
5.8 Creosote Formation and Removal	12
5.9 Adding Fuel	12
6. Maintenance	
6.1 Annual Stove Inspection	13
6.2 Ash Removal.....	13
6.3 Chimney System	13
6.4 Enamel Care	14
6.5 Glass Care/Glass Replacement.....	14
6.6 Gaskets	14
7. Accessories	15
8. Illustrations	
Figures	16-21
Clearance Chart and Diagrams	22-23
9. Appendix	
A. Catalytic Combustor Maintenance	24
Catalytic Combustor Replacement	25-26
B. Alternate Floor Protection	27
10. Warranty.....	28-30

Standards

The Jøtul F 445 Holliday solid fuel heater has been tested and listed to ANSI/UL 1482 in the U.S. and ANSI ULC-S627 in Canada.

Certified Safety Tests performed by Intertek Testing Services, Middleton, WI U.S.A.

Manufactured by
Jøtul North America, Inc.
55 Hutcherson Drive
Gorham, Maine 04038, U.S.A.

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

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 manual describes the installation and operation of the Jøtul F 445 catalytic equipped wood heater. This heater meets the 2020 U.S. Environmental Protection Agency's crib wood emission limits for wood heaters sold after May 15, 2020. Under specific test conditions, this heater has been shown to deliver heat at rates ranging from 13,726 to 35,722 Btu/hr.

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. 5.6 for details.



Combustion Specifications

Heat Output Range: ¹	13,726 to 35,722 BTU/hr. (4.0-10.5 kW)
Heating Capacity: ²	Up to 2300 sq. ft.
Maximum Burn Time: ²	Up to 9 hours
EPA Efficiency: ³	HHV: 72% LHV: 78%
CO Emissions: ⁴	.60 g/min.
Particulate Emissions: ⁵	.49 g/hr.

Fuel: Up to 20" Logs (508 mm)

- ¹ Heat Output Range results are determined during specific emissions tests established by the EPA.
- 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 efficiencies are determined per the CSA B415.1-10 test method. The difference between the HHV and LHV is how the energy in the exhaust gas water vapor is accounted for.
LHV efficiency assumes all the water vapor in combustion gases was condensed and the heat from such was recovered and transferred to the dwelling. HHV calculations do not assume all water vapor is condensed, therefore the HHV value is less than the LHV value.
- 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.

EPA Certified Emissions Tests performed by
PFS-TECO, Portland, OR U.S.A.



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.

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 CO 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.

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 this manual available to anyone using or servicing the stove.

1. Installation

1.1 Assembly Before Installation

The Jøtul F 445 is shipped with the flue collar attached in the top position and the front ash lip and combustor monitor (thermometer) inside the stove.

- Changing the Flue Collar to Rear Exit: While holding the M6 flange nuts on the inside of the flue collar to keep them from falling into the stove, use a 10 mm open end wrench or socket wrench to remove the two M6 bolts with M6 fender washers. Orient the flue collar to the rear and use the same hardware to re-attach it to the stove.
- Take out the front ash lip, which is inside the burn chamber. The ash lip is placed loosely on top of the base plate.
- See section 5.5 for combustor monitor installation.
- **INSTALL ACCESSORIES BEFORE LOCATING THE STOVE IN THE FINAL POSITION.** Use the instructions provided with those kits.

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 445, the chimney connector must be 6" (152mm) in diameter, with a minimum thickness of 24 gauge black steel. Attach the flue collar to the chimney connection using 2 self-drilling screws found in the miscellaneous kit.

- Aluminum and Galvanized steel pipe is not acceptable for use with the Jøtul F 445. 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 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.
- Where passage through a wall or partition of combustible construction is desired, the installation must conform with NFPA 211 and is also addressed in this manual.

- 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 and is also addressed in this manual.
- **Do not connect this unit to a chimney flue servicing another appliance.**

2.2 General Chimney Requirements

The F 445 is approved for use with:

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 .

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 "back puffing"- 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. 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 a chimney flue having 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.

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.

2.6 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.**

Consult your local building inspector and authorized Jøtul Dealer 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.
- The connector pipe or thimble sleeve must not protrude into the flue liner where it could restrict the free flow of exhaust gas and cause poor stove performance.
- The chimney connector should be sealed at the thimble with refractory cement and each connector joint must be secured with three sheet metal screws.
- **Do not connect this stove to a chimney flue servicing another appliance of any kind.**

3.2 Hearthmount Into a Masonry Fireplace

Consult your local building inspector for codes on fireplace installation. The Jøtul F 445 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).

- The NFPA 211 standard (12.4.5.1) requires that a **masonry flue serving a wood-burning appliance must be sealed off from room air**. This can be accomplished by two methods:
 - 1) Replace the fireplace damper with a fixed steel plate through which the connector pipe must extend from the stove to the chimney flue tile. See figure 6. Alternatively, the flue may be sealed off by installing a non-combustible plate at the fireplace opening. In either case, the block-off plate and connector pass-through must be sealed using high-temperature or other appropriate sealant. Jøtul recommends a block-off plate installed in any fireplace damper area for improved heat efficiency.
 - 2) Install a full, listed chimney liner from the stove to a direct connection at a sealed chimney cap. Your Jøtul dealer can recommend an approved system.
- See Section 2.3 on page 5 for cross-sectional flue size requirements related to interior vs exterior chimneys.
- If the chimney liner is too large to accommodate the stove, a code-approved relining system must be installed to resize the flue.
- The fireplace installation must also conform to the tested clearances to surrounding trim and mantels. See clearance specifications on pages 22-23. In addition, a fireplace installation must also comply with the floor protection guidelines specified on page 7.

3.3 Prefabricated Chimneys

The Jøtul F 445 may be connected to a prefabricated metal chimney following the pipe manufacture's instructions. Use all required components. Most manufacturers offer an adaptor that attaches to the bottom section of the metal chimney and permits the connector pipe to be secured to it using three sheet metal screws. See figure 7.

4. Clearances to Combustibles

4.1 Floor Protection Requirements

The F 445 requires floor protection as specified below in any installation unless installed on concrete over earth.

- * The supplied bottom heat shield must be installed on the stove.
- Floor protection under the stove must be composed of continuous, non-combustible materials for protection against sparks and embers.
- * Individual sections of floor protection must be mortared or otherwise sealed together to prevent spark penetration to combustible floor materials. Any carpeting must be removed from under the floor protection.
- **Alcove Installations:** In addition to the Bottom Heat Shield, floor protection must include materials having a minimum R-value of 1.6. See Appendix B, page 27, to determine various material R-values.

In the U.S.:

The hearth protection surface must extend continuously in front of the stove:

- A minimum of 16".
- A minimum of 6" on each side (measured from the opening of the front door).

This will result in a minimum floor protection of 33"W X 40"D . See figure 8a.

In the Canada:

The hearth protection surface must extend continuously in front of the stove:

- A minimum of 18" (457mm)
- A minimum of 8" (200mm) on the side and back of the stove (measured from side and back panels).

This will result in a minimum floor protection of 41"W X 48"D (1041mm x 1219mm). See figure 8b.

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 in both the U.S. and Canada. Figs. 8a and 8b.

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 F 445.

The following diagrams give the required clearances you must maintain when installing the F 445 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.

"Fire Resistant" materials are considered combustible; they are difficult to ignite, but will burn. "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:

Refer to NFPA 211, Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, for acceptable materials, proper sizing and construction guidelines.

Jøtul F 445 Rear Heatshield Kit #154332

This shield is specifically approved for use to reduce clearances on this appliance only. No other heat shield may be used.

See pages 22-23 for complete clearance specifications 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, page 17.)

1. The stove must be installed with listed, double-wall pipe.
2. In a protected alcove installation both side walls and rear wall must be protected per NFPA 211. 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 cooling air-flow.
3. The height of the wall protection including the bottom air space must be 48" (1219mm).
4. Clearance specifications are designated between the stove plates and the combustible wall surface.
5. The bottom heatshield is required in all Alcove installations. See figure 16, page 19 for installation instructions.
6. 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 B).

7. 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).

4.5 Mobile Home Installations

The F 445 has been approved for use in mobile homes in the U.S. and Canada provided:

1. The stove is physically secured to the floor or the mobile home. Use Jotul 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 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 #154335. Do not substitute any other connection method or device. See page 15 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 to determine other mobile home 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 445.

DO NOT OVERFIRE THIS HEATER.
 THE MAXIMUM RECOMMENDED OPERATING TEMPERATURE OF THE COMBUSTOR IS 1600°F (870°C). DAMAGE CAN OCCUR TO THE COMBUSTOR IF IT EXCEEDS 1750°F (954°C) FOR EVEN BRIEF PERIODS OF TIME.

5.1 Combustion Efficiency

The Jøtul F 445 has an EPA test High Heating Value (HHV) efficiency rate of 72%. 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 445 to CSA B415.1-10 resulted in a carbon monoxide emission rate of .60 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 445 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;
- Lawn clippings or yard waste;
- Salt water driftwood or other previously salt-water; saturated materials;
- Unseasoned wood;
- Colored paper, or
- Paper products, junk mail, 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 445 Control Functions

The F 445 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	3/16” 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 thermometer shown in figure 13a. Follow this procedure to install the thermometer:

1. Remove the lower set screw on the right side panel of stove using a 3mm hex key as shown in fig. 13b, pg. 18.
DO NOT REMOVE THE UPPER SET SCREW. It secures the top plate to the sides.
2. Take the magnet off of thermometer and replace it in the correct orientation as shown in fig. 13c-13e, pg. 18.
3. Insert the thermometer probe fully into the hole with the magnet attaching to the cast iron side plate as shown in fig. 13b.

Seated within the right side directly behind the catalytic element, the thermometer accurately responds to combustion activity. Secondary combustion takes place at temperatures between 500°F (260°C) and 1200°F (260°C - 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° (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 appendix A for more information regarding combustor performance.

5.6 Stove Break-In Procedure

The Jøtul F 445 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.

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.

Do not attempt to extinguish the fire in the stove. Doing so can make the matter worse by supplying additional oxygen, which will accelerate the fire in the chimney. When the roaring and crackling has subsided, resist the temptation to open the door to check 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).
- To minimize any smoke spillage, open the door slightly before opening fully. This will allow air flow to stabilize within the firebox and chimney flue.
- 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).
- DO NOT over-load the stove. For safety and best appearance, maintain a traditional three log configuration.
- Remember that when burning the stove with the screen in place, heat efficiency is sacrificed for aesthetics and wood will be consumed at a much faster rate.

WARNING: OPERATE THIS APPLIANCE ONLY WITH THE DOOR(S) FULLY CLOSED. OPERATION WITH THE DOOR(S) LEFT PARTIALLY OPEN MAY CAUSE OVERFIRING. Also, if doors are left partially open, combustion gas and flame may be drawn out of the stove, creating risks from both fire and smoke.

6. Maintenance

See Appendix A, page 24, 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 Appendix A, page 24.

6.2 Ash removal

Ash removal will be required periodically depending on how frequently the stove is used. Conveniently, the Jøtul F 445 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 inch bed of ashes on the firebox floor to help maintain a 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 refuelling, 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.

WARNING: DO NOT OVER-FIRE THIS HEATER. IF ANY PART OF THE STOVE OR CHIMNEY CONNECTOR GLOWS, WITH THE EXCEPTON OF THE COMBUSTOR, 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 AND VOID YOUR WARRANTY ON THE STOVE AND ITS COMPONENTS.

6.3 Chimney System

The Jøtul F 445 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

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

Universal Wood Stove Gasket Kit #157050 is available from your dealer to replace all the gaskets in the F 445. Self-adhesive gaskets do not require cement for installation.

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 445 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	3/8 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.

7. Accessories

The following accessories, specifically designed for the Jøtul F 445 wood stove, are available from your Jøtul authorized dealer.

Rear Heatshield - *****

A stove rear heatshield has been specifically designed for the Jøtul F 445 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 22-23 for specific clearance requirements. Complete installation instructions are supplied with the heatshield. No other type of heatshield may be used.

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 and must be installed with Rear Heat Shield 154332, not included in Blower Kit.

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 kit.

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.

Leg Leveler Kit - 156096

Replacement Door Knob Kit - 151991

Stove Gloves, pair - 157363

Heavy duty, flame retardant, with full gauntlet.

Universal Gasket Kit - 157050

This kit includes all the gasket material and instructions required to maintain the seal integrity of your wood stove.

Replacement Catalyst - 158287

Temperature Monitor - 226609

8. Illustrations

Fig. 1a

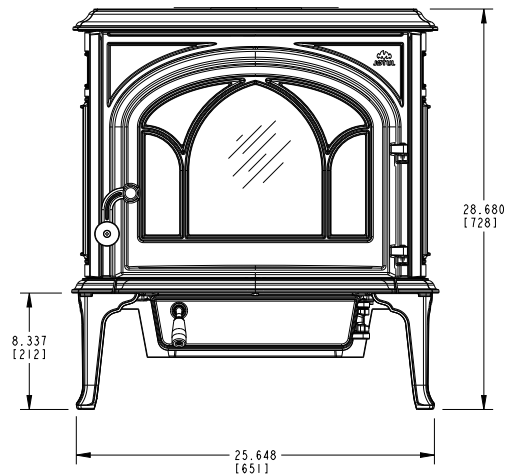


Fig. 1b

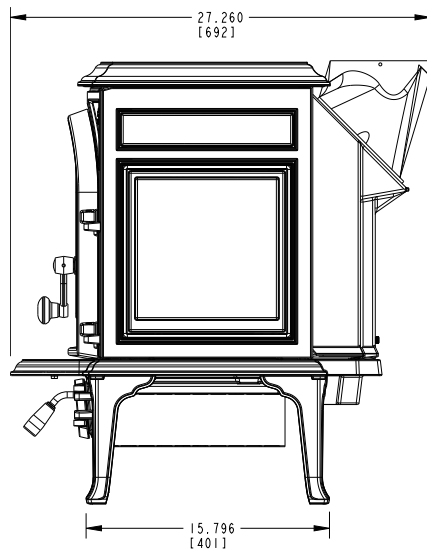


Fig. 2. Chimney connector assembly.

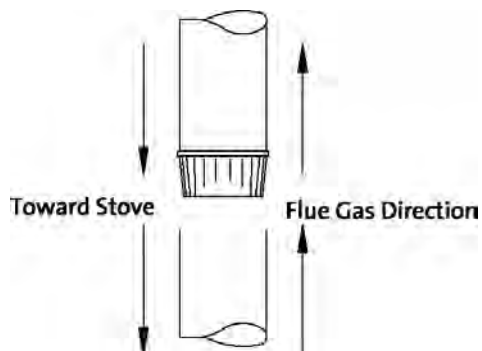


Fig. 3. Chimney height; 3 / 2 / 10 Rule.

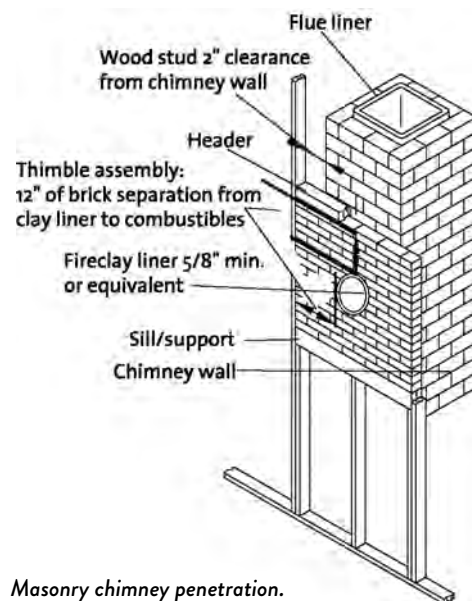
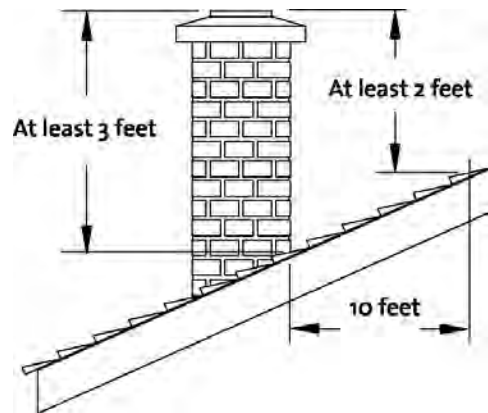


Fig. 4. Masonry chimney penetration.

Fig. 5. Chimney thimble components.

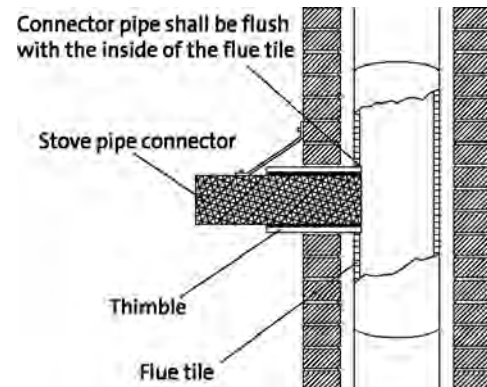


Fig. 6. Fireplace chimney construction.

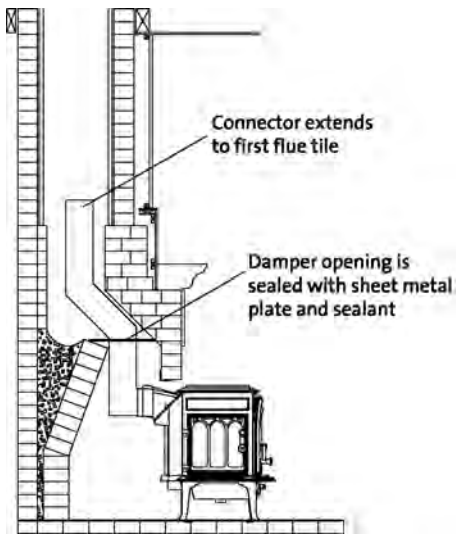


Fig. 7. Prefabricated chimney components.

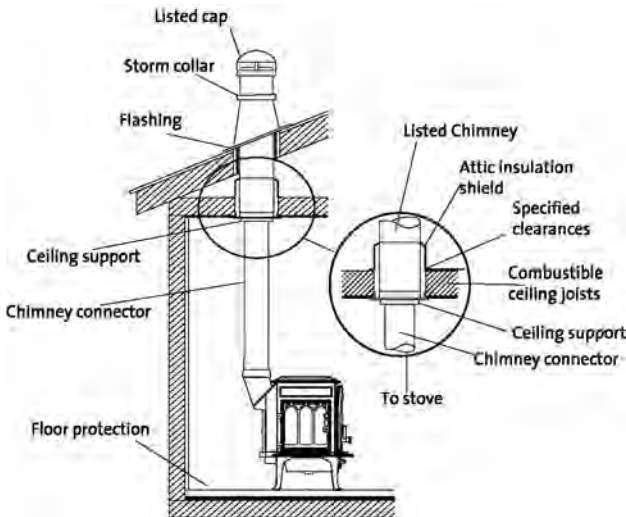


Fig. 8a. F 445 Hearth Dimensions USA.

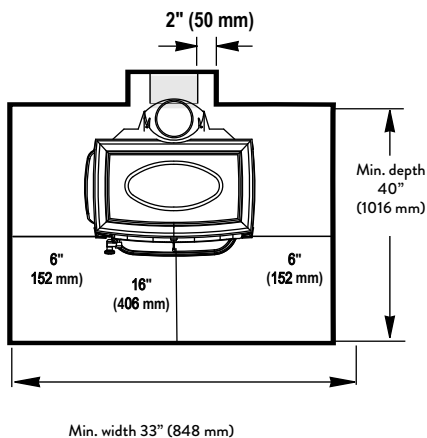


Fig. 9. Alcove unprotected wall clearances.

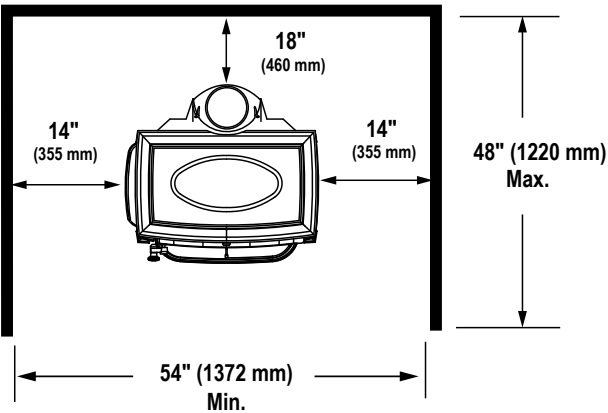


Fig. 10. Alcove protected wall clearances are designated between the stove surfaces and the combustible wall surface.

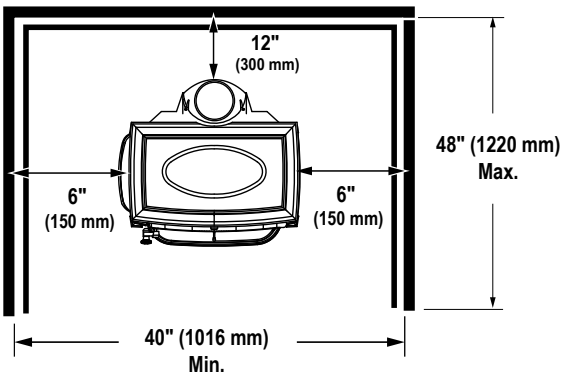


Fig. 8b. F 445 Hearth Dimensions Canada.

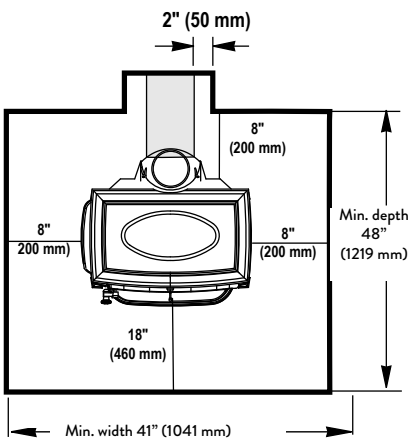


Fig. 11. F 445 Combustion air flow.

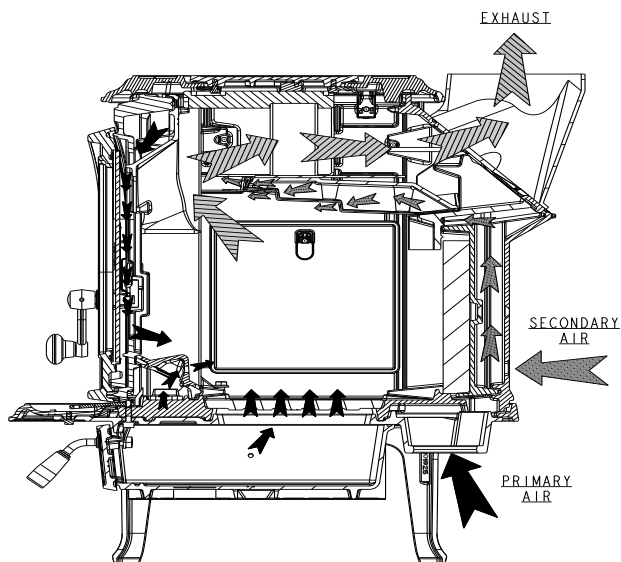


Fig. 12. Primary air lever settings

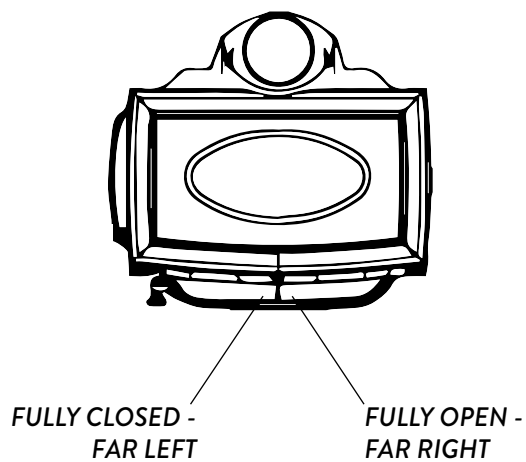


Fig. 13b.

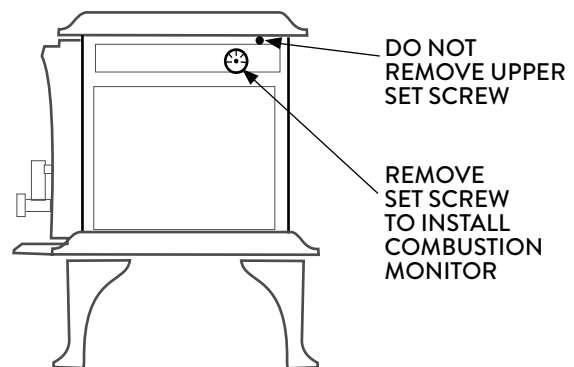


Fig. 13c. Remove magnet from current orientation



Fig. 13d. Orient magnet

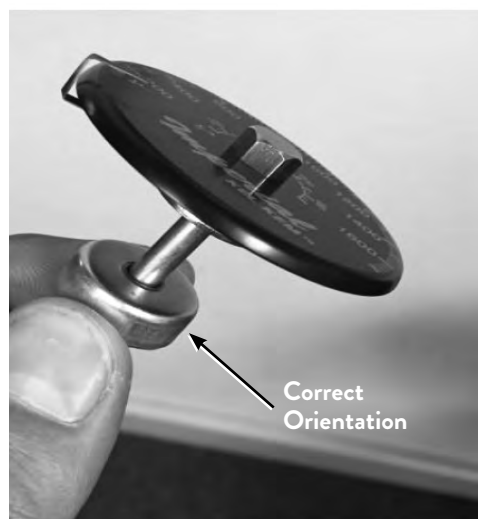


Fig. 13a. Catalyst Temperature Monitor, PN 226609



Fig. 13e. Final position of magnet

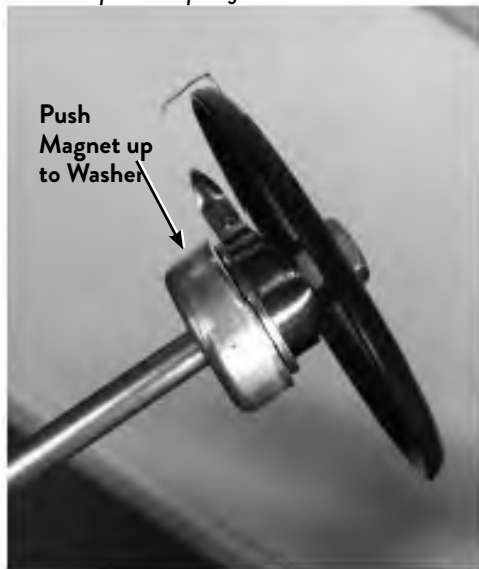


Fig. 14. Top-down fire-starting log tier.

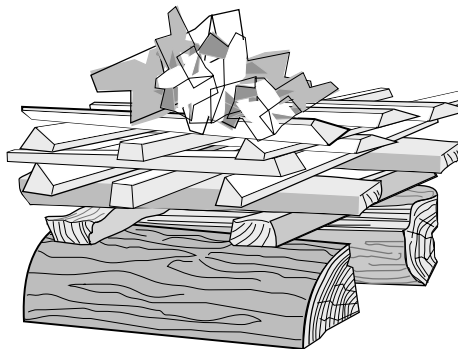


Fig. 15. Door glass components.

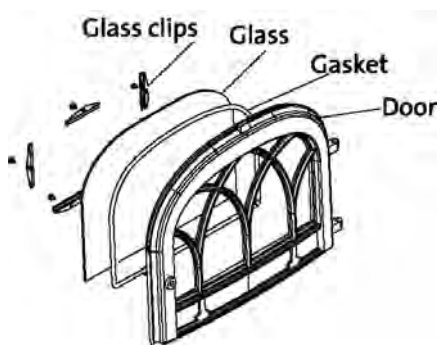
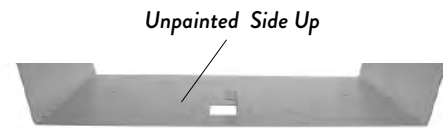


Fig. 16. Bottom heat shield installation.



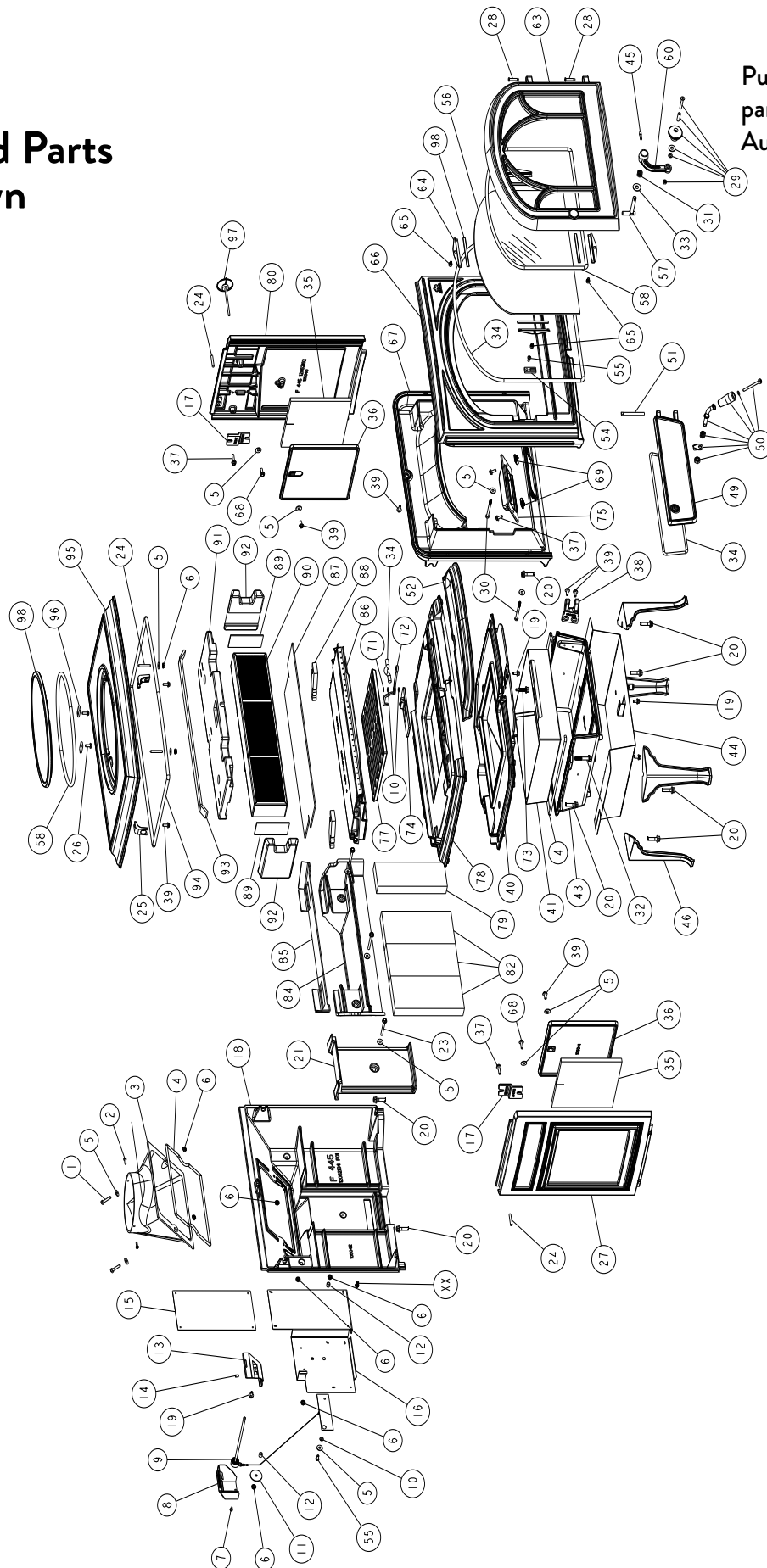
- 1) Bend the flattened heat shield on the perforations as shown, painted side down.
- 2) Use a 10 mm wrench to remove the two bolts from the bottom of the ash compartment.



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

F 445 Illustrated Parts Breakdown

Purchase replacement
parts only from a Jøtul
Authorized dealer.



F 445 Holliday Parts List

Cast Iron Parts		Matte Black
3. Smoke Outlet	103326	
18. Rear Plate	10504292	
27. Side Plate, Left	10503992	
38. Ash House Hinge	10505192	
46. Leg, Long (8")	10192592	
49. Ash Door	10503392	

Cast Parts		Matte Black
52. Ash Lip, Front	10503492	
63. Door, Frnt, Arched	10504792	
Door, Frnt, Cln Face	10504992	
66. Front Plate	10504692	
78. Bottom Plate	10503092	
80. Side Plate, Right	10504092	
95. Top Plate	10504892	
98. Top Cover	10505092	

1. Bolt, Hex Cap, M6x30, DIN 933 Blk	.....	9906
2. Screw, Hex Hd Self-drill, #8 x .75"	.....	118405
4. Gasket, LD2-250	.....	129644
5. Washer, Fender, M6	.....	120004
6. Nut, M6 Serrated Flange plain	.....	117968
7. Screw, HWH SMA #8 x 1/2 SL Blk Ox	.....	117917
8. Probe Retainer Cover,	.....	22703792
9. Bimetallic Coil Assembly, F 445	.....	158178
10. Washer, Flat M6 -.062 DIN 125A Plain	.....	117947
11. Washer, Fender .250 x 1.500 dia.	.....	118029
12. Sleeve, 10mm OD x 6mm ID x 10mm	.....	128934
13. Probe Retainer	.....	226400
14. Screw, Soc Set, cup pt, M6 X 10	.....	04-117720
15. Approval / Serial Number Plate	.....	n/a
16. Bracket, Approval Plate, F 445	.....	n/a
17. Locking Member	.....	105018
19. Bolt, Hex Head Serr Flange M6x12	.....	117130
20. Bolt, M8x30, Serr Flange Hex	.....	117877
21. Rear Air Riser,	.....	105013
23. Bolt, Hex Cap M6x60, DIN 933 8.8	.....	99101
24. Set Screw, M6 x 40 Hex Drive	.....	118288
25. Bracket, Top/Side Pieces	.....	103713
26. Screw, Socket Hd, M6x16, Blk Oxd	.....	9942
28. Hinge pin, New Style, Black	.....	127075
29. Wood Knob & Hardware	.....	151991
30. Bolt M6x70 Cap	.....	118420
31. Spring, Door Handle	.....	126164
32. Bolt, M8x45 Flange	.....	118421
33. Washer, Door Handle	.....	117587
34. Gasket, Round, LD2-375, Graphite	.....	225695
35. Insulation Blanket, Burn Plates	.....	227083
36. Side Burn Plate	.....	105041
37. Bolt, M6x25 Flanged	.....	118019
39. Bolt, M6 x 16, Serr. Hex Flange	.....	99625
40. Inner Bottom, F 500	.....	105031
41. Ashpan	.....	226966
42. Gasket, LD2-250	.....	129644
43. Ash House Ass'y	.....	10503292
44. Heat Shield, Bottom	.....	22703892
45. Set Screw, M6 x 25 Hex Drive	.....	118070
47. Latch Bolt	.....	126228
50. Handle, Complete, Ash Door	.....	155713
51. Ash door Hinge Pin	.....	128408
54. Door Catch with Dowel Pin	.....	22709392
55. Screw, M6 x 14, Button Head	.....	118215
56. Glass, Ceramic	.....	226852
57. Latch Bolt, Front Door	.....	129208
58. Gasket, Round, LD2-360	.....	220748
60. Front Door Handle, Curved	.....	10371292
64. Glass Clip	.....	126011
65. Screw, Cap, Low Socket Head, M6x8	.....	118292
67. Inner Front	.....	10503692
68. Bolt, Hex Head, Serr Flange M6x20	.....	117117
69. Steel Spring U Nut, M6	.....	118145
71. E-Clip, 5 mm	.....	118272
72.. Air Control Lever	.....	225625
73. Bolt, Air Control Lever	.....	118273
74. Air Valve,	.....	105016
75. Inspection Cover	.....	10385618
77. Grate, F 445	.....	105035
79. Brick, Refractory, 9" x 3.375" x 1.25"	.....	220513
82. Brick, Refractory, 9" x 4.50" x 1.25"	.....	129082
84. Secondary Manifold	.....	105044
85. Gasket, Secondary, Ledge	.....	226968
86. Air Chamber Complete	.....	158366
87. Gasket, Secondary, Base	.....	227064
88. Insulation Blanket, Baffle Corner	.....	227088
89. Gasket, Expansion	.....	226552
90. Catalytic Combustor	.....	158287
91. Refractory member, Top	.....	226226936
92. Refractory member, Sides	.....	226935
93. Insulation Strip	.....	227084
94. Gasket, Round, LD2-375 w/Adh.	.....	225696
96. Side Clip / Hang Tab	.....	128401
97. Catalytic Combustor Monitor	.....	226609
98. Gasket, Flat Self Adhesive 1/8 x 5/16	.....	127215

Jøtul F 445 Clearances

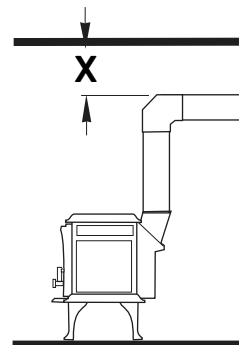
These clearance specifications result from safety testing by Intertek Testing Services, Inc. Use the table below together with the diagrams on the facing page to determine the clearances for your particular installation.

- Stove clearances result from tests that include the chimney connection in the system.
- Chimney connector clearances listed separately are from NFPA 211, independent of the stove position.

Stove Clearance	Unprotected surface			Protected surface*		
	Side	Rear	Corner **	Side	Rear	Corner*
Stove - no heat shield Single-wall pipe	14" A 356mm	16" B 406mm	13" C 330mm	6" D 152mm	12" E 305mm	9" F 230mm
Stove with rear heat shields and single-wall pipe	14" A 356mm	10" G 255mm	9" F 230mm	6" D 152mm	10" G 255mm	9" F 230mm
Stove with rear heat shield and connector shields or double-wall pipe	14" A 356mm	6" D 152mm	9" F 230mm	6" D 152mm	6" D 152mm	6" D 152mm

Horizontal Connector Clearance (X)

	Unprotected surface	Protected surface*
Single-wall pipe	18" 457mm	12" 300mm
Double-wall pipe	6" 152mm	6" 152mm



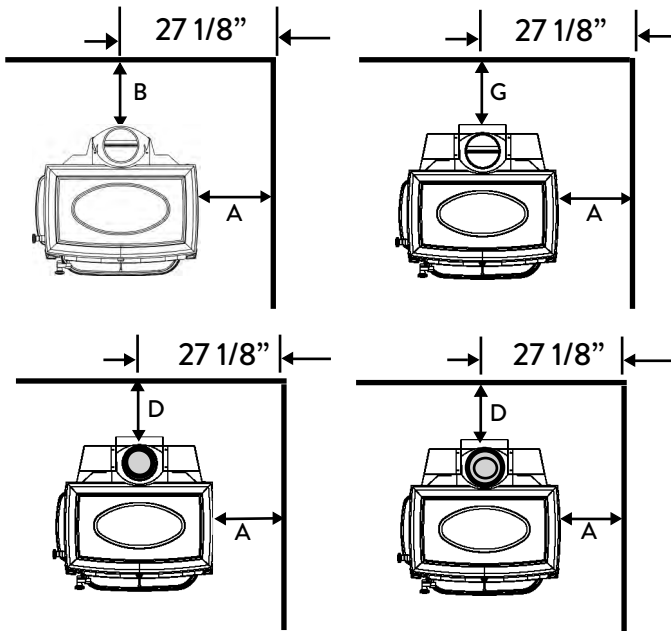
Fireplace Mantle and Trim Clearance

Stove Side to Side Trim - 1" thick or less:	12" 305mm
Stove Top to Upper Trim - 1" thick or less:	16" 406mm
Stove Top to Mantle - 12" maximum depth:	30" 762mm

Mantel and Trim clearances may be reduced by 50% following protection construction methods specified by NFPA 211 Standards for Chimneys, Fireplaces, Vent and Solid Fuel Burning Appliances or similar local regulations.

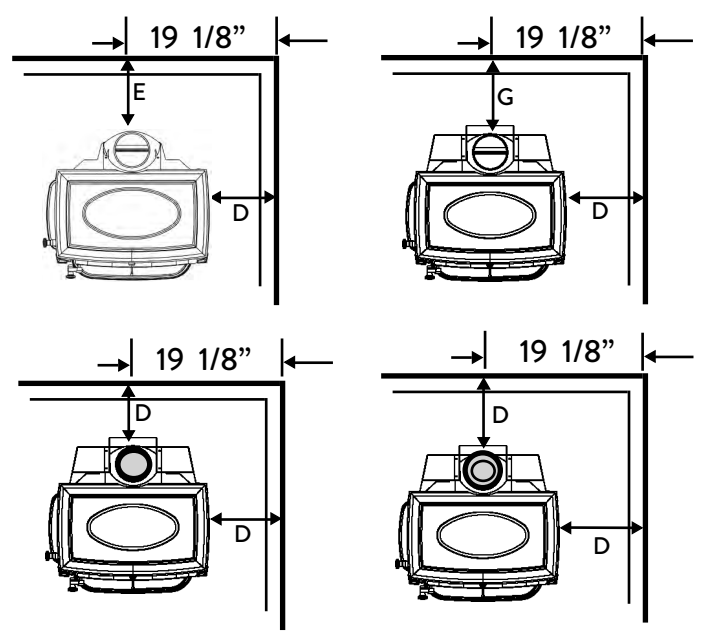
*Protection specified per NFPA 211.

Unprotected Surface Parallel to the Wall



Protected Surface Parallel to the Wall

PER NFPA 211 or
CAN/CSA-B365

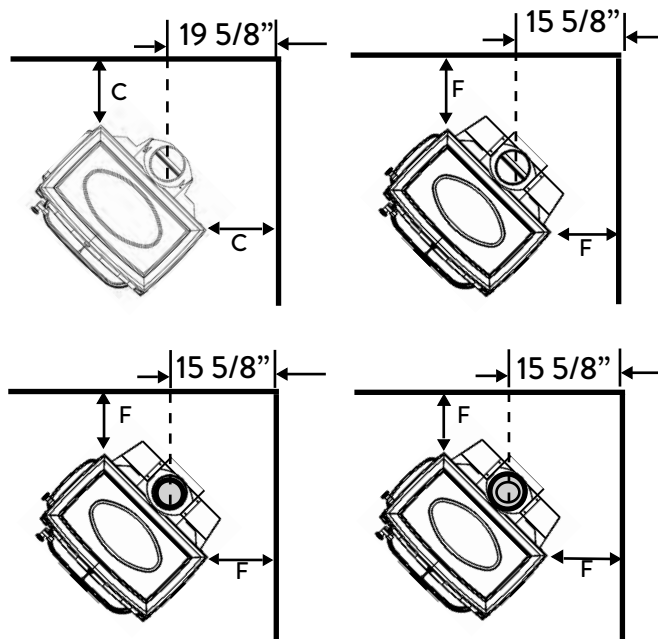


Important:
Connector heatshields and double wall pipe must be a listed product.
Always follow the manufacturer's instructions.

 = SINGLE WALL PIPE WITH CONNECTOR SHIELDS

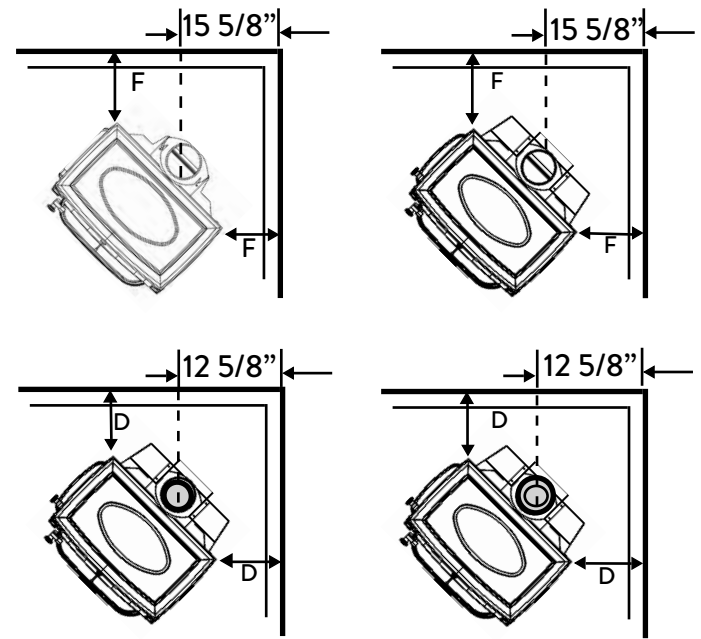
 = DOUBLE WALL PIPE

Unprotected Surface Corner Installation



Protected Surface Corner Installation

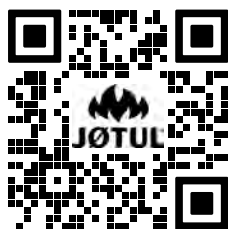
PER NFPA 211 or
CAN/CSA-B365



9. Appendix A

Combustion System Maintenance

WARNING: BURNING JUNK MAIL OR COPIOUS AMOUNTS OF NEWSPRINT TO START THE FIRE CAN ACCELERATE FLY ASH COLLECTION ON THE COMBUSTOR AND NECESSITATE MORE FREQUENT CLEANING OF THE COMBUSTOR.



For a detailed video scan the above code or go to
<https://www.youtube.com/watch?v=-fRnjMtt3pE>

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

It is important to periodically monitor the operation of the catalytic combustor to ensure that it is functioning properly and to determine when it needs to be replaced. A non-functioning combustor will result a loss of heating efficiency, and an increase in creosote and emissions. Following is a list of items that should be checked on a periodic basis:

- Combustors should be visually inspected at least three times during the heating season to determine if physical degradation has occurred. 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 combustion baffle. Use a flashlight or head lamp 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.

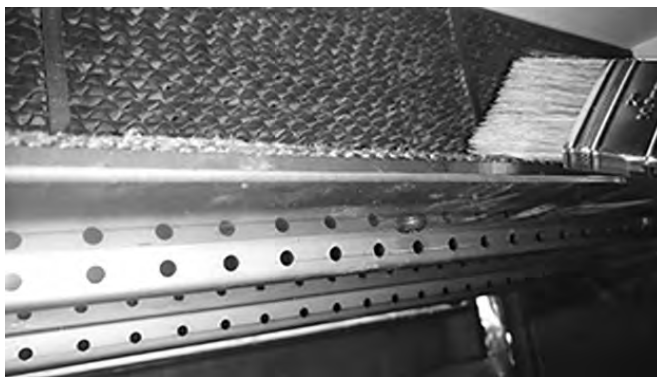


Fig. 18. Vacuum the combustor cells after brushing.



WARNING: DO NOT OPERATE WITH THE ASH DOOR OPEN. OPERATION WITH THE ASH DOOR OPEN CAN RESULT IN LARGE AMOUNTS OF FLY ASH AND CAN OVER-FIRE AND DAMAGE THE COMBUSTOR.

Combustor Replacement

Tools Required:

- 10 mm socket wrench with extension
- 3mm hex key
- Work gloves

The combustor components are accessed by removal of the top plate which is secured to the front plate by two M6 flange nuts with M6 fender washers, fig. 19, and two M6x40 set screws which are secured through the left and right sides, fig. 20.

Use the following instructions for combustor replacement:

1. Use the 10mm socket wrench with extension to remove the two top plate M6 flange nuts with M6 fender washers located behind the front plate inside the stove as in fig. 19.
2. Use the 3mm hex key to remove the two M6x40 set screws on the left and right sides. See fig. 20.
3. Wearing gloves, grasp each side and lift the front of the top plate slightly off of the front and side plates. See fig. 21.
4. Wearing gloves, use both hands to carefully remove the Insulation Gasket (A) and large Insulation Panel(B) from the firebox. Fig. 22.
5. Simply lift the catalytic combustor to remove it from the compartment channel. Fig. 23.
6. Remove the Left and Right Side Refractory Members and Expansion Gasket from the combustion chamber. Fig. 24.
7. Reassemble the catalytic combustion components in the reverse order used to remove them.



Fig. 20. Remove M6x40 set screws from left and right sides.



Fig. 21. Remove the top plate from stove.

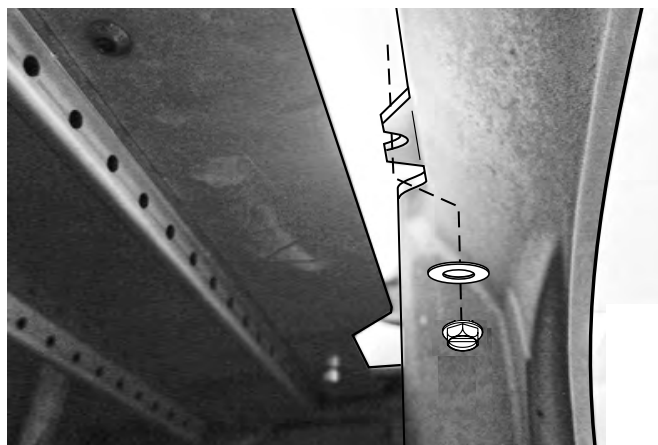


Fig. 19. Remove both top plate nuts located inside the front door opening.

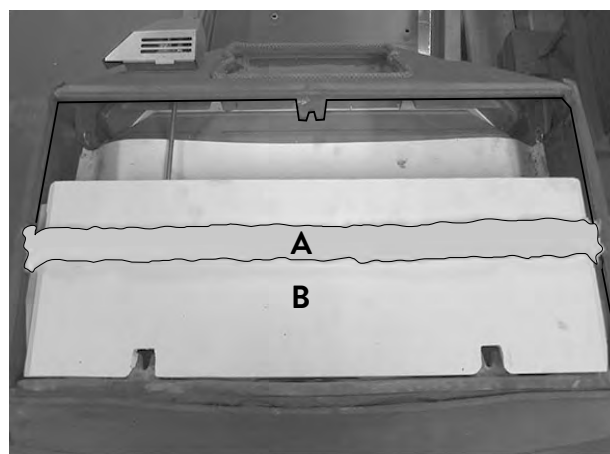
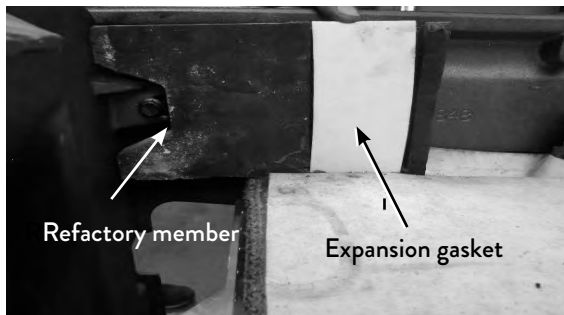


Fig. 22. Insulation gasket (A) and Insulation panel (B).

Fig. 23. Lift combustor from the chamber.



Fig. 24. Left and Right 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 =

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

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 445 Holliday Woodburning 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 separately warranted by Jøtul North America, Inc. and secondarily 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 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 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 stove or fireplace is defective, you should contact your nearest authorized Jøtul 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*

Jøtul High Flow™ Catalytic Combustor 158287 20-Year Limited Warranty

Jøtul North America, Inc. warrants to the consumer who purchases a Jøtul High Flow™ Combustor as a component in an EPA-Certified Jøtul solid fuel appliance, 100% against defects in materials and workmanship for a period of 20-years from the date of purchase.

Conditions and Exclusions:

- 1) The Jøtul High Flow™ Combustor 20-Year Warranty is to the original purchaser of the Jøtul wood stove or insert and is non-transferable.
- 2) The Jøtul High Flow™ Combustor 20-Year Warranty does not apply to any other component of the Jøtul wood stove or insert.
- 3) The Jøtul High Flow™ Combustor 20-Year Warranty covers replacement of the original Jøtul High Flow™ Combustor due to defects in material and workmanship.
- 4) Return the defective combustor to your local Jøtul Authorized Dealer who will submit a warranty claim on your behalf. All claims must be accompanied by a proof of purchase showing the name of the selling dealer, date of purchase, Jøtul stove or insert model and serial number. Retain your sales receipt for your records.
- 5) Related cost of replacement such as installation, travel, and shipping are excluded.
- 6) Return of the original Jøtul High Flow Combustor™ to Jøtul North America may be requested.

CUT

PERFORMANCE INDUSTRIES COMBUSTOR WARRANTY REGISTRATION CARD

Name: _____

Dealer Address: _____

Address: _____

City: _____

Stove Model _____

State: _____ Zip: _____

Return to:

Telephone _____

Jøtul North America Inc.

Date of Purchase: _____

55 Hutcherson Drive
Gorham, Maine 04038
USA

Place of Purchase: _____

This page is intentionally left blank

This page is intentionally left blank

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 445 Holliday

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

139946_
August 2023





Manufactured by /
Manufacturé par:
Jøtul North America, Inc.
Gorham, Maine U.S.A.

Listed Solid Fuel Room Heater
for use in the United States and Canada.
Inscrite Heater solides salle de carburant
et cheminée pour une utilisation aux
États-Unis et au Canada.
Certified to / Certifié à UL 1482,
ULC-S627
by Intertek Testing Services, Middleton, WI U.S.A.

Refer to the Intertek Directory of Building Products
(<https://bpdirectory.intertek.com>) for detailed information.
Reportez-vous au répertoire des produits de construction d'Intertek
(<https://bpdirectory.intertek.com>) pour obtenir des informations détaillées.



Intertek
21920

Serial No. / Nu. de Série:

Model: F 445
Modèle: F 445

Manufacture Date
Date de Fabrication

23	24	25	26	27	28
1	2	3	4	5	6
7	8	9	10	11	12

DO NOT REMOVE THIS LABEL.
NE PAS ENLEVER CETTE ÉTIQUETTE.

Minimum Clearances from stove to Unprotected Combustibles:
Dégagements minimaux du poêle aux combustibles non protégés:

- A: 16" / 406 mm
- B: 14" / 355 mm
- C: 13" / 330 mm

Floor Protection / Protection des soles

The stove must be placed on a non-combustible floor protector that extends: / Ce poêle doit être placé sur un protecteur de plancher incombustible qui s'étend:

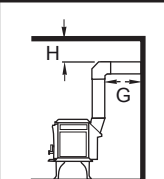
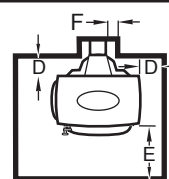
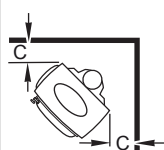
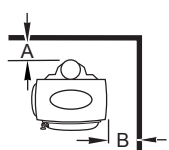
- D: From the back and sides: / de l'arrière et des côtés:
6" in the US and 8" / 200 mm in CAN.
- E: From the front door: / de la porte avant et du côté gauche:
16" U.S. 18" / 460 mm CAN.
- F: 2" / 50 mm under either side of a horizontal chimney connector. / - sous chaque côté d'un raccord de cheminée horizontal in U.S. and CAN.

See installation manual for other options.

Voir le manuel d'installation pour d'autres options.

Minimum Clearances from Chimney Connector to Unprotected Combustibles:
Dégagements minimaux entre le raccord de cheminée et les combustibles non protégés:

- G: 18" / 460 mm - horizontal
- H: 18" / 460 mm - vertical



SAFETY NOTICES

- **WARNING: FOR USE WITH SOLID WOOD FUEL ONLY. DO NOT BURN ANY OTHER FUELS. BURNING MATERIALS OTHER THAN THE SPECIFIED FUELS WILL DAMAGE THE CATALYTIC COMBUSTOR AND RENDER IT INEFFECTIVE.**
See Owner's Manual for fuel recommendations and prohibitions.
- The catalytic combustor is fragile. Handle carefully. The performance of the catalytic device or its durability has not been evaluated as part of the certification. Replace only with Jøtul Catalytic Combustor 158000. See manual for warranty.
- Install and use only in accordance with the Installation and Operating Instruction manual. In absence of local codes, installation must meet minimum requirements of NFPA 211 in the U.S. Always contact your local building or fire officials about restrictions and installation inspections in your area.
- Do not connect this appliance to a chimney flue serving another appliance.
- This heater must be installed on the legs provided - the space beneath the heater may not be obstructed.
- Do not use a grate or elevate the fire - build wood fire directly on hearth.
- Risk of smoke spillage - Operate only with the door fully closed, except for refueling.
- **DO NOT OVERFIRE** - if heater or chimney connector glows, you are overfiring.
- Chimney connector must be 6" dia. 24 MSG black or 26 MSG blued steel.
- Chimney must be a minimum 6" dia. factory-built, listed UL 103HT or lined masonry in the U.S.
- When passing the chimney or chimney connector through a combustible wall, always consult the Installation and Operating Manual, NFPA 211 and your local codes.
- **PREVENT CHIMNEY FIRES.** Inspect and clean chimney frequently - Under certain conditions of use, creosote buildup may occur rapidly.
- Replace glass only with glass supplied by the manufacturer or distributor of this appliance.
- Approved for use with optional Blower Kit 156431. Class H, 120 V, 0.53 A, 60 Hz, 120 cfm.

AVIS DE SÉCURITÉ

- **AVERTISSEMENT: À UTILISER UNIQUEMENT AVEC DU COMBUSTIBLE EN BOIS SOLIDE. NE BRÛLEZ AUCUN AUTRE COMBUSTIBLE. BRÛLER DES MATÉRIEAUX AUTRES QUE LES COMBUSTIBLES SPÉCIFIÉS ENDOMMAGERA LE COMBUSTEUR CATALYTIQUE ET LE RENDRA INEFFECTIF.**
Consultez le manuel du propriétaire pour les recommandations et interdictions concernant le carburant.
- La chambre de combustion catalytique est fragile. Manipulez avec soin. Les performances du dispositif catalytique ou sa durabilité n'ont pas été évaluées dans le cadre de la certification. Remplacez-le uniquement par le brûleur catalytique Jøtul 158000. Voir le manuel pour la garantie.
- Installez et utilisez uniquement conformément au manuel d'instructions d'installation et d'utilisation. En l'absence de codes locaux, l'installation doit répondre aux exigences minimales de la NFPA 211 aux États-Unis. Contactez toujours votre bâtiment local ou les responsables des incendies pour connaître les restrictions et les inspections d'installation dans votre région.
- Ne raccordez pas cet appareil à un conduit de cheminée desservant un autre appareil.
- Ce radiateur doit être installé sur les pieds fournis - l'espace sous le radiateur ne doit pas être obstrué.
- N'utilisez pas de grille ou ne surélevez pas le feu - faites du feu de bois directement sur le foyer.
- Risque de fuite de fumée ou de flammes - ne fonctionne qu'avec la porte complètement fermée.
- **NE PAS SURCHAUFFER** - si le chauffage ou le raccord de cheminée s'allume, vous surchauffez.
- Le raccord de cheminée doit avoir un diamètre de 6". Acier 24 MSG noir ou 26 MSG bleu.
- La cheminée doit mesurer au moins 6 po de diamètre. aux États-Unis, maçonnerie homologuée UL 103HT ou doublée en usine
- Lorsque vous passez la cheminée ou le raccord de cheminée à travers un mur combustible, consultez toujours le Manuel d'installation et d'utilisation, NFPA 211 et vos codes locaux.
- **PRÉVENIR LES INCENDIES DE CHEMINÉE.** Inspectez et nettoyez la cheminée fréquemment - Dans certaines conditions d'utilisation, une accumulation de créosote peut se produire rapidement.
- Remplacez le verre uniquement par du verre fourni par le fabricant ou le distributeur de cet appareil.
- Approuvé pour une utilisation avec le kit de soufflerie 156431 en option. Classe H, 120 V, 0,53 A, 60 Hz, 120 cfm.

U.S. ENVIRONMENTAL PROTECTION AGENCY -
CERTIFIED TO COMPLY WITH 2020 PARTICULATE
EMISSIONS STANDARDS USING CRIB WOOD.

CERTIFIED EMISSIONS VALUE .50 G/Hr
EPA TEST METHOD 28R

EPA CERTIFIED TESTING BY
PFS-TECO COMPANY
CLACKAMAS, OR U.S.A.

This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operation instructions in the owner's manual.

Ce poêle à bois doit être inspecté et réparé périodiquement pour un fonctionnement correct. Consultez le manuel du propriétaire pour plus d'informations. Il est contraire à la réglementation fédérale de faire fonctionner ce poêle à bois de manière incompatible avec les instructions de fonctionnement du manuel du propriétaire.

CAUTION: Hot while in operation. Do not touch. Keep children, clothing, and furniture away. Contact may cause severe burns. See nameplate and instruction manual.

AVEC: Chaud pendant le fonctionnement. Ne pas toucher. Gardez les enfants, les vêtements et meubles loin. Le contact peut provoquer de graves brûlures. Voir plaque signalétique et manuel d'instructions.



227101



QUALITY CONTROL SERVICES

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



PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIRI0182484A0912013i221214

A2LA ACCREDITED CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Digiweigh	DWP12i 300kg x 0.	82484A0912013i	#050	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
kg	0.01	QC033	12/14/22	1/27/22	12/2023

FUNCTIONAL CHECKS

SHIFT TEST		LINEARITY		REPEATABILITY		ENVIRONMENTAL CONDITIONS
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:	
100	0.05	HB44	HB44	100	0.01	
As-Found:		As-Found:		As-Found:		
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	
As-Left:		As-Left:		As-Left:		
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	

☐	☒	☐
Good	Fair	Poor
Temperature: 18.6°C		

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
200	200.00	200.00	0.005
120	100.00	100.00	0.005
80	80.00	80.00	0.005
40	40.00	40.00	0.005
20	20.00	20.00	0.005
10	10.00	10.00	0.005

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	R.L./Troemner	10kg to 1mg	G782	4/14/22	4/2023	20220751
Weight Set	Rice Lake	.001 to 10lb	PW0990	1/19/21	1/2023	20202519

Permanent Information Concerning this Equipment:

Comments/Information Concerning this Calibration

12/22: RH-46.7%

Report prepared/reviewed by: LD Date: 12/14/22

Technician: K. Dexter

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. Calibrations comply with ISO/IEC 17025 and ANSI/Z540-1-1994 quality standards.

Dry Gas Meter Calibration

DUT

Manufacturer: APEX
 Model: XC-60
 Lab ID #: 53
 Serial #: 1902130
 Calibration Date: 1/26/2023
 Calibration Expiration: 7/26/2023
 Barometric Pressure: 30.51 in. Hg



Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer: Apex		Fluke	Aquatech	Dwyer
Model: SK25DA		52 II	DBX2	475
Lab ID#: 47		196	202	174
Calibration Expiration Date: 3/30/2023		11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor: 0.9978				

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Calibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	149.049	145.786	156.580
Standard DGM Temperature (°F)	64.0	64.0	64.0
Standard DGM Pressure (in H ₂ O)	0.00	0.00	0.0
DGM Initial Volume (ft ³)	0.000	0.000	0.000
DGM Final Volume (ft ³)	5.425	5.311	5.765
DGM Temperature (°F)	89.0	92.0	94.0
DGM Pressure (in H ₂ O)	2.00	3.50	1.2
Net Volume for Standard DGM (ft ³)	5.264	5.148	5.530
Net Volume for DGM (ft ³)	5.425	5.311	5.765
Dry Gas Meter γ Factor	1.009	1.010	1.009
γ Factor Deviation From Average	1.009	1.010	1.009

Average Gas Meter γ Factor

1.010

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{std} \times (\gamma_{std}) \times (P_{bar} + P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/13.6)]$

Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-856-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 28140-203323-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	Reference:	ASME B40.100
Recommended Due Date:	March 1, 2024	Cal-Cert Procedure:	CP-003
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Unknown	Temperature:	69 °F
Type:	Pressure Transducer	Humidity:	36% RH
Model Number:	Unknown	Cal Factor:	None
Serial #:	Unknown	Asset #:	53B
Capacity:	1 In H2O	Service Location:	Service Address
Tolerance:	± 1.00% of Span	As Found:	Pass
Gauge Class:	A	As Left:	Pass

Instrument Range:		Range Resolution:		Mode Verified:		Pressure		
UUT Reading	Standard As Found	Standard Verification Reading #1	Error	Standard Verification Reading #2	Error	Tolerance	Expanded Uncertainty ±	
In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005	
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005	
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005	
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005	
1.00	1.00	1.00	0.00	1.00	0.00	0.01	0.005	
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005	
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005	
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005	
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005	

Manufacturer: Unknown

Type: Pressure Transducer

Serial #: Unknown

Remarks:

**We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.**

**Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: March 1, 2023

Technical Manager: Marshall Doyle

Signature:



Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-856-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 28140-203324-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	Reference:	ASME B40.100
Recommended Due Date:	March 1, 2024	Cal-Cert Procedure:	CP-003
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Newport	Temperature:	73 °F
Type:	Pressure Transducer	Humidity:	30% RH
Model Number:	Unknown	Cal Factor:	None
Serial #:	Unknown	Asset #:	53C
Capacity:	5 In H2O	Service Location:	Service Address
Tolerance:	± 1.00% of Span	As Found:	Pass
Gauge Class:	A	As Left:	Pass

Instrument Range:		Range Resolution:		Mode Verified:		Pressure		
UUT Reading	Standard As Found	Standard Verification Reading #1	Error	Standard Verification Reading #2	Error	Tolerance	Expanded Uncertainty ±	
In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005	
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005	
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006	
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007	
5.00	5.00	5.00	0.00	5.00	0.00	0.05	0.008	
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007	
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006	
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005	
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005	

Manufacturer: Newport

Type: Pressure Transducer

Serial #: Unknown

Remarks:

**We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.**

**Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: March 1, 2023

Technical Manager: Marshall Doyle

Signature:



Report and Certificate of Calibration



Toll Free
800-356-4662

www.Cal-Cert.com

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-0620



Report #: 26398-201253-5 **Customer PO#:** 1079
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212
City: Clackamas **State:** OR **Zip:** 97015
Contact: Ethan Frederick
Service Address: 5777 SE International Way Milwaukie, OR 97222

Calibration Standards

LP-00397 | Gage Block Set | Mitutoyo | SN: 509020 | Cal: 11/25/2020 | Due: 11/30/2022 | Vendor: BHD Test and Measurement | Report #: 112520A
LP-01346 | Thermo-Hygrometer | Comark | SN: 06210350198 | Cal: 02/07/2022 | Due: 02/28/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 22748-67215-3486

Instrument Data

Calibration Date:	October 21, 2022	Reference:	ASME B89.1.14 2018
Calibration Due Date:	October 21, 2023	Cal-Cert Procedure:	CP-008
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Mitutoyo	Temperature:	69 °F
Type:	Digital Caliper	Humidity:	38% RH
Model Number:	CD-P6"S	Asset #:	208
Serial #:	B22159310	Service Location:	Cal-Cert Lab
Capacity:	6 Inches	As Found:	PASS
Resolution:	0.0005 Inches	As Left:	PASS

Instrument Range:	6.0000 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	0.3000	0.0010
0.6000	0.6005	0.6005	0.6005	0.0010
1.2000	1.2000	1.2000	1.2000	0.0010
2.4000	2.4005	2.4005	2.4005	0.0010
3.5000	3.5000	3.5000	3.5000	0.0010
5.0000	5.0005	5.0005	5.0005	0.0010
6.0000	6.0005	6.0005	6.0005	0.0010

Expanded Uncertainty ± 0.00036 Inches

Verifications (for information only)			
	Target	Measured	Tolerance ±
Resolution Check	0.1005	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 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Cameron Walling

Date: October 21, 2022

Technical Manager: Marshall Doyle

Signature:

Mr Doyle

Caliper CF-008-01

Revision 16

9/19/2022

Dry Gas Meter Calibration

DUT

Manufacturer: APEX
 Model: XC-60
 Lab ID #: 54
 Serial #: 1902133
 Calibration Date: 1/26/2023
 Calibration Expiration: 7/26/2023
 Barometric Pressure: 30.49 in. Hg



Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer: Apex		Fluke	Aquatech	Dwyer
Model: SK25DA		52 II	DBX2	475
Lab ID#: 47		196	202	174
Calibration Expiration Date: 3/30/2023		11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor: 0.9978				

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Calibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	160.750	154.658	151.064
Standard DGM Temperature (°F)	64.0	65.0	66.0
Standard DGM Pressure (in H ₂ O)	0.00	0.00	0.0
DGM Initial Volume (ft ³)	0.000	0.000	0.000
DGM Final Volume (ft ³)	5.962	5.736	5.621
DGM Temperature (°F)	97.0	96.0	97.0
DGM Pressure (in H ₂ O)	3.00	2.00	1.0
Net Volume for Standard DGM (ft ³)	5.677	5.462	5.335
Net Volume for DGM (ft ³)	5.962	5.736	5.621
Dry Gas Meter γ Factor	1.003	1.001	1.000
γ Factor Deviation From Average	1.003	1.001	1.000

Average Gas Meter γ Factor

1.001

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{std} \times (\gamma_{std}) \times (P_{bar} + P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/13.6)]$

Technician:

Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-856-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 28140-203325-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	Reference:	ASME B40.100
Recommended Due Date:	March 1, 2024	Cal-Cert Procedure:	CP-003
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Newport	Temperature:	68 °F
Type:	Pressure Transducer	Humidity:	37% RH
Model Number:	Unknown	Cal Factor:	None
Serial #:	Unknown	Asset #:	54B
Capacity:	1 In H2O	Service Location:	Service Address
Tolerance:	± 1.00% of Span	As Found:	Pass
Gauge Class:	A	As Left:	Pass

Instrument Range:		Range Resolution:		Mode Verified:		Pressure		
UUT Reading	Standard As Found	Standard Verification Reading #1	Error	Standard Verification Reading #2	Error	Tolerance	Expanded Uncertainty ±	
In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005	
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005	
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005	
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005	
1.00	0.99	0.99	-0.01	0.99	-0.01	0.01	0.005	
0.75	0.75	0.75	0.00	0.75	0.00	0.01	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.01	0.005	
0.25	0.25	0.25	0.00	0.25	0.00	0.01	0.005	
0.10	0.10	0.10	0.00	0.10	0.00	0.01	0.005	
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005	

Manufacturer: Newport

Type: Pressure Transducer

Serial #: Unknown

Remarks:

--

**We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.**

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01. A2LA 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/NCSL Z540.1, 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:

Jon Rau

Date:

March 1, 2023

Technical Manager:

Marshall Doyle

Signature:



Dry Gas Meter Calibration

DUT

Manufacturer: APEX
 Model: XC-50-DIR
 Lab ID #: 203
 Serial #: A2204292
 Calibration Date: 1/26/2023
 Calibration Expiration: 7/26/2023
 Barometric Pressure: 30.50 in. Hg



Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer: Apex		Fluke	Aquatech	Dwyer
Model: SK25DA		52 II	DBX2	475
Lab ID#: 47		196	202	174
Calibration Expiration Date: 3/30/2023		11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor: 0.9978				

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Calibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	230.939	193.894	200.071
Standard DGM Temperature (°F)	66.0	66.0	66.0
Standard DGM Pressure (in H ₂ O)	0.00	0.00	0.0
DGM Initial Volume (ft ³)	0.000	0.000	0.000
DGM Final Volume (ft ³)	8.610	7.251	7.491
DGM Temperature (°F)	92.0	92.0	91.0
DGM Pressure (in H ₂ O)	2.56	1.30	0.8
Net Volume for Standard DGM (ft ³)	8.156	6.847	7.065
Net Volume for DGM (ft ³)	8.610	7.251	7.491
Dry Gas Meter γ Factor	0.986	0.986	0.984
γ Factor Deviation From Average	0.986	0.986	0.984

Average Gas Meter γ Factor

0.985

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{std} \times (\gamma_{std}) \times (P_{bar} + P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/13.6)]$

Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-856-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 28140-203319-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	Reference:	ASME B40.100
Recommended Due Date:	March 1, 2024	Cal-Cert Procedure:	CP-003
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Red Lion	Temperature:	69 °F
Type:	Pressure Transducer	Humidity:	35% RH
Model Number:	Unknown	Cal Factor:	None
Serial #:	Unknown	Asset #:	203B
Capacity:	1 In H2O	Service Location:	Service Address
Tolerance:	± 1.00% of Span	As Found:	Pass
Gauge Class:	A	As Left:	Pass

Instrument Range:		Range Resolution:		Mode Verified:		Pressure		
UUT Reading	Standard As Found	Standard Verification Reading #1	Error	Standard Verification Reading #2	Error	Tolerance	Expanded Uncertainty ±	
In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	
0.000	0.000	0.000	0.00	0.000	0.00	0.01	0.0005	
0.100	0.100	0.100	0.00	0.100	0.00	0.01	0.0005	
0.250	0.250	0.250	0.00	0.250	0.00	0.01	0.0006	
0.500	0.500	0.500	0.00	0.500	0.00	0.01	0.0008	
0.750	0.750	0.750	0.00	0.750	0.00	0.01	0.001	
1.000	1.000	1.000	0.00	1.000	0.00	0.01	0.0012	
0.750	0.750	0.750	0.00	0.750	0.00	0.01	0.001	
0.500	0.500	0.500	0.00	0.500	0.00	0.01	0.0008	
0.250	0.250	0.250	0.00	0.250	0.00	0.01	0.0006	
0.100	0.100	0.100	0.00	0.100	0.00	0.01	0.0005	
0.000	0.000	0.000	0.00	0.000	0.00	0.01	0.0005	

Manufacturer: Red Lion

Type: Pressure Transducer

Serial #: Unknown

Remarks:

**We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.**

**Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: March 1, 2023

Technical Manager: Marshall Doyle

Signature:



Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-856-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 28140-203320-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	Reference:	ASME B40.100
Recommended Due Date:	March 1, 2024	Cal-Cert Procedure:	CP-003
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Red Lion	Temperature:	73 °F
Type:	Pressure Transducer	Humidity:	30% RH
Model Number:	Unknown	Cal Factor:	None
Serial #:	Unknown	Asset #:	203C
Capacity:	5 In H2O	Service Location:	Service Address
Tolerance:	± 1.00% of Span	As Found:	Pass
Gauge Class:	A	As Left:	Pass

Instrument Range:		Range Resolution:		Mode Verified:		Pressure		
UUT Reading	Standard As Found	Standard Verification Reading #1	Error	Standard Verification Reading #2	Error	Tolerance	Expanded Uncertainty ±	
In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005	
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005	
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006	
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007	
5.00	5.00	5.00	0.00	5.00	0.00	0.05	0.008	
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007	
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006	
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005	
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005	

Manufacturer: Red Lion

Type: Pressure Transducer

Serial #: Unknown

Remarks:

--

**We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.**

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01. A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: March 1, 2023

Technical Manager: Marshall Doyle

Signature:



Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-856-4662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 28140-203326-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
LA-01776 | Pressure Transducer | Fluke | SN: 5956001 | Cal: 11/25/2022 | Due: 11/25/2023 | Range: 10 in H2O | Report #: EVL846346

Instrument Data

Calibration Date:	March 1, 2023	Reference:	ASME B40.100
Recommended Due Date:	March 1, 2024	Cal-Cert Procedure:	CP-003
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Newport	Temperature:	73 °F
Type:	Pressure Transducer	Humidity:	30% RH
Model Number:	Unknown	Cal Factor:	None
Serial #:	Unknown	Asset #:	54C
Capacity:	5 In H2O	Service Location:	Service Address
Tolerance:	± 1.00% of Span	As Found:	Pass
Gauge Class:	A	As Left:	Pass

Instrument Range: 5.00		Range Resolution: 0.01		Mode Verified: Pressure				
UUT Reading	Standard As Found	Standard Verification Reading #1	Error	Standard Verification Reading #2	Error	Tolerance	Expanded Uncertainty ±	
In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	In H2O	
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005	
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005	
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006	
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007	
5.00	5.00	5.00	0.00	5.00	0.00	0.05	0.008	
3.75	3.75	3.75	0.00	3.75	0.00	0.05	0.007	
2.50	2.50	2.50	0.00	2.50	0.00	0.05	0.006	
1.25	1.25	1.25	0.00	1.25	0.00	0.05	0.005	
0.50	0.50	0.50	0.00	0.50	0.00	0.05	0.005	
0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.005	

Manufacturer: Newport

Type: Pressure Transducer

Serial #: Unknown

Remarks:

--

**We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.**

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01. A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: March 1, 2023

Technical Manager: Marshall Doyle

Signature:



Dry Gas Meter Calibration

DUT

Manufacturer: APEX
 Model: Apex-AK-600
 Lab ID #: 55
 Serial #: 810016
 Calibration Date: 1/27/2023
 Calibration Expiration: 7/27/2023
 Barometric Pressure: 30.15 in. Hg



Equipment Used:	Ref. Std. DGM	Thermometer	Barometer	Manometer
Manufacturer: Apex		Fluke	Aquatech	Dwyer
Model: SK25DA		52 II	DBX2	475
Lab ID#: 47		196	202	174
Calibration Expiration Date: 3/30/2023		11/29/2023	4/16/2023	3/29/2023
Calibration γ Factor: 0.9978				

Use in accordance with EPA Method 5, sections 10.3 and 16.1. Use only calibrated, NIST traceable reference standard DGM. Calibrate over expected operating flow range of DUT.

Calibration Data	Run 1	Run 2	Run 3
Standard DGM Initial Volume (L)	0.000	0.000	0.000
Standard DGM Final Volume (L)	155.374	168.471	375.274
Standard DGM Temperature (°F)	65.0	66.0	67.0
Standard DGM Pressure (in H ₂ O)	0.00	0.00	0.0
DGM Initial Volume (ft ³)	0.000	0.000	0.000
DGM Final Volume (ft ³)	5.505	5.830	13.012
DGM Temperature (°F)	73.0	74.0	75.0
DGM Pressure (in H ₂ O)	0.50	0.50	0.5
Net Volume for Standard DGM (ft ³)	5.487	5.949	13.253
Net Volume for DGM (ft ³)	5.505	5.830	13.012
Dry Gas Meter γ Factor	1.008	1.032	1.030
γ Factor Deviation From Average	1.008	1.032	1.030

Average Gas Meter γ Factor

1.024

Measurement Uncertainty: Total measurement uncertainty +/- 0.748% RD, K=2

Calculations:

- Deviation = |Average value for all runs - current run value|
- $\gamma = [V_{std} \times (\gamma_{std}) \times (P_{bar} + P_{std}/13.6) \times (T_{DGM} + 460)] / [V_{DGM} \times (T_{std} + 460) \times (P_{bar} + P_{DGM}/13.6)]$

Technician *Sebastian* *Quinn*

Report and Certificate of Calibration



Portland Laboratory
5777 SE International Way
Milwaukie, OR 97222
800-356-4662
503-654-9620

Anaheim Laboratory
120 S. Chaparral Ct Suite 110
Anaheim Hills, CA 92808
888-700-4100
714-696-5300

www.Cal-Cert.com

Report #: 25314-28785-47 **Customer PO#:** 1073
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212
City: Clackamas **State:** OR **Zip:** 97015
Contact: John Steinert
Service Address: 120 S. Chaparral Court, Suite 110 Anaheim Hills, CA 92808

Calibration Standards

2-01754 | Thermo-Hygrometer | Comark | SN: 06257740553 | Cal: 08/12/2022 | Due: 07/31/2023 | Report #: 25476-198970-3646
ACS318 | Electrical Meter | Fluke | SN: 895650804 | Cal: 06/26/2022 | Due: 06/30/2024 | Vendor: Fluke | Range: Various | Report #: EVL809627
ACS403 | Electrical Meter | Extech | SN: H241956 | Cal: 04/02/2022 | Due: 04/30/2023 | Vendor: Associated Calibration Inc. | Range: 11111110 Ohms | Report #: 23340-70023-1546

Instrument Data

Calibration Date:	August 19, 2022	Reference:	Manufactures Tolerances
Recommended Due Date:	August 19, 2023	Cal-Cert Procedure:	CP-080
Calibration Frequency:	12 Months	Indicating System:	Gauge
Manufacturer:	Delmhorst	Temperature:	71.9 °F
Type:	Resistivity Meter	Humidity:	48% RH
Model Number:	MCS-1	Asset #:	#094
Serial #:	#094	Service Location:	Cal-Cert Lab
Capacity:	120 Megaohms	As Found:	Pass
Tolerance:	5.00 % of indication	As Left:	Pass

Instrument Range:		120 Megaohms		Resolution:	N/A	Mode Verified:	Resistance
Standard Reading	UUT As Found	UUT Reading #1	Error	UUT Reading #2	Error		
0.000	0.000	0.000	0.000	0.000	0.000		
1.100	1.095	1.095	-0.005	1.095	-0.005		
120.000	121.20	121.20	1.200	121.31	1.310		
0.000	0.000	0.000	0.000	0.000	0.000		
0.000	0.000	0.000	0.000	0.000	0.000		

Expanded Uncertainty± 2.50 Megaohms

Remarks:

We sincerely thank you for your business. Please call us at 714-696-5300 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

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 ANSI/NCCL Z540.1, 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: Michael Rondeau

Date: August 19, 2022

Technical Manager: Marshall Doyle

Signature:



CERTIFICATE OF CALIBRATION

CUSTOMER:	PFS-TECO : CLACKAMAS, OR	CALIBRATION DATE:	05/03/2022
PO NUMBER:	1071	CALIBRATION DUE:	05/03/2023
INST. MANUFACTURER:	DWYER	PROCEDURE:	T.O.33K6-4-1769-1
INST. DESCRIPTION:	VELOMETER	CALIBRATION FLUID:	AIR @ 14.7 PSIA 70°F
MODEL NUMBER:	471	RECEIVED CONDITION:	WITHIN MFG. SPECS.
SERIAL NUMBER:	CP288559 ID# 095	LEFT CONDITION:	WITHIN MFG. SPECS.
RATED ACCURACY:	SEE NOTES BELOW.	AMBIENT CONDITIONS:	763mm HGA 51% RH 72°F
UNCERTAINTY GIVEN:	± 0.43% RD ; k=2	CERTIFICATE FILE #:	490265.2021
NOTES:	± 3% FS (0-500 / 0-1500) *** ± 4% F.S. (0-5000) *** ± 5% F.S. (0-15000) *** ± 2 °F		

Q.MANUAL IM 2.0 REV 2020.2 DATED 7-27-2020 ** DECISION RULE : NO PFA%**

UUT INDICATED FT/MIN	DM.STD. ACTUAL FT/MIN	UUT INDICATED DEG. F	DM STD. ACTUAL DEG. F
65	68	0 TO 200°F	0 TO 200°F
129	133	45.1	44.2
260	266	71.7	70.9
498	509	99.3	98.5
526	534		
1039	1058		
1484	1517		
523	534		
3076	3151		
4998	5127		
6752	6907		
14679	15068		

STANDARDS USED:

A24: HART SCIENTIFIC TEMP. STANDARD | ± 0.024 F | TRACE# 1617259390	DUE	04/12/2023
A800: FLOW-DYNE SONIC NOZZLE SYSTEM | 0 - 1086 CFM ± 0.46% RD. | TRACE# 1329407628, 89576, 152043238	DUE	12/10/2022

All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) and the Unit Under Test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed according to the shown procedure. The use of IAS/ILAC logo indicates calibrations are in accordance to ISO/IEC 17025:2017.

Dick Munns Company • 11133 Winners Circle, Los Alamitos, CA 90720
Phone: 714-827-1215 • www.dickmunns.com

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

Issuing Date:

Approved By:

Cal. Technician:

Calibrated at: ☒ Lab

☐ On-Site (Customer's)

05/03/2022

[Signature]

D.C.

Page 1 of 1

Certificate of Calibration

Certificate Number: 743892



JJ Calibrations, Inc.

7724 SE Aspen Summit Drive

Portland, OR 97266-9217

Phone 503.786.3005

FAX 503.786.2994

PFS TECO

11785 SE Hwy 212

Suite 305

Clackamas, OR 97015

PO: 1033

Order Date: 03/08/2021

Authorized By: N/A

Calibrated on: 03/18/2021

*Recommended Due: 03/18/2026

Environment: 19 °C 41 % RH

* As Received: Other - See Remarks

* As Returned: Other - See Remarks

Action Taken: Calibrated

Technician: 126



0723.01

Calibration

Property #: 097

User: N/A

Department: N/A

Make: Unknown

Model: 10 Lbs.

Serial #: 097

Description: Mass

Procedure: DCN 500901

Accuracy: Raw Data

Remarks: * Many factors may cause the unit to drift out of calibration before the recommended due date. Any reported error is the absolute value between the reference and the unit. Uncertainties include the effects of the unit.

Data is provided for your determination of acceptability. Received/returned without accessories.

Standards Used

Std ID	Manufacturer	Model	Nomenclature	Due Date	Trace ID
484A	Rice Lake	1kg-10kg (Class ASTM 1)	Mass Set,	05/28/2021	699197
503A	Rice Lake	1mg-200g (Class 0)	Mass Set,	09/11/2021	729241
550A	And (A&D) Co.	HP-30K	Balance 30 Kg	12/31/2021	739307
723A	Rice Lake	1mg-200g (Class 0)	Mass Set,	06/09/2021	723431

Parameter

Measurement Data

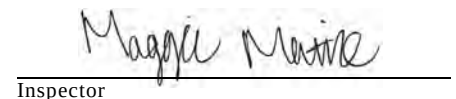
Measurement Description	Range Unit	Reference	Min	Max	*Error	UUT	Uncertainty
Before/After							Accredited = $\bar{u}$
Mass							
Raw Data	g	4535.92370000	0.0000000	0.0000000	0.1785299	4536.1022299 g	3.5E-01 $\bar{u}$

This instrument has been calibrated in accordance with the JJ Calibrations Quality Assurance Manual and is traceable to either the SI or to National Institute of Standards and Technology (NIST). The quality system and this certificate are in compliance with ANSI/NCSL Z540-1-1994, ISO/IEC 17025-2017, ISO 10012-1, the ISO 9000 family and QS 9000. The expanded uncertainties of measurements for this calibration are based upon 95% (2 sigma) confidence limits. Unless stated in the comments, certificates reflect the "Simple Acceptance Rule" as specified by JCGM 106:2012. Unless otherwise stated, a test accuracy ratio (TAR) of 4:1, if achievable, is maintained. The results reported herein apply only to the calibration of the item described above. This report may not be reproduced, except in full, without written approval of JJ Calibrations.


Reviewer

3 Issued 03/25/2021

Rev # 15


Inspector



QUALITY CONTROL SERVICES

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



PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIRI0134307497221214

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	12/14/22	6/9/22	12/2023

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		
As-Found:		As-Found:		1.100.0002	5.1000.0003	9.1000.0003	
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	2.1000.0001	6.1000.0002	10.1000.0002	
As-Left:		As-Left:		3.1000.0002	7.1000.0002	<u>Result</u>	
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	4.1000.0002	8.1000.0003	284.60499	

☐ ☒ ☐

Good Fair Poor

Temperature: 20.6°C

A2LA ACCREDITED SECTION OF REPORT

Standard	As-Found	As-Left	Expanded Uncertainty
200	200.0009	200.0004	569.20999
100	100.0005	100.0002	569.20999
50	50.0004	50.0001	569.20999
20	20.0003	20.0000	569.20999
1	1.0001	1.0000	569.20999
0.1	0.1001	0.1000	569.20999

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Weight Set	Rice Lake	20 kg to 1mg	2831W	3/1/22	3/2023	20220382

Permanent Information Concerning this Equipment:

6 month calibration cycle
1/22 Extra checkpoint to encapsulate user range 0.05g.
AF= 0.0500g A/L= 0.0500

Comments/Info Concerning this Calibration:

12/22 RH= 45%. Adjusted span.

Report prepared/reviewed by: SC

Date: 12/14/22

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.

Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-356-1662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Report #: 31538-218157-14 **Customer PO#:**
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212, Suite 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212, Suite 305 Clackamas, OR 97015

Calibration Standards

10-00209 | Weight | Rice Lake | SN: 43334 | Cal: 02/02/2022 | Due: 02/28/2024 | Vendor: Oregon Dept of Ag | Report #: 20220092
19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 08/14/2023 | Due: 08/31/2024 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 30530-30694-3646

Instrument Data

Calibration Date:	October 12, 2023	Reference:	ASTM E898-20, D4753-15
Calibration Due Date:	April 12, 2024	Cal-Cert Procedure:	CP-002
Calibration Frequency:	6 Months	Indicating System:	Digital
Manufacturer:	Sartorius	Temperature:	73 °F
Model Number:	ENTRIS224	Humidity:	52% RH
Type:	Digital Balance	Asset #:	107
Serial #:	34307497	Service Location:	Service Address
Scale Capacity:	200 grams	As Found:	PASS
		As Left:	PASS

Scale Linear Test								
Instrument Range:			Resolution:			0.0001 grams		
Calibration Standard	As Found UUT	As Found Error	As Left UUT	As Left Error	As Left % of Error	Tolerance (As Left) Allowable Error		
grams	grams	grams	grams	grams		Error	Condition	Expanded Unc. (grams)
0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.0000	PASS	0.00000
20.0000	19.9998	-0.0002	19.9998	-0.0002	0.00	0.0200	PASS	0.00463
40.0000	39.9997	-0.0003	40.0000	0.0000	0.00	0.0400	PASS	0.00924
60.0000	59.9996	-0.0004	60.0001	0.0001	0.00	0.0600	PASS	0.01386
80.0000	79.9995	-0.0005	80.0001	0.0001	0.00	0.0800	PASS	0.01848
100.0000	99.9994	-0.0006	99.9999	-0.0001	0.00	0.1000	PASS	0.02310
120.0000	119.9993	-0.0007	119.9999	-0.0001	0.00	0.1200	PASS	0.02771
140.0000	139.9991	-0.0009	140.0000	0.0000	0.00	0.1400	PASS	0.03233
160.0000	159.9990	-0.0010	160.0001	0.0001	0.00	0.1600	PASS	0.03695
180.0000	179.9990	-0.0010	180.0000	0.0000	0.00	0.1800	PASS	0.03926
200.0000	199.9989	-0.0011	200.0000	0.0000	0.00	0.2000	PASS	0.04619
100.0000	99.9994	-0.0006	99.9999	-0.0001	0.00	0.1000	PASS	0.02310
0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.0000	PASS	0.00000

FUNCTIONAL CHECKS					
ECCENTRIC LOAD TEST:		HYSTERESIS: Load Increments		REPEATABILITY:	
Loading position	100.0000	Test Weight Applied. % of load	Readings	Test Weight Applied	100.0000
Right	99.9999	0%	0.0000	1st	99.9999
Left	99.9998	(R1) 50%	99.9999	2nd	100.0000
Front	99.9998	100%	200.0000	3rd	99.9999
Back	99.9999	(R2) 50%	99.9999	4th	100.0000
Center	99.9999	0%	0.0000	5th	100.0000
As Left	PASS	As Left	PASS	As Left	PASS
Tolerance: The maximum error of the eccentric loading must be less than .1% of center load value.		Tolerance: The Difference of R1 and R2 must be within 0.1%		Tolerance: Deviation of lowest and highest reading within 0.1%	

Remarks:

The scale was adjusted prior to taking the As Left readings.

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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:

Jon Rau

Date:

October 12, 2023

Technical Manager:

Marshall Doyle

Signature:

REPORT#: 31538-218157-14



QUALITY CONTROL SERVICES

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



Report of Calibration

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

Test Completed: 05/09/22
Purchase Order: 1067
Traceable Number: 20220682

Test Item: 200 mg and 100 mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner
Customer ID: Listed in Table

<u>Material</u>	<u>Assumed Density</u>	<u>Range</u>	<u>Tolerance Class</u>
Stainless Steel	7.95 g/cm ³	200 mg & 100 mg	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:

100 g to 1 mg Working Standards Were Calibrated: 07/02/21 Due: 07/31/22 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. 8.0 g/cm³).

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

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

page 1 of 2

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

Date: 05/09/22


Signature David S. Thompson

This document shall not be reproduced, except in full, without the written approval of Quality Control Services Mass Laboratory.

Member: National Conference of Standards Laboratories and Weights & Measures



QUALITY CONTROL SERVICES

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



Report of Calibration

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

Test Completed: 05/09/22
Purchase Order: 1067
Traceable Number: 20220682

Test Item: 200 mg and 100 mg Individual Weights
Serial No.: Listed in Table

Manufacturer: Troemner
Customer ID: Listed in Table

Laboratory Environment at time of test

Temperature °C	Pressure mmHg	Humidity %RH
21.93 to 21.94	760.7 to 760.8	47.8 to 47.9

Conventional Mass Value

Nominal Value	As Found Value (g)	As Found Correction* (mg)	As Left Value (g)	As Left Correction* (mg)	Uncertainty (mg)	Tolerance (mg)
200 mg, 1000101395, #109-B	0.2000082	0.0082	0.2000082	0.0082	0.0014	0.010
100 mg, 1000126267, #109-A	0.1000065	0.0065	0.1000065	0.0065	0.0014	0.010

*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 ASTM Class 1 tolerances As Found.

Recalibration Due: The customer has requested a 5-year calibration cycle. The calibration due date for these weights is 05/09/27. The values listed above were found at the time of calibration. Any number of factors may cause these items to drift out of calibration before the calibration interval has expired.

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 17025:2017 *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 to 2

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

Date: 05/09/22


Signature David S. Thompson

This document shall not be reproduced, except in full, without the written approval of Quality Control Services Mass Laboratory.

Member: National Conference of Standards Laboratories and Weights & Measures



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

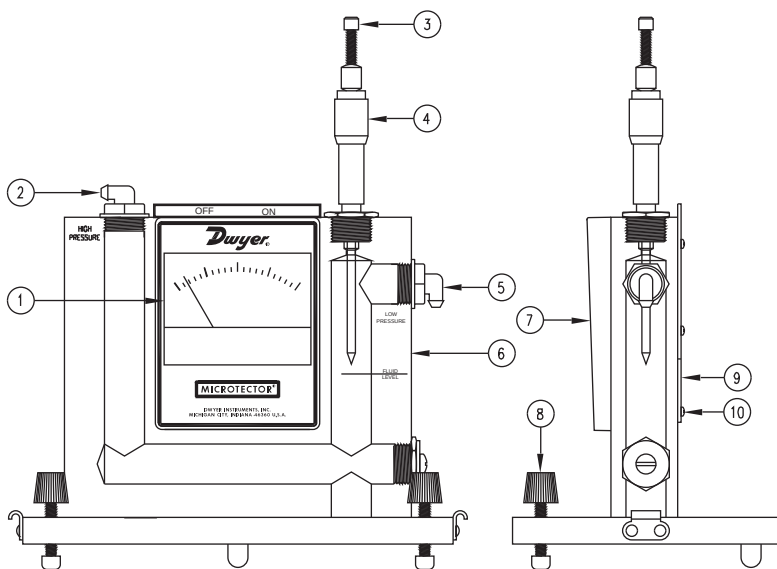
MICHIGAN CITY, INDIANA 46361, U.S.A

Phone: 219/879-8000

Fax: 219/872-9057

www.dwyer-inst.com

e-mail: info@dwyer-inst.com



Microtector® Gage

Precision Pressure Measurement

The Microtector® Gage combines the time-proven principles of the Hook Gage type manometer and modern solid-state integrated circuit electronics. It provides an inexpensive means of achieving accuracy and repeatability within $\pm .00025$ inches water column throughout its 0 to 2 inches w.c. range. It is truly a new standard in precision measuring devices.

Principles of Operation

A pressure to be measured is applied to the manometer fluid which is displaced in each leg of the manometer by an amount equal to $1/2$ the applied pressure. A micrometer mounted point is then lowered until it contacts the manometer gage fluid. The instant of contact is detected by completion of a low-power A.C. circuit. Current for this circuit is supplied by a 1.5 volt penlight cell feeding two semiconductor amplifiers which act as a free-running multivibrator operating at a frequency of approximately two kilohertz. Completion of the A.C. circuit activates a bridge rectifier which provides the signal for indication on a sensitive (0 to 50 microamps) D.C. microammeter.

On indication of contact, the operator stops lowering the point and reads the micrometer which indicates one half the applied pressure. By interpolating eight divisions (each being $.000125$ " w.c.) between $.001$ micrometer graduations, a total accuracy of $.00025$ can easily be achieved. The micrometer complies with Federal Specification GGG-C-105A and is traceable to a master at the NIST.

Locating and Opening

Stand the Microtector® Gage and case on a firm flat level surface. Remove cover by releasing the latches and lifting it straight up. If it is necessary to move the gage without case, handle only the base plate or clear acrylic block. **(CAUTION:** Do not handle gage by grasping meter-electronic package housing Item 7 on drawing.)

Fluid Level

Level the gage by adjusting the two front leveling screws (Item 8 on drawing) until the bubble in the spirit level is centered in the small circle. After leveling the gage, open both rapid shut-off valve tube connectors (Items 2 and 5). Back off the micrometer (Item 4), if necessary, to make sure that the point is not immersed in the gage fluid. The fluid level in the gage should now coincide with the mark on the right hand bore (Item 6) plus or minus approximately 1/32 inch. If the level of fluid is too high, fluid can be removed with an eye dropper pipette or carefully poured out of the right connection (Item 5).

If the level is too low, remove the top left rapid shut-off valve tube connector (Item 2) and add distilled water pre-mixed with the proper amount of green concentrate. (See maintenance instructions for proportions. After correcting the fluid level, re-install the rapid shut-off connectors and, with these in the open position, re-level the Microtector® Gage. The gage is now ready to be zeroed.

Zeroing

Turn the Micrometer barrel (Item 4) until its lower end just coincides with the zero mark on the scale and the zero on the barrel scale coincides with the vertical line on the internal scale. Note that the internal scale is graduated every .025" from 0 to 1.00 inch and the barrel scale is graduated in one thousandths from 0 to .025". Turn the meter circuit switch at the top of gage to the "on" position. While holding the barrel at the zero position (and with gage level), raise or lower the point by turning the knurled knob (Item 3) until the point is above, but near, the fluid.

Check to be sure that the meter registers zero. Watch the meter, hold the barrel, and lower the point slowly by turning the top knurled knob. As the knob is turned, the point will contact the fluid and the meter pointer will move from zero to some upscale position.

After making contact, turn the point out of the fluid by turning the micrometer barrel counter-clockwise to a reading of .010 or more. Again, watch the meter and, this time, lower the point by turning the micrometer barrel. The point position where the meter pointer begins to move up scale is the zero position. This position should correspond to the zero reading on the micrometer. Adjust the point in relation to the micrometer barrel by turning the top knob while holding the barrel steady. Repeat lowering the point, watching the meter for contact, and adjusting the point until the zero position and zero reading exactly coincide. The gage is now zeroed and should not be moved.

An alternative method of zeroing and reading can be used wherein, instead of zeroing the gage completely, a zero correction reading is taken and recorded, then subtracted from the final reading. Comparable results can be obtained with either method.

Positive Pressure Measurement

With the fluid at its proper level, a pressure of 2.0" water column maximum can be measured. Positive pressure should be applied to the top left connection (Item 2) with the micrometer zeroed as described above. This will permit a simple direct reading to be taken.

After an unknown pressure has been applied at the top left connection, the fluid level will drop in the left bore and rise over the point in the right bore. Note that the indicating meter point has moved upscale because the point is immersed in the fluid. Turn the micrometer counter-clockwise until the point leaves the fluid as indicated by the meter pointer dropping to zero on its scale. Then slowly turn the micrometer down until its point just touches the fluid surface, causing movement of the meter pointer. Withdraw the point and repeat several times, noting each time the micrometer reading where the meter pointer begins. The average of these readings multiplied by two is the pressure applied to the gage. (Avg. reading $\times 2$ = pressure applied in inches w.c. The degree of uncertainty for the operator is indicated by the difference in these readings.

When the readings are complete, the pressure should be removed and the zero setting of Microtector® Gage rechecked. Any change in the zero position will indicate inaccurate readings. Should this happen, the zero-set and pressure measurement procedure should be repeated.

Negative Pressure or Vacuum Measurement

Zero the gage. Connect the source of vacuum or negative pressure to the right-side gage connection (Item 5) and proceed as described under Positive Pressure Measurement section. Remember that the pressure measured in this way is negative.

Differential Pressure Measurement

Differential pressures may be measured by connecting the higher (more positive) pressure to the left connection (Item 2) and the lower pressure to the right connection (Item 5).

Storage

Turn meter circuit switch to "off" position and withdraw the point well clear of fluid (by turning micrometer clockwise) when gage is not in use. This will conserve the batteries and minimize build-up of oxides, etc., on the point. Keep the unit covered and in an area free of strong solvent fumes.

Maintenance

When the meter reading becomes reduced or the pointer movement gets sluggish (with the circuit on and the point in fluid), the following should be done:

(1) Remove the point (by unscrewing) and clean the tip lightly using fine crocus cloth. Wipe off all grit and dirt with a clean rag; reassemble and recheck meter operation.

(2) If the meter operation continues to be sluggish, replace the size AA, 1.5 volt battery. (Replace the battery at least once a year to avoid deterioration of battery and damage to gage. Leakproof alkaline battery is recommended.)

To replace the battery, remove center screw (Item 10) located in the back of the electronic enclosure. Cover (Item 9) will come off, exposing the battery. Pull the old battery out and push a new battery into the battery holder with the positive (center) terminal to the right (to the end marked with + on the holder).

If the fluid becomes contaminated and requires replacement: empty old fluid from gage; flush out with clear water and replace with distilled water and A-126 fluorescein green color concentrate mixed with 3/4 oz. concentrate to each quart of water.

CAUTION:

1. Do not substitute other gage fluids, as proper gage operation depends on use of the specified gage fluid to provide proper surface tension, wetting ability and electrolyte capability with unity specific gravity.

If the gage bore is very dirty, a mild soap solution may be used to aid in cleaning prior to flushing with clear water.

2. Do not clean with liquid soaps, special solvents, de-greasers, aromatic hydrocarbons, etc. Such cleaners and solvents may contain chlorine, fluorine, acetone and related compounds that will permanently damage the gage and prevent proper operation.

J-2000

owner's manual



DELMHORST®
===== INSTRUMENT CO. =====
WHEN ACCURACY IS THE POINT.™



QUALITY CONTROL SERVICES

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



PFS Teco
11785 SE Hwy 212 STE#305
Clackamas, OR 97015

Report Number: DIRI01C101887027221214

A2LA ACCREDITED CERTIFICATE OF CALIBRATION WITH DATA

INSTRUMENT INFORMATION

Item	Make	Model	Serial Number	Customer ID	Location
Scale	Mettler	IND570 - 1000lxb0	C101887027	#189	Lab
Units	Readability	SOP	Cal Date	Last Cal Date	Cal Due Date
lbs	0.02	QC033	12/14/22	1/27/22	12/2023

FUNCTIONAL CHECKS

SHIFT TEST		LINEARITY		REPEATABILITY		ENVIRONMENTAL CONDITIONS		
Test Wt:	Tol:	Test Wt:	Tol:	Test Wt:	Tol:			
400	0.10	HB44	HB44	200	0.04			
As-Found:		As-Found:		As-Found:				
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	☐	☒	☐
						Good	Fair	Poor
As-Left:		As-Left:		As-Left:		Temperature: 16.7°C		
Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐	Pass: ☒	Fail: ☐			

CALIBRATION DATA

Standard	As-Found	As-Left	Expanded Uncertainty
1000	1000.84	1000.02	0.012
600	600.32	600.00	0.011
400	400.10	400.00	0.011
200	200.00	199.98	0.011
100	100.00	99.98	0.011
50	50.00	50.00	0.011

CALIBRATION STANDARDS

Item	Make	Model	Serial Number	Cal Date	Cal Due Date	NIST ID
Avoirdupois Cast W	Rice Lake	25 and 50lb	PWO990-CA	7/18/22	7/2024	20221688

Permanent Information Concerning this Equipment:

Comments/Information Concerning this Calibration

12/14 As-Found Failed Linearity. Performed 3 point Linearity adjustment. As-Left Passed Linearity. Adjusted span.

Report prepared/reviewed by: JC

Date: 12/14/22

Technician: J. Colacchio

Signature: [Signature]

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

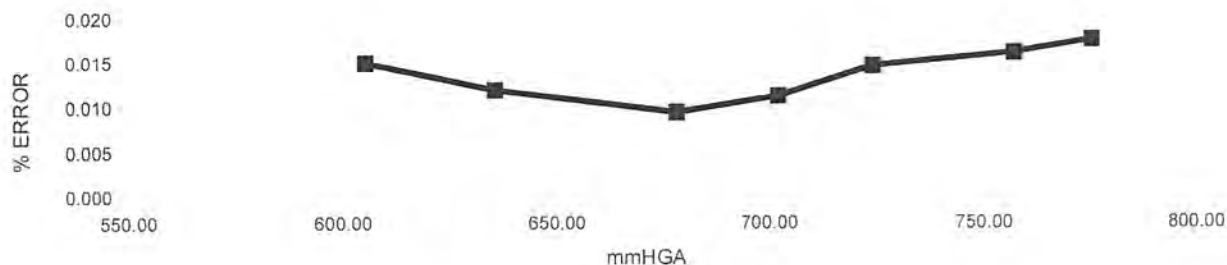
The uncertainty is calculated according to the ISO Guide to the Expression of Uncertainty in Measurement and includes the uncertainty of standards used combined with the observed standard deviation of the unit under test. The uncertainty is expanded with a k factor of 2 for an approximate 95% level of 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.

CERTIFICATE OF CALIBRATION

CUSTOMER: PFS-TECO; CLACKAMAS, OR
PO NUMBER: 1096
INST. MANUFACTURER: AQUATECH SCIENTIFIC INSTRUMENTS
INST. DESCRIPTION: DIGITAL BAROMETER
MODEL NUMBER: DBX2
SERIAL NUMBER: 118222
RATED ACCURACY: +/- .18 mmHGA
UNCERTAINTY GIVEN: +/- .03mmHGA.;k=2
NOTES: AS REC./AS LEFT WITHIN SPECS. ** DECISION RULE: PFA NOT USED TO DETERMINE CONFORMITY **

CALIBRATION DATE: 05/23/2023
CALIBRATION DUE: 05/23/2024
PROCEDURE: NAVAIR-17-20MP-03
CALIBRATION FLUID: AIR @ 70F
STANDARD(S) USED: A321, A22 DUE 3-2024
NIST TRACE # 'S: 1236086968,1583142077
AMBIENT CONDITIONS: 757 mmHGA, 60% RH, 68F
CERTIFICATE FILE #: 533813

TEST POINT NUMBER	UUT INDICATED mmHGA	DM.STD. ACTUAL mmHGA	% RD. ERROR
1	605.24	605.330	0.015
2	635.45	635.525	0.012
3	678.24	678.303	0.009
4	702.18	702.258	0.011
5	724.19	724.295	0.014
6	757.11	757.231	0.016
7	775.39	775.525	0.017



All instruments used in the performance of the shown calibration have traceability to the National Institute of Standards and Technology (NIST). The uncertainty ratio between the calibration standards (DM.STD.) and the Unit Under Test (UUT) is a minimum of 4:1, unless otherwise noted. Calibration has been performed according to the shown procedure. The use of IAS/ILAC logo indicates calibrations are in accordance to ISO/IEC 17025:2017.

Dick Munns Company • 11133 Winners Circle, Los Alamitos, CA 90720
Phone: 714-827-1215 • www.dickmunns.com

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

Issuing Date:

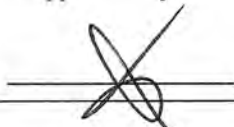
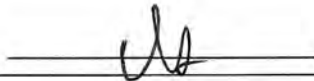
Approved By:

Cal. Technician:

Calibrated at: ☒ Lab

☐ On-Site (Customer's)

5-23-2023

Page 1 of 1

Report and Certificate of Calibration



www.Cal-Cert.com

Toll Free
800-556-4682

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620



Revision to Report #: 26398-201251-5 to correct serial number.

Date: 2/20/23

Report #: 26398-201251-5-01

Customer PO#: 1079

Customer Name: PFS TECO

Customer Address: 11785 SE Highway 212

City: Clackamas

State: OR

Zip: 97015

Contact: Ethan Frederick

Service Address: 5777 SE International Way Milwaukie, OR 97222

Calibration Standards

10-00515 | Steel Rule | SPI | SN: 00515 | Cal: 06/01/2022 | Due: 05/31/2023 | Vendor: Cal-Cert | Range: 24 Inches | Report #: 24589-30769-3616
LP-01346 | Thermo-Hygrometer | Comark | SN: 06210350198 | Cal: 02/07/2022 | Due: 02/28/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 22748-67215-3486

Instrument Data

Calibration Date:	October 21, 2022	Reference:	Manufacturer's Spec
Calibration Due Date:	October 21, 2023	Cal-Cert Procedure:	CP-115
Calibration Frequency:	12 Months	Indicating System:	Scaling
Manufacturer:	Starrett	Temperature:	69 °F
Type:	Tape Measure	Humidity:	3% RH
Model Number:	Exact	Asset #:	207
Serial #:	138054-2203-00002249	Service Location:	Cal-Cert Lab
Capacity:	192.00 Inches	As Found:	Pass
		As Left:	Pass

Instrument Range:	192.000 Inches	Range Resolution:	0.031 Inches
	Calibration Standard	As Found Reading	Verification Reading #1
		Verification Reading #2	
	24.000	24.000	24.000
	48.000	48.000	48.000
	96.000	96.000	96.000
	120.000	120.000	120.000
	144.000	144.000	144.000
	168.000	168.000	168.000
	192.000	192.000	192.000

Expanded Uncertainty ± 0.03580 Inches

Remarks:

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs. Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Cameron Walling

Date: October 21, 2022

Technical Manager: Marshall Doyle

Signature:

Mr Doyle

Report and Certificate of Calibration



Toll Free
800-556-4662

www.Cal-Cert.com

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-0620



Report #: 26398-201253-5 **Customer PO#:** 1079
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212
City: Clackamas **State:** OR **Zip:** 97015
Contact: Ethan Frederick
Service Address: 5777 SE International Way Milwaukie, OR 97222

Calibration Standards

LP-00397 | Gage Block Set | Mitutoyo | SN: 509020 | Cal: 11/25/2020 | Due: 11/30/2022 | Vendor: BHD Test and Measurement | Report #: 112520A
LP-01346 | Thermo-Hygrometer | Comark | SN: 06210350198 | Cal: 02/07/2022 | Due: 02/28/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 22748-67215-3486

Instrument Data

Calibration Date:	October 21, 2022	Reference:	ASME B89.1.14 2018
Calibration Due Date:	October 21, 2023	Cal-Cert Procedure:	CP-008
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	Mitutoyo	Temperature:	69 °F
Type:	Digital Caliper	Humidity:	38% RH
Model Number:	CD-P6"S	Asset #:	208
Serial #:	B22159310	Service Location:	Cal-Cert Lab
Capacity:	6 Inches	As Found:	PASS
Resolution:	0.0005 Inches	As Left:	PASS

Instrument Range:	6.0000 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	0.3000	0.0010
0.6000	0.6005	0.6005	0.6005	0.0010
1.2000	1.2000	1.2000	1.2000	0.0010
2.4000	2.4005	2.4005	2.4005	0.0010
3.5000	3.5000	3.5000	3.5000	0.0010
5.0000	5.0005	5.0005	5.0005	0.0010
6.0000	6.0005	6.0005	6.0005	0.0010

Expanded Uncertainty ± 0.00036 Inches

Verifications (for information only)			
	Target	Measured	Tolerance ±
Resolution Check	0.1005	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 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Cameron Walling **Date:** October 21, 2022
Technical Manager: Marshall Doyle **Signature:**

Caliper CF-008-01

Revision 16 9/19/2022

Report and Certificate of Calibration



www.Cal-Cert.com



Toll Free
800-356-1662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620

Report #: 28134-206391-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
19-01135 | Thermocouple Meter | Tegam | SN: T-312250 | Cal: 08/01/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 2,450 °F | Report #: 25315-30977-3646

Instrument Data

Calibration Date:	February 28, 2023	Reference:	NAVAIR 17-20.ST-95
Recommended Due Date:	February 28, 2024	Cal-Cert Procedure:	CP-013
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	National Instruments	Temperature:	70 °F
Type:	Data Logger	Humidity:	31% RH
Model Number:	NI 9213	Asset #:	215 Booth 1
Serial #:	1B182FB	Service Location:	Service Address
Resolution:	0.1 °F	As Found:	Pass
Capacity:	2500 °F	As Left:	Pass
Tolerance:	± 3.0 °F		
Additional Error	± - °F		

Type K Thermocouple METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Tunnel	0.00	0.20	0.20	0.20	0.20	0.346
	500.00	500.30	500.30	500.30	0.30	
	1000.00	1000.40	1000.40	1000.40	0.40	
	1500.00	1500.40	1500.40	1500.40	0.40	
	2000.00	2000.50	2000.50	2000.50	0.50	
	2400.00	2400.70	2400.70	2400.70	0.70	

Type K Thermocouple METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Flue	0.00	0.10	0.10	0.10	0.10	0.346
	500.00	500.30	500.30	500.30	0.30	
	1000.00	1000.30	1000.30	1000.30	0.30	
	1500.00	1500.30	1500.30	1500.30	0.30	
	2000.00	2000.50	2000.50	2000.50	0.50	
	2400.00	2400.60	2400.60	2400.60	0.60	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Filter A	0.00	0.10	0.10	0.10	0.10	0.346
	500.00	500.10	500.10	500.10	0.10	
	1000.00	1000.20	1000.20	1000.20	0.20	
	1500.00	1500.30	1500.30	1500.30	0.30	
	2000.00	2000.30	2000.30	2000.30	0.30	
	2400.00	2400.40	2400.40	2400.40	0.40	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Back	0.00	0.10	0.10	0.10	0.10	0.346
	500.00	500.00	500.00	500.00	0.00	
	1000.00	1000.20	1000.20	1000.20	0.20	
	1500.00	1500.50	1500.50	1500.50	0.50	
	2000.00	2000.60	2000.60	2000.60	0.60	
	2400.00	2400.70	2400.70	2400.70	0.70	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Catgalyst	0.00	-0.30	-0.30	-0.30	-0.30	0.346
	500.00	499.90	499.90	499.90	-0.10	
	1000.00	1000.10	1000.10	1000.10	0.10	
	1500.00	1500.10	1500.10	1500.10	0.10	
	2000.00	2000.10	2000.10	2000.10	0.10	
	2400.00	2400.20	2400.20	2400.20	0.20	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Meter A	0.00	-0.50	-0.50	-0.50	-0.50	0.346
	500.00	499.70	499.70	499.70	-0.30	
	1000.00	999.90	999.90	999.90	-0.10	
	1500.00	1500.00	1500.00	1500.00	0.00	
	2000.00	2000.00	2000.00	2000.00	0.00	
	2400.00	2400.00	2400.00	2400.00	0.00	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Left	0.00	-0.50	-0.50	-0.50	-0.50	0.346
	500.00	499.70	499.70	499.70	-0.30	
	1000.00	999.70	999.70	999.70	-0.30	
	1500.00	1500.00	1500.00	1500.00	0.00	
	2000.00	2000.10	2000.10	2000.10	0.10	
	2400.00	2400.20	2400.20	2400.20	0.20	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Right	0.00	-0.60	-0.60	-0.60	-0.60	0.346
	500.00	499.70	499.70	499.70	-0.30	
	1000.00	999.80	999.80	999.80	-0.20	
	1500.00	1499.80	1499.80	1499.80	-0.20	
	2000.00	1999.90	1999.90	1999.90	-0.10	
	2400.00	2400.00	2400.00	2400.00	0.00	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Filter B	0.00	0.00	0.00	0.00	0.00	0.346
	500.00	500.80	500.80	500.80	0.80	
	1000.00	1000.60	1000.60	1000.60	0.60	
	1500.00	1500.20	1500.20	1500.20	0.20	
	2000.00	2000.00	2000.00	2000.00	0.00	
	2400.00	2399.70	2399.70	2399.70	-0.30	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Top	0.00	-0.80	-0.80	-0.80	-0.80	0.346
	500.00	499.30	499.30	499.30	-0.70	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.60	1499.60	1499.60	-0.40	
	2000.00	1999.60	1999.60	1999.60	-0.40	
	2400.00	2399.70	2399.70	2399.70	-0.30	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Bottom	0.00	-1.00	-1.00	-1.00	-1.00	0.346
	500.00	499.20	499.20	499.20	-0.80	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.50	1499.50	1499.50	-0.50	
	2000.00	1999.60	1999.60	1999.60	-0.40	
	2400.00	2399.60	2399.60	2399.60	-0.40	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Meter B	0.00	-0.80	-0.80	-0.80	-0.80	0.346
	500.00	499.30	499.30	499.30	-0.70	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.50	1499.50	1499.50	-0.50	
	2000.00	1999.60	1999.60	1999.60	-0.40	
	2400.00	2399.50	2399.50	2399.50	-0.50	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Meter C	0.00	-1.20	-1.20	-1.20	-1.20	0.346
	500.00	499.00	499.00	499.00	-1.00	
	1000.00	999.20	999.20	999.20	-0.80	
	1500.00	1499.30	1499.30	1499.30	-0.70	
	2000.00	1999.30	1999.30	1999.30	-0.70	
	2400.00	2399.30	2399.30	2399.30	-0.70	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Filter C	0.00	-1.00	-1.00	-1.00	-1.00	0.346
	500.00	499.20	499.20	499.20	-0.80	
	1000.00	999.40	999.40	999.40	-0.60	
	1500.00	1499.50	1499.50	1499.50	-0.50	
	2000.00	1999.50	1999.50	1999.50	-0.50	
	2400.00	2399.50	2399.50	2399.50	-0.50	

Manufacturer: National Instruments

Type: Data Logger

Serial #: 1B182FB

Type T Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Ambient	0.00	0.00	0.00	0.00	0.00	0.346
	20.00	17.70	17.70	17.70	-2.30	
	40.00	37.80	37.80	37.80	-2.20	
	60.00	57.70	57.70	57.70	-2.30	
	80.00	77.90	77.90	77.90	-2.10	
	100.00	97.90	97.90	97.90	-2.10	

Remarks:

15 Channels tested. Ambient is Type T, tested from 0 to 100 °F per customer request.

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: February 28, 2023

Technical Manager Marshall Doyle

Signature:



Report and Certificate of Calibration



www.Cal-Cert.com



Toll Free
800-356-1662

Address
5777 SE International Way
Milwaukie, OR 97222

Local
503-654-9620

Report #: 28134-206391-14 **Customer PO#:** 1090
Customer Name: PFS TECO
Customer Address: 11785 SE Highway 212 Ste 305
City: Clackamas **State:** OR **Zip:** 97015
Contact: Aaron Kravitz
Service Address: 11785 SE Highway 212 Ste 305 Clackamas, OR 97015

Calibration Standards

19-00269 | Thermo-Hygrometer | Comark | SN: 6237360167 | Cal: 09/14/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 122 °F 95 %RH | Report #: 25699-30694-3486
19-01135 | Thermocouple Meter | Tegam | SN: T-312250 | Cal: 08/01/2022 | Due: 08/31/2023 | Vendor: Cal-Cert | Range: 2,450 °F | Report #: 25315-30977-3646

Instrument Data

Calibration Date:	February 28, 2023	Reference:	NAVAIR 17-20.ST-95
Recommended Due Date:	February 28, 2024	Cal-Cert Procedure:	CP-013
Calibration Frequency:	12 Months	Indicating System:	Digital
Manufacturer:	National Instruments	Temperature:	72 °F
Type:	Data Logger	Humidity:	30% RH
Model Number:	NI 9213	Asset #:	215 Booth 1
Serial #:	1B182FB	Service Location:	Service Address
Resolution:	0.1 °F	As Found:	Pass
Capacity:	2500 °F	As Left:	Pass
Tolerance:	± 2.0 °F		
Additional Error	± - °F		

Type K Thermocouple METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Tunnel	0.00	-0.20	-0.20	-0.20	-0.20	0.346
	500.00	499.80	499.80	499.80	-0.20	
	1000.00	1000.00	1000.00	1000.00	0.00	
	1500.00	1500.10	1500.10	1500.10	0.10	
	2000.00	2000.10	2000.10	2000.10	0.10	
	2400.00	2400.10	2400.10	2400.10	0.10	

Type K Thermocouple METER FUNCTION

Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Flue	0.00	-0.40	-0.40	-0.40	-0.40	0.346
	500.00	499.60	499.60	499.60	-0.40	
	1000.00	999.70	999.70	999.70	-0.30	
	1500.00	1499.90	1499.90	1499.90	-0.10	
	2000.00	1999.80	1999.80	1999.80	-0.20	
	2400.00	2400.00	2400.00	2400.00	0.00	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Filter A	0.00	-0.60	-0.60	-0.60	-0.60	0.346
	500.00	499.50	499.50	499.50	-0.50	
	1000.00	999.60	999.60	999.60	-0.40	
	1500.00	1499.70	1499.70	1499.70	-0.30	
	2000.00	1999.80	1999.80	1999.80	-0.20	
	2400.00	2399.80	2399.80	2399.80	-0.20	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Back	0.00	-0.70	-0.70	-0.70	-0.70	0.346
	500.00	499.50	499.50	499.50	-0.50	
	1000.00	999.50	999.50	999.50	-0.50	
	1500.00	1499.60	1499.60	1499.60	-0.40	
	2000.00	1999.70	1999.70	1999.70	-0.30	
	2400.00	2399.60	2399.60	2399.60	-0.40	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Catgalyst	0.00	-0.70	-0.70	-0.70	-0.70	0.346
	500.00	499.40	499.40	499.40	-0.60	
	1000.00	999.60	999.60	999.60	-0.40	
	1500.00	1499.60	1499.60	1499.60	-0.40	
	2000.00	1999.70	1999.70	1999.70	-0.30	
	2400.00	2399.70	2399.70	2399.70	-0.30	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Meter A	0.00	-1.30	-1.30	-1.30	-1.30	0.346
	500.00	498.80	498.80	498.80	-1.20	
	1000.00	999.10	999.10	999.10	-0.90	
	1500.00	1499.10	1499.10	1499.10	-0.90	
	2000.00	1999.10	1999.10	1999.10	-0.90	
	2400.00	2399.10	2399.10	2399.10	-0.90	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Left	0.00	-1.30	-1.30	-1.30	-1.30	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.20	1499.20	1499.20	-0.80	
	2000.00	1999.20	1999.20	1999.20	-0.80	
	2400.00	2399.20	2399.20	2399.20	-0.80	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Right	0.00	-1.40	-1.40	-1.40	-1.40	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.00	1499.00	1499.00	-1.00	
	2000.00	1999.00	1999.00	1999.00	-1.00	
	2400.00	2399.10	2399.10	2399.10	-0.90	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Filter B	0.00	0.00	0.00	0.00	0.00	0.346
	500.00	500.60	500.60	500.60	0.60	
	1000.00	1000.30	1000.30	1000.30	0.30	
	1500.00	1500.10	1500.10	1500.10	0.10	
	2000.00	1999.80	1999.80	1999.80	-0.20	
	2400.00	2399.50	2399.50	2399.50	-0.50	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Top	0.00	-1.40	-1.40	-1.40	-1.40	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.10	1499.10	1499.10	-0.90	
	2000.00	1999.00	1999.00	1999.00	-1.00	
	2400.00	2399.00	2399.00	2399.00	-1.00	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Bottom	0.00	-1.50	-1.50	-1.50	-1.50	0.346
	500.00	498.80	498.80	498.80	-1.20	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.00	1499.00	1499.00	-1.00	
	2000.00	1999.00	1999.00	1999.00	-1.00	
	2400.00	2399.00	2399.00	2399.00	-1.00	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Meter B	0.00	-1.30	-1.30	-1.30	-1.30	0.346
	500.00	499.00	499.00	499.00	-1.00	
	1000.00	999.00	999.00	999.00	-1.00	
	1500.00	1499.20	1499.20	1499.20	-0.80	
	2000.00	1999.20	1999.20	1999.20	-0.80	
	2400.00	2399.10	2399.10	2399.10	-0.90	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Meter C	0.00	-1.20	-1.20	-1.20	-1.20	0.346
	500.00	498.90	498.90	498.90	-1.10	
	1000.00	999.10	999.10	999.10	-0.90	
	1500.00	1499.20	1499.20	1499.20	-0.80	
	2000.00	1999.20	1999.20	1999.20	-0.80	
	2400.00	2399.20	2399.20	2399.20	-0.80	

Type K Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Filter C	0.00	-1.20	-1.20	-1.20	-1.20	0.346
	500.00	499.10	499.10	499.10	-0.90	
	1000.00	999.20	999.20	999.20	-0.80	
	1500.00	1499.30	1499.30	1499.30	-0.70	
	2000.00	1999.30	1999.30	1999.30	-0.70	
	2400.00	2399.20	2399.20	2399.20	-0.80	

Manufacturer: National Instruments

Type: Data Logger

Serial #: 1B182FB

Type T Thermocouple METER FUNCTION						
Channel	Calibration Standard	UUT As Found	UUT As Left Reading 1	UUT As Left Reading 2	As Left Error	Expanded Uncertainty±
Ambient	0.00	-1.40	-1.40	-1.40	-1.40	0.346
	20.00	18.80	18.80	18.80	-1.20	
	40.00	38.80	38.80	38.80	-1.20	
	60.00	58.70	58.70	58.70	-1.30	
	80.00	78.80	78.80	78.80	-1.20	
	100.00	98.70	98.70	98.70	-1.30	

Remarks:

15 Channels tested. Ambient is Type T, tested from 0 to 100 °F per customer request.

We sincerely thank you for your business. Please call us at 503-654-9620 for all your sales and calibration needs.
Cleaning and preventative maintenance were performed as part of this service.

Cal-Cert is accredited by A2LA under Calibration Laboratory Code #4986.01.
A2LA 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/NCSL Z540.1, 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: Jon Rau

Date: February 28, 2023

Technical Manager Marshall Doyle

Signature:



CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E04NI61E15A0574	Reference Number:	48-402546580-1
Cylinder Number:	CC121798	Cylinder Volume:	143.7 CF
Laboratory:	124 - Los Angeles (SAP) - CA	Cylinder Pressure:	2016 PSIG
PGVP Number:	B32022	Valve Outlet:	590
Gas Code:	CO,CO2,O2,BALN	Certification Date:	Sep 23, 2022

Expiration Date: Sep 23, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON MONOXIDE	4.250 %	4.306 %	G1	+/- 0.6% NIST Traceable	09/23/2022
CARBON DIOXIDE	17.00 %	17.01 %	G1	+/- 0.6% NIST Traceable	09/23/2022
OXYGEN	17.00 %	17.11 %	G1	+/- 0.7% NIST Traceable	09/23/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12061520	CC354777	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024
NTRM	98051002	SG9150866BAL	12.05 % OXYGEN/NITROGEN	+/- 0.7%	Dec 14, 2023
NTRM	08061402	CC267714	1.959 %W CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jul 02, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS 6E CO2	NDIR	Sep 16, 2022
SIEMENS 6E CO HIGH	NDIR	Sep 06, 2022
SIEMENS OXYMAT 6	PARAMAGNETIC	Sep 12, 2022

Triad Data Available Upon Request



Approved for Release



CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PXPKG TUALATIN OR H
10450 SW TUALATIN SHERWOOD ROAD
TUALATIN OR 97062-9547

Certificate Issuance Date: 10/16/2019

Praxair Order Number: 71120745

Part Number: NI CD10CO33E-AS

Customer PO Number: 79106732

Fill Date: 10/08/2019

Lot Number: 70086928102

Cylinder Style & Outlet: AS

CGA 590

Cylinder Pressure and Volume: 2000 psig 140 ft³

Certified Concentration

Expiration Date:	10/16/2027	NIST Traceable
Cylinder Number:	CC139173	Expanded Uncertainty
10.09 %	Carbon dioxide	± 0.4 %
2.53 %	Carbon monoxide	± 0.6 %
10.48 %	Oxygen	± 0.4 %
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 10/16/2019

Term: 96 Months

Expiration Date: 10/16/2027

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 Oxygen IR Broadening effect. O2 responses have been corrected for CO2 interference.

Analytical Data:

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

1. Component: Carbon dioxide

Requested Concentration: 10 %

Certified Concentration: 10.09 %

Instrument Used: Horiba VIA-510 S/N 20C194WK

Analytical Method: NDIR

Last Multipoint Calibration: 09/18/2019

First Analysis Data:				Date
Z:	0	R:	14	10/16/2019
C:	10.09	Conc:	10.09	
R:	14	Z:	0	
C:	10.1	Conc:	10.1	
Z:	0	R:	14.01	
C:	10.1	Conc:	10.1	
UOM:	%	Mean Test Assay:	10.09	%

Reference Standard: Type / Cylinder #: GMIS / CC164230

Concentration / Uncertainty: 14.00 % ±0.265%

Expiration Date: 04/16/2027

Traceable to: SRM # / Sample # / Cylinder #: SRM 1675b / 6-F-51 / CAL014538

SRM Concentration / Uncertainty: 13.963% / ±0.034%

SRM Expiration Date: 05/16/2022

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

2. Component: Carbon monoxide

Requested Concentration: 2.5 %

Certified Concentration: 2.53 %

Instrument Used: Horiba VIA-510 S/N UB9UCSYX

Analytical Method: NDIR

Last Multipoint Calibration: 09/19/2019

First Analysis Data:				Date
Z:	0	R:	5	10/16/2019
C:	2.53	Conc:	2.53	
R:	5	Z:	0	
C:	2.53	Conc:	2.53	
Z:	0	R:	5.01	
C:	2.54	Conc:	2.54	
UOM:	%	Mean Test Assay:	2.53	%

Reference Standard: Type / Cylinder #: GMIS / CC242633

Concentration / Uncertainty: 5.00 % ±0.543%

Expiration Date: 04/03/2025

Traceable to: SRM # / Sample # / Cylinder #: SRM 2642a / 51-D-23 / FF23106

SRM Concentration / Uncertainty: 7.859% / ±0.039%

SRM Expiration Date: 07/15/2019

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

3. Component: Oxygen

Requested Concentration: 10.5 %

Certified Concentration: 10.48 %

Instrument Used: OXYMAT 5E

Analytical Method: Paramagnetic

Last Multipoint Calibration: 09/18/2019

First Analysis Data:				Date
Z:	0	R:	9.88	10/16/2019
C:	10.49	Conc:	10.48	
R:	9.88	Z:	0	
C:	10.49	Conc:	10.48	
Z:	0	R:	9.89	
C:	10.5	Conc:	10.49	
UOM:	%	Mean Test Assay:	10.48	%

Reference Standard: Type / Cylinder #: NTRM / DT0010384

Concentration / Uncertainty: 9.875 % ±0.4%

Expiration Date: 11/18/2022

Traceable to: SRM # / Sample # / Cylinder #: NTRM / 170701 / NTRM DT0010384

SRM Concentration / Uncertainty: 9.875% / ±0.040%

SRM Expiration Date: 11/18/2022

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

Analyzed By

Jose Vasquez

Certified By

Jenna Lockman