



TEST REPORT

REPORT NUMBER: 102366578MID-002R2
REPORT DATE: December 22, 2015
REVISED REPORT DATE: March 5, 2021
REVISED REPORT DATE: February 2, 2022

EVALUATION CENTER
Intertek Testing Services NA Inc.
8431 Murphy Drive
Middleton, WI 53562

RENDERED TO
ARDISAM, INC.
1690 ELM STREET
CUMBERLAND, WI 54829

PRODUCT EVALUATED:

MODEL SERENITY PELLET FUEL ROOM HEATER

Report of Testing Model Serenity Pellet Fuel Room Heater for compliance as an “Affected Wood Heater” with the applicable requirements of the following criteria: EPA 40 CFR Part 60 “Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces”, March 16, 2015.

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REVISION SUMMARY

DATE	SUMMARY
3/5/2021	Section II.A Pretest Information – Updated conditioning burn information from 10 hours to 50 hours performed by the manufacturer. Section II.D Description of test runs – Added statement regarding anomalies, test validity, and test appropriateness.
2/2/2022	Section II.E, Table 6b – Added table to include efficiency data based on current fuel analysis of Marth pellets. Section III.C – Added information regarding the use of the default oak fuel analysis for the efficiency data. Included information regarding the current fuel analysis for Marth pellets.

I. INTRODUCTION

Intertek Testing Services NA (Intertek) has conducted testing for Ardisam, Inc., on model Serenity Pellet Burning Room Heater to evaluate all applicable performance requirements included in “Determination of particulate matter emissions from wood heaters.”

***I.A* PURPOSE OF TEST**

The test was conducted to determine if the unit is in accordance with U.S EPA requirements under EPA 40 CFR Part 60 “Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces”. This evaluation was conducted on December 7, 2015. The following test methods were applicable:

ASTM E2515-11- Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel

ASTM E2779-10 - Standard Test Method for Determining Particulate Matter Emissions from Pellet Heaters

CSA B415.1-10 - Performance Testing of Solid-Fuel-Burning Heating Appliances

***I.B* LABORATORY**

The tests on the model Serenity Pellet Burning Heater were conducted at the Intertek testing Services Laboratory located at 8431 Murphy Drive, Middleton, WI, 53562. The laboratory is accredited by the U.S. EPA, Certificate Number 3. The test was conducted by Ken Slater and observed by Seth Bailey of Ardisam, Inc.

***I.C* DESCRIPTION OF UNIT**

The model Serenity Pellet Fuel Room Heater is constructed of sheet steel. The outer dimensions are 20.25-inches deep, 34-inches high, and 18.25-inches wide. The unit has a door located on the front with a viewing glass.

(See product drawings.)

Proprietary drawings and manufacturing methods are on file at Intertek in (Intertek location)

I.D REPORT ORGANIZATION

This report includes summaries of all data necessary to determine compliance with the regulations. Raw data, calibration records, intermediate calculations, drawings, specifications and other supporting information are contained in appendices to this report.

II. SUMMARY

II.A PRETEST INFORMATION

A sample was submitted to Intertek directly from the client. The sample was not independently selected for testing. The test unit was received at Intertek in Middleton, WI on December 7, 2015 and was shipped via the client. The unit was inspected upon receipt and found to be in good condition. The unit was set up following the manufacturer's instructions without difficulty.

Prior to beginning the emissions tests, the manufacturer operated the unit for a minimum of 50 hours at high-to-medium burn rates to break in the stove. This break-in period was performed by the manufacturer's staff and data is included in the final report. The unit was found to be operating satisfactory during this break-in. The 50 plus hours of condition burning was conducted from November 10, 2015 to November 12, 2015. The fuel used for the break-in process was Indeck premium hardwood wood pellets. 129.2 lbs. of pellets were used in the conditioning process.

Following the pre-burn break-in process the unit was allowed to cool and ash and residue was removed from the firebox. The unit's chimney system and laboratory dilution tunnels were cleaned using standard wire brush chimney cleaning equipment. On December 7, 2015 the unit was set-up for testing.

II.B INFORMATION LOG

II.B(1) TEST STANDARD

On December 7, 2015, the unit was tested for EPA emissions. For pellet stoves, the test was conducted in accordance with ASTM E2779-10. The fuel used for the test run was premium-Grade Pellets (Marthwood).

The applicable EPA regulatory limits are:

Step 1 – 2015 – 4.5 grams per hour.

Step 2 – 2020 – 2.0 grams per hour.

II.B(2) Deviation from Standard Method

No deviations from the standards were performed, however, only the applicable sections from each standard were used during all testing.

II.C SUMMARY OF TEST RESULTS

The appliance tests resulted in the following performance:

Particulate Emissions: 1.119 g/hr

Carbon Monoxide Emissions: 5.37 g/hr

Heating Efficiency: 69.8% (Higher Heating Value Basis)

II.D DESCRIPTION OF TEST RUNS

RUN #1 (December 7, 2015): The test for pellet heaters is a continuous test with three separate burn rates. At 9:20 the unit was started and operated for a minimum of 1 hour for the pretest operation. At 10:20 the unit was set to the maximum feed rate (level 5) with a burn rate of 1.78 kg/hr (wet), the scale was tared and a 25-lb weight was added to the scale to determine feed rate of the fuel, and the sampling system was started. At 11:20, the system #2 sampling filter was changed out and the unit was set to $\leq 50\%$ feed rate (level 3) with a burn rate of 1.22 kg/hr (wet). At 13:20, the heater was changed to the minimum feed rate (level 1) with a burn rate of 0.79 kg/hr (wet). At 16:20, testing was completed. The total burn time was 360 minutes.

The test run has been found to be appropriate, with no anomalies, and the test run has been validated and is deemed compliant. No negative weight was found on the filters, as the filters and gaskets are weighed together to eliminate filter material transfer to gaskets. All weightings were handled properly, with no negative weight on gaskets or probes.

II.E SUMMARY OF OTHER DATA

TABLE 1. - EMISSIONS

Run Number	Test Date	Burn Rates (kg/hr)(Dry)		Particulate Emission Rate (g/hr)	1 st Hour Emissions (g)	CO Emissions (g/hr)	Heating Efficiency (% HHV)
1	12/7/15	H*	1.70	1.119	1.290	5.37	69.8
		M*	1.17				
		L*	0.75				
		OA*	1.05				

*Notes: H= High burn rate, M= Medium burn rate, L= low burn rate, OA= overall burn rate.

TABLE 2. - TEST FACILITY CONDITIONS

Run	Room Temp. °F before	Room Temp °F after	Baro. Pres. In. Hg before	Baro. Pres. In. Hg after	R.H.% before	R.H.% after	Air Vel. Ft/min before	Air Vel. Ft/min after
1	71	69	29.17	29.03	30.0	27.0	0	0

TABLE 3. - DILUTION TUNNEL FLOW RATE MEASUREMENTS AND SAMPLING DATA

Run No.	Burn Time (min)	Velocity (ft/sec)	Volumetric Flow Rate (dscf/min)	Ave. Temp. (°R)	Sample Volume (DSCF)		Particulate Catch (mg)	
					1	2	1	2
1	360	13.55	145.82	550.60	83.34	84.10	11.80	9.60

TABLE 4. - DILUTION TUNNEL DUAL TRAIN PRECISION

Run No.	Sample Ratios		Total Emissions (g)		% Deviation	g/kg Deviation
	Train 1	Train 2	Train 1	Train 2		
1	629.93	624.20	7.43	5.99	10.73%	0.219

TABLE 5. - GENERAL SUMMARY OF RESULTS

Run No.	Burn Rate (kg/hr)(Dry) (Overall)	Initial Draft (in/H ₂ O)	Run Time (min)	Average Draft (in/H ₂ O)
1	1.099	0.024	360	0.021

TABLE 6a. - CSA B415.1 RESULTS - Using default fuel values for oak

Burn Rate (kg/hr)(Dry)	CO Emissions (g/hr)	Heating Efficiency (% HHV)	Heat Output (Btu/hr)
High – 1.70	5.61	69.5	22,266
Medium – 1.17	1.78	69.4	15,319
Low – 0.75	8.00	67.3	9,575
Overall – 1.05	5.37	69.8	13,831

TABLE 6b. - CSA B415.1 RESULTS - Using fuel values for Marth pellets (10/25/2021)

Burn Rate (kg/hr)(Dry)	CO Emissions (g/hr)	Heating Efficiency (% HHV)	Heat Output (Btu/hr)
High – 1.70	5.24	69.8	21,322
Medium – 1.17	1.67	69.7	14,676
Low – 0.75	7.47	67.7	9,183
Overall – 1.05	5.01	70.1	13,251

III. PROCESS DESCRIPTION

III.A TEST SET-UP DESCRIPTON

A 3" horizontal flue is connected by a 90° elbow and adapters to a standard 6" diameter vertical single wall pipe and insulated chimney system was installed to 15' above floor level. The single wall pipe extended to 8 feet above the floor and insulated chimney extended the remaining height.

III.B AIR SUPPLY SYSTEM

Combustion air enters a 2" inlet pipe located on the back of the heater, which is directed to the pellet burn pot. All gases exit through the 3" flue also located at the back of the heater. The exhaust gases are assisted by a combustion blower.

III.C TEST FUEL PROPERTIES

Wood pellets used for the testing were Marth wood pellets (premium grade), with a majority of the wood species consisting of oak and maple. The pellets have a measured heating value, using the oak default value of 8556 Btu/hr (19887 kJ/kg) and a moisture content of 4.71% on a dry basis and 4.49% on a wet basis.

The efficiency values were created using the oak default fuel values of 19,887 kJ/kg (HHV), 50% carbon, 6.6% hydrogen, and 0.5% ash.

Added efficiency values are included in the report using the fuel values acquired on 10/25/2021 for Marth wood pellets, which are the same brand of pellets used in the 2015 testing. These values are 18,967 kJ/kg (HHV), 46.9% carbon, 6.4% hydrogen, and 0.1% ash.

Including the fuel analysis of Marth wood pellets did increase the efficiency slightly, as it has a lower heating value, compared to the default value for oak wood. However, the increase in efficiency was not significant.

IV. SAMPLING SYSTEMS

IV.A. SAMPLING LOCATIONS

Particulate samples are collected from the dilution tunnel at a point 20 feet from the tunnel entrance. The tunnel has two elbows and two mixing baffles in the system ahead of the sampling section. (See Figure 3.) The sampling section is a continuous 13 foot section of 6 inch diameter pipe straight over its entire length. Tunnel velocity pressure is determined by a standard Pitot tube located 60 inches from the beginning of the sampling section. The dry bulb thermocouple is located six inches downstream from the Pitot tube. Tunnel samplers are located 60 inches downstream of the Pitot tube and 36 inches upstream from the end of this section. (See Figure 1.)

Stack gas samples are collected from the steel chimney section 8 feet ± 6 inches above the scale platform. (See Figure 2.)

IV.A.(1) DILUTION TUNNEL

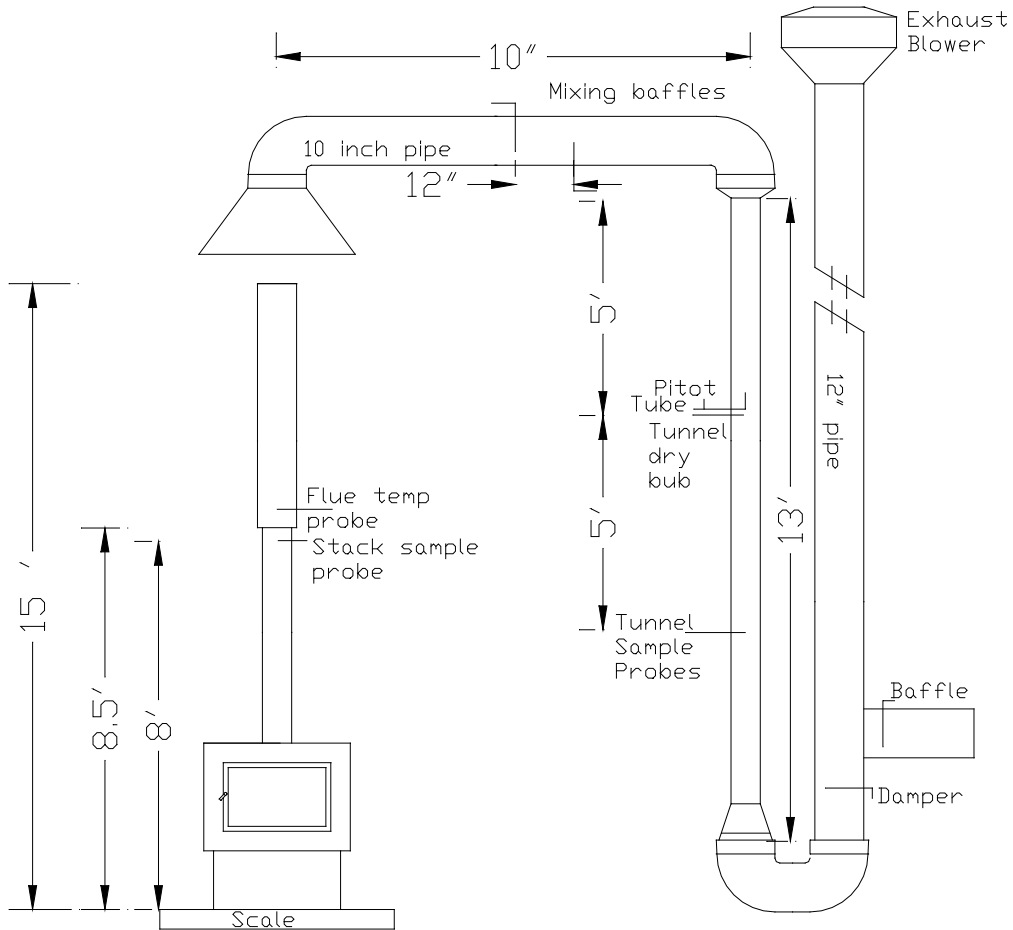
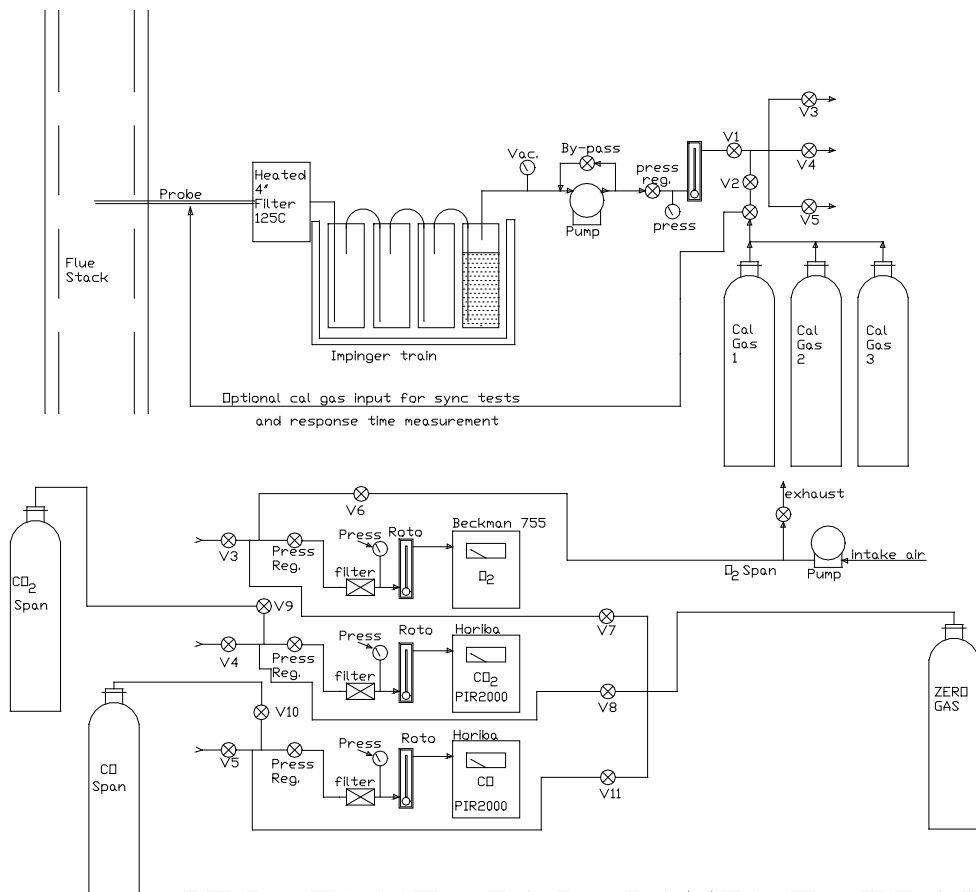


FIGURE 1

IV.B. OPERATIONAL DRAWINGS

IV.B.(1) STACK GAS SAMPLE TRAIN



ITS FLUE GAS SAMPLE TRAIN

FIGURE 2

IV.B.(2). DILUTION TUNNEL SAMPLE SYSTEMS

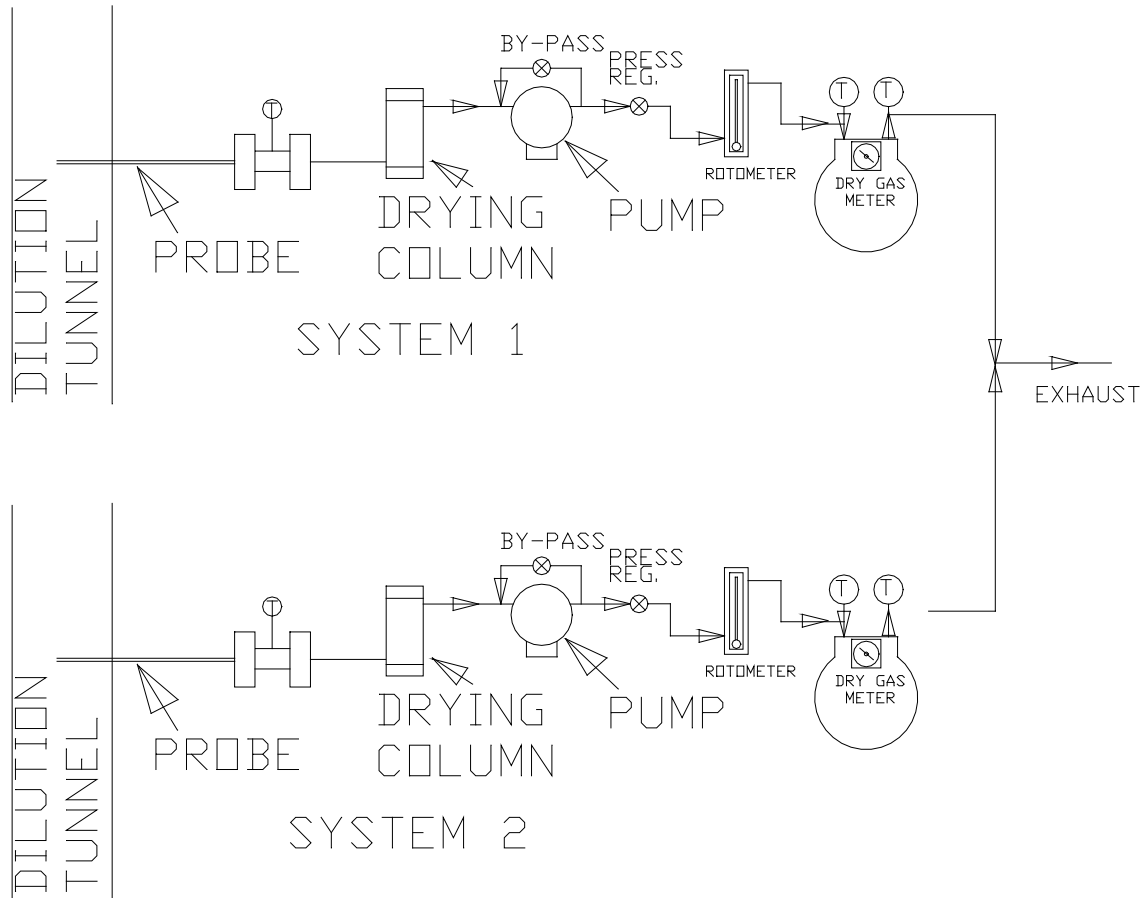


Figure 3

V. SAMPLING METHODS

V.A. PARTICULATE SAMPLING

Particulates were sampled in strict accordance with ASTM E2515-2011. This method uses two identical sampling systems with Gelman A/E 61631 binder free, 47-mm diameter filters. The dryers used in the sample systems are filled with “Drierite” before each test run. In order to measure first-hour emissions rates the a third filter set is prepared at one hour into the test run, the filter sets are changed in one of the two sample trains. The two filter sets used for this train are analyzed individually to determine the first hour and total emissions rate.

VI. QUALITY ASSURANCE

VI.A. INSTRUMENT CALIBRATION

VI.A. (1). DRY GAS METERS

At the conclusion of each test program the dry gas meters are checked against our standard dry gas meter. Three runs are made on each dry gas meter used during the test program. The average calibration factors obtained are then compared with the six-month calibration factor and, if within 5%, the six-month factor is used to calculate standard volumes. Results of this calibration are contained in Appendix D.

An integral part of the post test calibration procedure is a leak check of the pressure side by plugging the system exhaust and pressurizing the system to 10” W.C. The system is judged to be leak free if it retains the pressure for at least 10 minutes.

The standard dry gas meter is calibrated every 6 months using a Spirometer designed by the EPA Emissions Measurement Branch. The process involves sampling the train operation for 1 cubic foot of volume. With readings made to .001 ft³, the resolution is .1%, giving an accuracy higher than the ±2% required by the standard.

VI.A.(2). *STACK SAMPLE ROTAMETER*

The stack sample rotometer is checked by running three tests at each flow rate used during the test program. The flow rate is checked by running the rotometer in series with one of the dry gas meters for 10 minutes with the rotometer at a constant setting. The dry gas meter volume measured is then corrected to standard temperature and pressure conditions. The flow rate determined is then used to calculate actual sampled volumes.

VI.A.(3). *GAS ANALYZERS*

The continuous analyzers are zeroed and spanned before each test with appropriate gases. A mid-scale multi-component calibration gas is then analyzed (values are recorded). At the conclusion of a test, the instruments are checked again with zero, span and calibration gases (values are recorded only). The drift in each meter is then calculated and must not exceed 5% of the scale used for the test.

At the conclusion of each unit test program, a three-point calibration check is made. This calibration check must meet accuracy requirements of the applicable standards. Consistent deviations between analyzer readings and calibration gas concentrations are used to correct data before computer processing. Data is also corrected for interferences as prescribed by the instrument manufacturer's instructions.

VI.B. *TEST METHOD PROCEDURES***VI.B.(1). *LEAK CHECK PROCEDURES***

Before and after each test, each sample train is tested for leaks. Leakage rates are measured and must not exceed 0.02 CFM or 4% of the sampling rate. Leak checks are performed checking the entire sampling train, not just the dry gas meters. Pre-test and post-test leak checks are conducted with a vacuum of 10 inches of mercury. Vacuum is monitored during each test and the highest vacuum reached is then used for the post test vacuum value. If leakage limits are not met, the test run is rejected. During, these tests the vacuum was typically less than 2 inches of mercury. Thus, leakage rates reported are expected to be much higher than actual leakage during the tests.

VI.B.(2). TUNNEL VELOCITY/FLOW MEASUREMENT

The tunnel velocity is calculated from a center point Pitot tube signal multiplied by an adjustment factor. This factor is determined by a traverse of the tunnel as prescribed in EPA Method 1. Final tunnel velocities and flow rates are calculated from EPA Method 2, Equation 6.9 and 6.10. (Tunnel cross sectional area is the average from both lines of traverse.)

Pitot tubes are cleaned before each test and leak checks are conducted after each test.

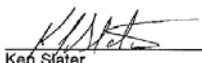
VI.B.(3). PM SAMPLING PROPORTIONALITY

Proportionality was calculated in accordance with ASTM E2515-11. The data and results are included in Appendix C.

VII. CONCLUSION

This test demonstrates that this unit is an affected facility under the definition given in the regulation. The emission rate of 1.119 g/hr meets the EPA requirements for the Step 2 limits.

INTERTEK TESTING SERVICES NA

Evaluated by: 
Ken Slater

Ken Slater
Associate Engineer - Hearth

Reviewed by: 
Brian Ziegler

Brian Ziegler
Lead Engineer - Hearth

CERTIFICATE OF CONFORMITY

Emissions – Pellet Heater

EPA 40 CFR Part 60, Subpart AAA, ASTM E2515-2017, ASTM E2779-2017, CSA B415.1-2010

WHI15 – 223943001

Organization

Ardisam, Inc.
1737 Industrial Avenue,
Cumberland, WI 54829
USA

Product: Serenity

Catalytic: No
Maximum Output: 22,000 Btu/hr
Weighted Average Emissions: 1.12 g/hr
Weighted Average Annual Delivered Efficiency (HHV): 70%
Test Fuel Type: Premium Wood Pellets
Weighted Average CO Emissions Rate (g/min): 0.08
Conformance: Complies with 2020 particulate emissions standard
Product Evaluation No.: 104591879MID-001
Test Report No.: 102366578MID-002

Certification Body: Intertek Testing Services NA, Inc.
Registered Address: 545 E. Algonquin Rd., Arlington Heights, IL 60005, USA
Initial Issue Date: 25-Jan-16
Date of Expiry: 08-Feb-27
Issue Status: 3

This is a certificate of conformity to confirm that the bearer has successfully completed the requirements of the Intertek certification scheme which include the testing of products and the initial assessment. The bearer is subject to continuing assessments of their compliance through surveillance and testing of products samples taken from production (as applicable to the scheme) and has been registered within the scheme for the products detailed. The validity of this certificate is contingent to the listing's status on the Intertek Directory of Building Products: bpdirectory.intertek.com.

Jean-Philippe Kayl
Vice President – Global
Certification



08-Feb-22

Name

Signature

Date

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Version: 11 November 2021 SFT-BCH-OP-19c

Certificate of Conformity WHI15-223943001

Appendix A

Certificate of Conformity #:		Certificate of Conformity Issue Date:	
WHI15-223943001		January 25, 2016	
REVISION #	REVISION DATE	REPORT PAGES	REVISION
0	January 25, 2016	N/A	Original Report Issue
1	March 5, 2021	N/A	5-year renewal
2	February 2, 2022	N/A	Update per EPA deficiency letter issued 1/26/22

Revised Report #:		Report Issue Date:	
102366578MID-002		December 22, 2015	
REVISION #	REVISION DATE	REPORT PAGES	REVISION
0	December 22, 2015	N/A	Original Report Issue
1	March 5, 2021	5, 6	Section II.A Pretest Information – Updated conditioning burn information from 10 hours to 50 hours performed by the manufacturer. Section II.D Description of test runs – Added statement regarding anomalies, test validity, and test appropriateness.
2	February 2, 2022	8, 9	Section II.E, Table 6b – Added table to include efficiency data based on current fuel analysis of Marth pellets. Section III.C – Added information regarding the use of the default oak fuel analysis for the efficiency data. Included information regarding the current fuel analysis for Marth pellets.
		Appendix B	Added efficiency data with Marth fuel analysis.

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From: [Seth Bailey](#)
To: sanchez.rafael@epa.gov
Cc: [Robert Ruppel](#); [Joseph Miller](#); [Scott Thue Intertek](#); [Brian Ziegler Intertek](#)
Subject: 30-day notice of intent to test
Date: Friday, November 6, 2015 3:54:10 PM

To whom this may concern:

We are submitting our 30-day notification to the EPA for testing of our Serenity model pellet wood heater. Testing date will be December 7,8 and 9, 2015 providing EPA approves this notification.

Please see information below.

Manufacturer:

Ardisam, Inc.
1160 8th Ave
Cumberland, WI 54829

Test Lab:

Intertek
8431 Murphy Drive
Middleton, WI 53562
BRIAN.ZIEGLER@intertek.com

Third Party Certifier:

Intertek
Rick.curkeet@intertek.com

Model:

Serenity

Test Dates:

December 7,8,9

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(m) 608.332.3943
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Appendix A

Laboratory Operating Procedure

INTRODUCTION

This document provides a systematic guide for the technician conducting tests to EPA standard requirements. Procedures outlined here, when followed, will result in tests in conformance with ASTM E2779 and ASTM E2515. This guide cannot cover every possible contingency that may develop during a particular test program. Many questions that may arise can be answered by a complete understanding of the test standards and their intent. When in doubt on any detail check with the laboratory manager and be sure you understand the procedures involved.

The primary measurements to be obtained are particulate emission data and efficiency data. The technician's duties include the following steps. It is critical that all spaces on the data forms be properly filled in. Each test must be represented by a complete record of what was done and when.

I. APPLIANCE INSPECTION AND SET-UP

- A. Incoming Inspection
- B. Unit Set-Up

II. SAMPLING SYSTEMS - SET-UP

- A. Gas Analysis
- B. Dilution Tunnel

III. TEST CONDUCT

- A. Pre-Test Fuel Load
- B. Test Fuel Load
- C. Unit Start - up
- D. Test Run

IV. POST TEST PROCEDURE

- A. Leak Checks
- B. Particulate Sample Recovery

The technician running this test must be familiar with the following documents that are to be kept in the laboratory at all times.

1. ASTM E2779
2. ASTM E2515

INTERTEK/WARNOCK HERSEY
SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY
OPERATING PROCEDURES

pg. 2 of 8

I. APPLIANCE INSPECTION AND SET-UP

A. Incoming Inspection

1. Check for completeness of unit including parts, accessories, installation and operating instructions, drawings and specifications, etc. Note any discrepancies or missing parts.
2. Check for shipping damage. If damage has occurred, notify the laboratory manager. In some cases repairs may be made, provided the manufacturer and laboratory manager concur that repairs will not affect the unit's performance. If damage is irreparable, a new unit will need to be obtained.
3. Mark unit with manufacturer's name, model number, work order number, and date received.
4. If unit is safety listed, note label data including listing agency and serial number.

B. Unit Set-Up

1. All units must be operated by the manufacturer or Intertek for a break-in period of 50 hours at a medium burn rate. NOTE: Inserts are tested as if they are freestanding stoves.
2. Once break-in is completed, allow unit to cool then clean unit thoroughly.
3. Prior to placing unit on scale, the scale must be turned on and allowed to warm up for 1-hour minimum.
4. Place unit on scale and align so chimney will be centered in hood. Record the weight of the unit and all accessories. (Do not weigh with chimney attached.)
5. Chimney and connector should be cleaned with a wire brush prior to mounting. Attach chimney and connector then seal all joints. Be sure the single wall stove pipe terminates and insulated pipe starts at proper level above scale platform. Chimney must be supported from scale so that it does not touch test enclosure or hood walls.
6. Plug thermocouples into data acquisition system jacks and verify that all instrumentation is working properly.
7. Dilution tunnel must be cleaned prior to each certification test series, and at anytime a higher burn rate follows a lower burn rate.

II. SAMPLING SYSTEMS SET-UP

A. Gas Analysis

1. All instruments should be turned on and allowed to warm up for 1-hour minimum.

2. Prior to calibrating, make sure that the outlet pressure on each calibration gas bottle reads 10 PSI. Adjust flow meters at each gas analyzer to required flow.

The gas analyzer (CO₂, CO, O₂) is zeroed on nitrogen. The O₂, CO₂ and CO analyzer is spanned with a certified span gas mixture.

Calibrate analyzers as follows:

- a. With calibration switch at "SPAN", adjust all span controls to values specified on span gas label.
- b. Switch to "ZERO" and adjust zero controls to provide 0.00 readout on all analyzers.
- c. Repeat a. and b. until no further adjustment is required.
- d. Record these values on the appropriate data sheet.
- e. Switch to "CAL." and record all analyzer values.

3. Response time synchronization check.

- a. With switch at "SAMPLE" and no fire in unit, allow readings to stabilize (O₂ analyzer should read 20.93, CO and CO₂ should read 0.00).
- b. Switch to "CAL" setting and start the stopwatch. Note the time required for each unit to reach the calibration gas bottle value. If all three analyzers reach this value within 5 seconds of each other, synchronization is adequate. If not, contact the laboratory manager. Synchronization is adjusted by either internal instrument setting or adjustment of sample line length.
- c. Use EPA Method 5H 6.7-6.9 procedures to check calibration of instruments.

4. Sample clean-up train.

- a. Load a new filter in 4-inch glass filter holder.
- b. Load four Impingers as follows:
 - #1: 100 ml. distilled water
 - #2: 100 ml. distilled water
 - #3: Empty
 - #4: 200-300 grams Drierite.
- c. Place Impingers in container and connect with greased "U TUBES". (Grease carefully on bottom half of ball joint so that grease will not get into tubes.)
- d. Connect filter to impinger #1 and sample line to impinger #4.
- e. Connect stack probe to filter.
- f. Leak check system as follows:

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OPERATING PROCEDURES

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- 1) Plug probe.
- 2) Turn on sample system and increase flow rate slowly.
- 3) Set vacuum-adjust valve to obtain a vacuum of 10 inches mercury.
- 4) If sapphire float in rotometer does not stabilize below 10 on scale, system must be resealed.
- 5) Repeat leak-check procedure until satisfactory results are obtained.
- 6) Unplug probe slowly, then decrease flow rate slowly before shutting off system.

g. Just prior to starting test, fill impinger container with ice.

B. Dilution Tunnel Sample Train Set-Up:

1. Filters and holders.
 - a. Clean probes and filter holder front housings carefully and desiccate to a constant weight prior to use.
 - b. Filters and filter probe combinations should be numbered and labeled prior to use.
 - c. Weigh desiccated filters and probe filter units on analytical balance. Record the weights on the appropriate form. Note that the probe and front half of the front filter holder is to be weighed as a unit.
 - d. Carefully assemble the filter holder units and connect to sampling systems.
 - e. System #1 (Filter set #1) will have one filter set and System #2 (Filter set #2 and #3) will have two filter sets. Filter set #2 will be changed 1-hour into the test.
 - e. Change desiccate columns with dry absorbent before each test series.
2. Leak checking.
 - a. Each sample system is to be checked for leakage prior to inserting probes in tunnel.
 - b. Plug probes and start the samplers. Adjust pump bypass valve to produce a vacuum reading of 10 inches mercury. NOTE: During test, highest vacuum recorded is required for posttest leak check.
 - c. Allow vacuum indication to stabilize at 10" mercury, record dry gas meter readings, (DGM₁, DGM₂). At a convenient DGM value start stopwatch. Time for 1 minute then stop vacuum pumps. Record dry gas meter readings again, (DGM₃, DGM₄). NOTE: If rotometer ball is floating above the 5-mm mark, system is leaking too much and all seals should be checked.

- d. Calculate leakage rate as follows.

$$\text{System 1: DGM3-DGM}_1 = \text{CFM}_1$$
$$\text{System 2: DGM4-DGM}_2 = \text{CFM}_2$$

If CFM_1 or CFM_2 is greater than 0.02 cfm, or $1S$ greater than $0.04 \times$ Sample Rate, leakage is unacceptable and system must be resealed. For most tests the sample rate will be 0.25 cfm, thus leakage rates in excess of $0.04 \times 0.25 = 0.010$ cfm are not acceptable.

- e. To prevent contamination, do not insert probes in tunnel until the start of the test run.

III. TEST CONDUCT

A. Pre-Test Fuel Load

1. Fill hopper with pellets, tare the scale, and place a 25lb weight on the scale to measure fuel consumed.

B. Test Fuel Load

1. Determine moisture content of pellets per ASTM E871 by weighing pellets before and after oven drying.
2. Verify and document the pellet manufacturer and grade of pellets used for test.
3. Confirm enough pellets are in the hopper to complete the test, add if necessary. Tare scale and place a 25lb weight on the scale to measure fuel consumed.

C. Unit Start-Up

1. With all doors and air controls closed, zero draft Magnehelic using screw located at bottom of meter.
2. Before lighting a fire turn on dilution tunnel and set flow rate to 140 scfm (approximately 715 fpm) if burn rate is to be less than 3 kg/hr. For higher burn rates set flow for a 150:1 air fuel ratio (see chart for approximate values).
3. Check draft imposed on cold stove. All inlets must be closed and a draft gauge in the chimney. If draft is greater than 0.005 inches water column, adjust tunnel to stack gap until draft is less than 0.005 inches water column.
4. With hot wire anemometer check for ambient airflow around unit (must be less than 50 ft/min).

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5. Tare scale and start fire by turning the unit on per manufacturer's instructions. (Make sure stack sample probe is on the unit.)
6. Once fuel is burning well, operate at high fire for sufficient time to get the fuel burning well. Then adjust settings to intended test run levels.
7. Perform the dilution tunnel traverse as prescribed in ASTM E2515, Section 9.3.2 (Pitot tube should be carefully cleaned prior to each test.)
8. Pretest must burn for a minimum of 1 hour. Record room and flue temperatures.

D. Test Run

1. Stack gas analyzers should be on and in the sample mode.
2. When the 1-hour pre-burn is complete, the test is to be started.
 - a. Insert the sample probes into the tunnel being careful not to hit sides of tunnel with probe tip.
 - b. Check tunnel Pitot tube for proper position.
 - c. Confirm heater is set to the maximum burn rate.
 - d. Record initial readings.
 - e. Turn on probe sample systems and start timing test.
 - f. Tare platform scale and add 25lb weight.
 - g. Every 10 minutes record the following:
 - 1) Dry gas meter readings.
 - 2) Weight remaining.
 - 3) All thermocouple temperatures.
 - 4) Tunnel Pitot tube reading.
 - 5) Draft reading.
 - 6) Rotometer readings.
 - h. Filter temperatures shall not exceed 90°F anytime during the test. If the filters are approaching 90°F turn on cooling pump. Filters must be kept above the dilution tunnel wet bulb temperature in order to prevent condensation.
 - i. Regularly check impinger train for ice level during test.
 - j. At 1-hour, Filter set #2 is to be removed from the dilution tunnel and Filter set #3 is added. The heater is changed from the high burn setting to the ≤50% of maximum burn rate setting and operated for 2-hours.
 - k. At the 3-hour point, the heater is changed to the lowest burn rate setting.
 - l. At the 6-hour point, shut off sample trains and record last reading.
 - m. Record final dry gas meter values.
 - n. Shut down heater per manufacturer's instructions.

IV. POST TEST PROCEDURES

A. Leak Checks

1. Dilution Tunnel
 - a. Remove sample probes from tunnel and plug with rubber stopper.
 - b. Turn on sample system and set vacuum to 10" mercury or to the highest value reached during the test.
 - c. At a convenient value start stopwatch and record the DGM starting value.
 - d. After 1 minute stop sample system and record ending DGM value.
 - e. Calculate leakage rate per pre-test description (see II.B.2.c.).

2. Gas Analyzers
 - a. Set stack sample flow to about 75 mm on the rotometer.
 - b. Plug with rubber stopper.
 - c. Adjust vacuum to 10" mercury.
 - d. Let system stabilize then record rotometer readings.
 - e. If the rotometer readings do not equal zero, check with the laboratory manager.
 - f. SLOWLY unplug probe and decrease flow rate to zero.
 - g. Turn off stack sampling system.
 - h. Zero, span and calibrate the analyzers (see Gas Analysis). RECORD ONLY these meter values.

B. Particulate Sample Recovery

1. Disassemble filter holder and collect all loose material on filters.
2. Weigh and record probes and filters for each train. NOTE: 24 hours of desiccation must pass before final "no change" weight values can be recorded.
3. Weigh and record probes and fillers at 6-hour intervals until weight change between weighing is less than 0.5 mg.

V. DISPOSITION OF TESTED UNIT.

In order to meet the requirements of section 60.533(b)(8) of the EPA's 40CFR Part 60 Standards of Performance for New Residential Wood Heaters, Intertek Testing Services seals certified wood heaters by:

- 1) Applying tamper-indicating tape to the firebox door, ash pan door, and the air controls.

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- 2) Totally covering the unit with stretch wrap and stamping the stretch wrap with our WHI logo at various locations.
- 3) Strapping the door and ash pan closed with plastic banding so that the banding goes both around the unit laterally and from top to bottom. The banding is then stamped with our WHI logo so that the banding can't be simply replaced.
- 4) The certificate is then placed on the top of the unit and a second layer of stretch wrap is applied and stamped with our WHI logo.
- 5) The unit is placed on a pallet and strapped down with additional strapping to keep it on the pallet. It is then shipped back to the manufacturer.

Appendix B

Data and Calculation Forms

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 360
Output Category: Overall

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	69.8%	75.2%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70%	75.6%

Output Rate (kJ/h)	14,580	13,831	(Btu/h)
Burn Rate (kg/h)	1.05	2.31	(lb/h)
Input (kJ/h)	20,881	19,808	(Btu/h)

Test Load Weight (dry kg)	6.30	13.89	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	32		
Test Duration (h)	6.00		

Emissions	Particulate	CO
g/MJ Output	0.08	0.37
g/kg Dry Fuel	1.07	5.12
g/h	1.12	5.37
lb/MM Btu Output	0.18	0.86

Air/Fuel Ratio (A/F)	45.66
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578

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

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

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

Test Duration: 360
 Output Category: Overall

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 14.54
 Burn Rate (dry kg/h): 1.05
 Total Particulate Emissions: 6.71 g

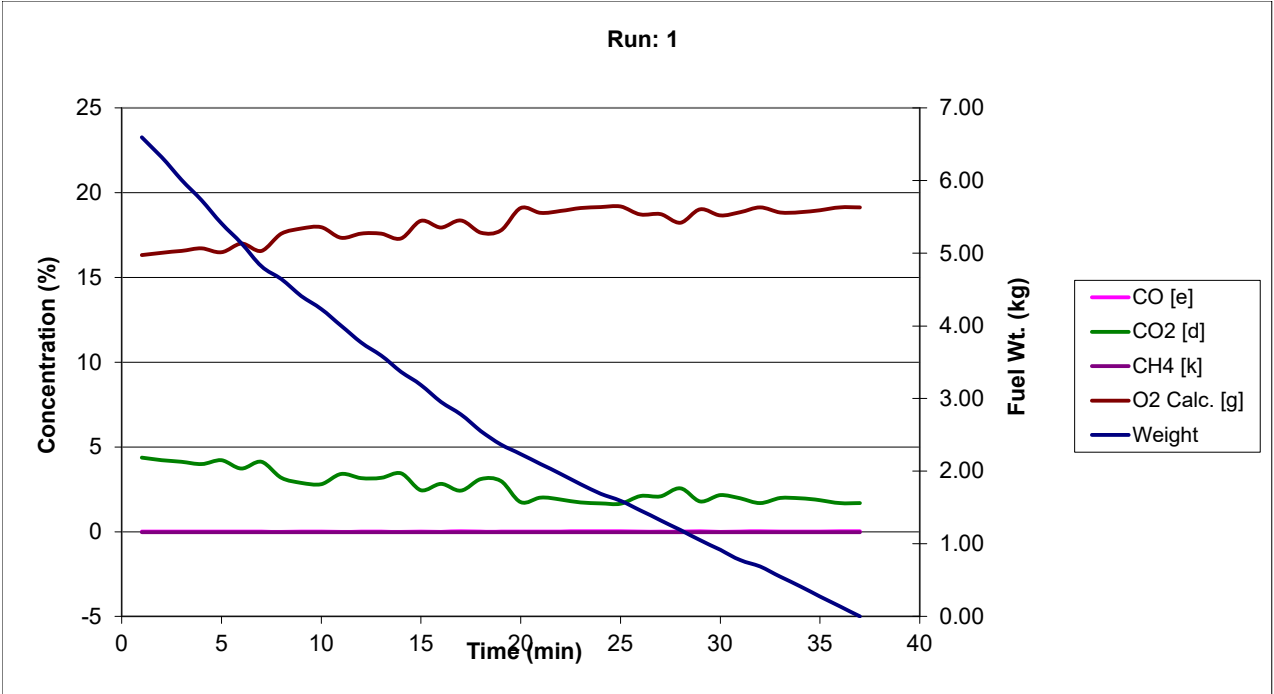
Fuel Data
 D. Fir
 HHV 19,887 kJ/kg
 %C 50
 %H 6.6
 %O 42.9
 %Ash 0.5

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Averages 0.01 2.67 17.85 228.17 69.45

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Composition (%)			Temp. (°F)	
		CO	CO ₂	O ₂	Flue Gas	Room Temp
0	14.54	0.01	4.37	16.10	292.2	70.9
10	13.94	0.01	4.23	16.25	279.8	71.8
20	13.24	0.01	4.13	16.36	297.2	72.2
30	12.63	0.01	3.99	16.51	295.0	71.0
40	11.92	0.01	4.21	16.27	299.7	71.1
50	11.32	0.01	3.72	16.79	280.5	69.9
60	10.62	0.00	4.13	16.36	297.1	69.6
70	10.23	0.00	3.18	17.34	247.8	69.2
80	9.73	0.01	2.89	17.65	244.9	69.8
90	9.33	0.00	2.81	17.71	252.1	69.3
100	8.82	0.00	3.41	17.07	238.6	69.4
110	8.31	0.00	3.16	17.34	250.0	69.7
120	7.92	0.00	3.18	17.32	240.1	68.7
130	7.42	0.00	3.44	17.05	239.2	68.9
140	7.02	0.01	2.45	18.10	245.5	68.9
150	6.51	0.00	2.82	17.69	244.5	68.9
160	6.13	0.03	2.42	18.12	235.8	69.8
170	5.63	0.00	3.11	17.38	243.0	68.8
180	5.22	0.00	2.99	17.49	243.7	69.0
190	4.93	0.01	1.74	18.82	203.8	69.0
200	4.62	0.00	2.02	18.52	203.9	68.4
210	4.32	0.02	1.90	18.67	201.4	69.0
220	4.01	0.03	1.73	18.82	186.4	68.6
230	3.72	0.02	1.68	18.87	189.1	69.7
240	3.51	0.03	1.65	18.91	188.3	69.1
250	3.22	0.00	2.11	18.40	194.5	68.7
260	2.92	0.00	2.08	18.45	194.8	68.8
270	2.62	0.00	2.56	17.95	197.7	68.9
280	2.31	0.03	1.79	18.76	196.3	69.0
290	2.02	0.00	2.16	18.36	188.4	69.8
300	1.71	0.01	1.96	18.57	187.3	69.4
310	1.51	0.03	1.69	18.88	186.6	69.4
320	1.21	0.00	1.99	18.55	186.0	69.4
330	0.92	0.02	1.97	18.57	198.5	69.3
340	0.60	0.01	1.86	18.69	186.4	68.3
350	0.31	0.03	1.69	18.88	196.4	69.0
360	0.00	0.04	1.69	18.88	189.9	69.0

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

All data from a test run are entered on the "Data" sheet. The cells requiring data entry are highlighted. Please note that input data can be entered in either yard/pound or SI units. Select the units in cells F4 and F5 of the "Data" sheet.

Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

Please report any errors or problems to Tony Joseph at CSA.

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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 360
Output Category: Overall

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	70.1%	75.7%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70%	76.0%

Output Rate (kJ/h)	13,968	13,251	(Btu/h)
Burn Rate (kg/h)	1.05	2.31	(lb/h)
Input (kJ/h)	19,915	18,892	(Btu/h)

Test Load Weight (dry kg)	6.30	13.89	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	30		
Test Duration (h)	6.00		

Emissions	Particulate	CO
g/MJ Output	0.08	0.36
g/kg Dry Fuel	1.07	4.78
g/h	1.12	5.01
lb/MM Btu Output	0.19	0.83

Air/Fuel Ratio (A/F)	45.66
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578
 Test Duration: 360
 Output Category: Overall

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

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

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

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 14.54
 Burn Rate (dry kg/h): 1.05
 Total Particulate Emissions: 6.71 g

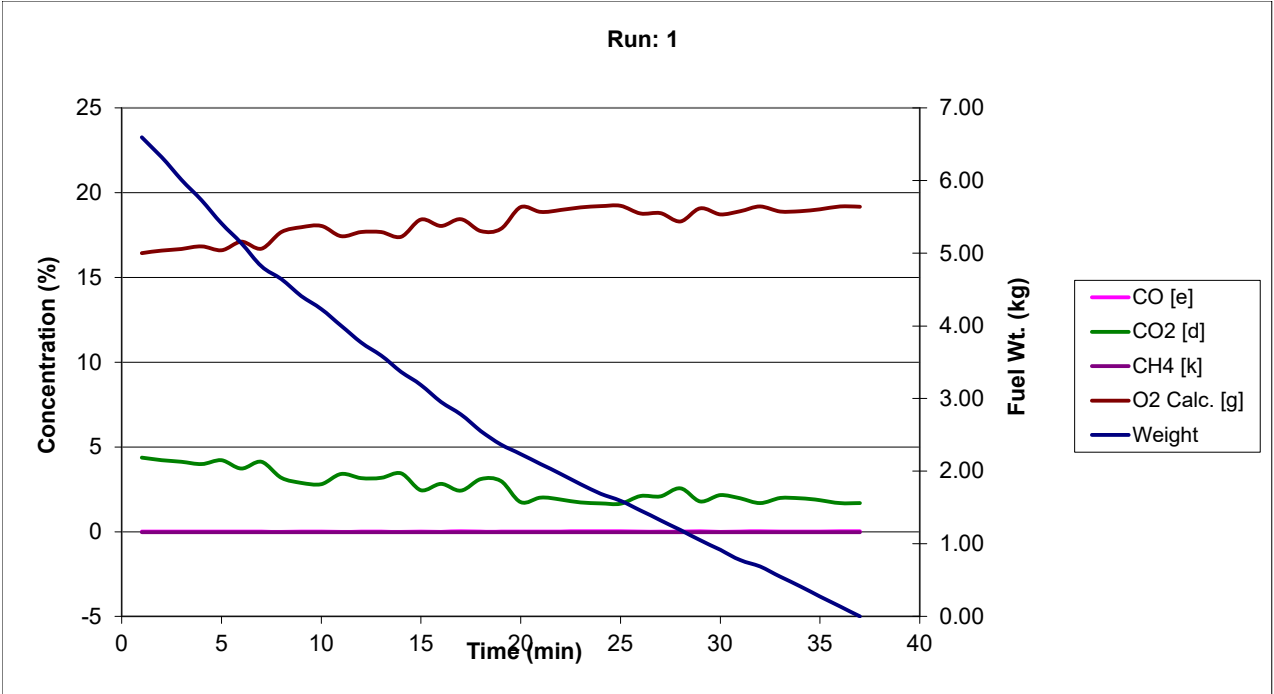
Fuel Data
 Marth
 HHV 18,967 kJ/kg
 %C 46.87
 %H 6.41
 %O 46.62
 %Ash 0.1

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Averages 0.01 2.67 17.85 228.17 69.45
 Temp. (°F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Composition (%)			Flue Gas Temp	Room Temp
		CO	CO ₂	O ₂		
0	14.54	0.01	4.37	16.10	292.2	70.9
10	13.94	0.01	4.23	16.25	279.8	71.8
20	13.24	0.01	4.13	16.36	297.2	72.2
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70	10.23	0.00	3.18	17.34	247.8	69.2
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100	8.82	0.00	3.41	17.07	238.6	69.4
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160	6.13	0.03	2.42	18.12	235.8	69.8
170	5.63	0.00	3.11	17.38	243.0	68.8
180	5.22	0.00	2.99	17.49	243.7	69.0
190	4.93	0.01	1.74	18.82	203.8	69.0
200	4.62	0.00	2.02	18.52	203.9	68.4
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290	2.02	0.00	2.16	18.36	188.4	69.8
300	1.71	0.01	1.96	18.57	187.3	69.4
310	1.51	0.03	1.69	18.88	186.6	69.4
320	1.21	0.00	1.99	18.55	186.0	69.4
330	0.92	0.02	1.97	18.57	198.5	69.3
340	0.60	0.01	1.86	18.69	186.4	68.3
350	0.31	0.03	1.69	18.88	196.4	69.0
360	0.00	0.04	1.69	18.88	189.9	69.0

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This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

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Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

Please report any errors or problems to Tony Joseph at CSA.

Tony Joseph
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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 60
Output Category: High Burn Rate

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	69.5%	74.9%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70%	75.3%

Output Rate (kJ/h)	23,473	22,266	(Btu/h)
Burn Rate (kg/h)	1.70	3.74	(lb/h)
Input (kJ/h)	33,760	32,025	(Btu/h)

Test Load Weight (dry kg)	1.70	3.74	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	6		
Test Duration (h)	1.00		

Emissions	Particulate	CO
g/MJ Output	0.29	0.24
g/kg Dry Fuel	3.95	3.31
g/h	6.71	5.61
lb/MM Btu Output	0.66	0.56

Air/Fuel Ratio (A/F)	29.74
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578
 Test Duration: 60
 Output Category: High Burn Rate

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

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

Default Fuel Values

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

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 3.92
 Burn Rate (dry kg/h): 1.70
 Total Particulate Emissions: 6.71 g

Fuel Data

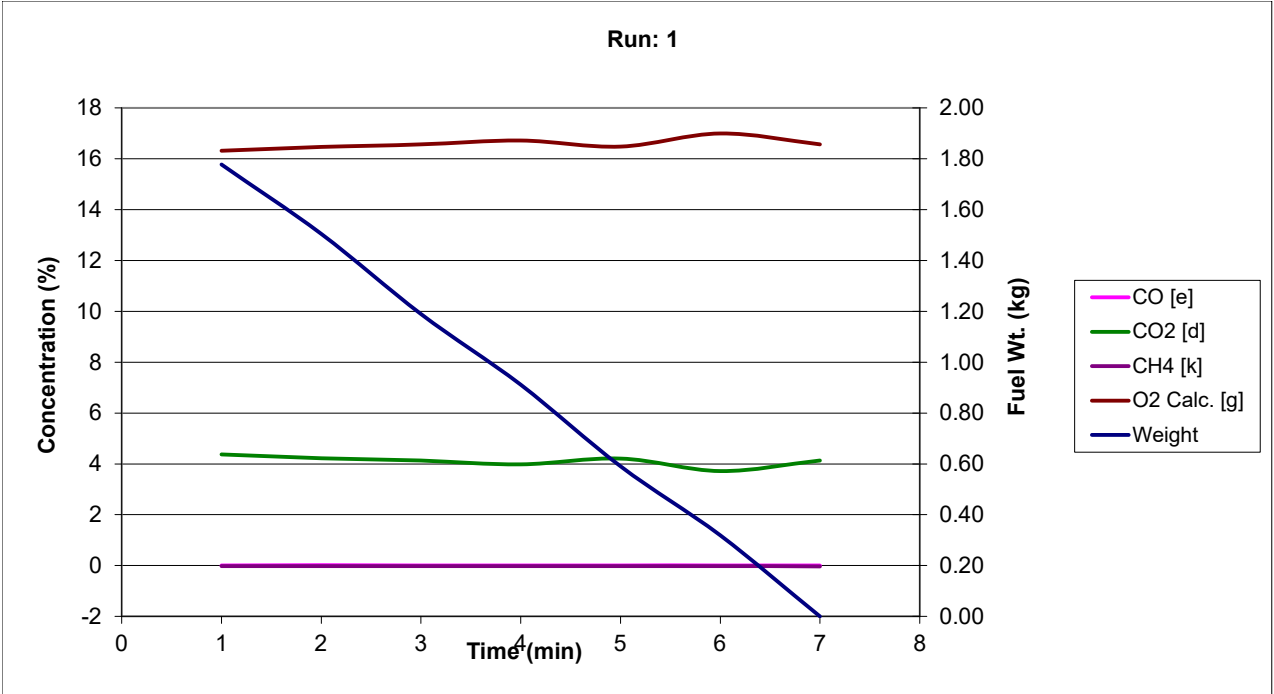
D. Fir	
HHV	19,887 kJ/kg
%C	50
%H	6.6
%O	42.9
%Ash	0.5

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Averages 0.01 4.11 16.38 291.63 70.93
 Temp. (°F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Composition (%)			Temp. (°F)	
		CO	CO ₂	O ₂	Flue Gas	Room Temp
0	3.92	0.01	4.37	16.10	292.2	70.9
10	3.32	0.01	4.23	16.25	279.8	71.8
20	2.62	0.01	4.13	16.36	297.2	72.2
30	2.01	0.01	3.99	16.51	295.0	71.0
40	1.30	0.01	4.21	16.27	299.7	71.1
50	0.70	0.01	3.72	16.79	280.5	69.9
60	0.00	0.00	4.13	16.36	297.1	69.6

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

All data from a test run are entered on the "Data" sheet. The cells requiring data entry are highlighted. Please note that input data can be entered in either yard/pound or SI units. Select the units in cells F4 and F5 of the "Data" sheet.

Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

Please report any errors or problems to Tony Joseph at CSA.

Tony Joseph
A.L.P. (Tony) Joseph
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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 60
Output Category: High Burn Rate

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	69.8%	75.3%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70%	75.7%

Output Rate (kJ/h)	22,477	21,322	(Btu/h)
Burn Rate (kg/h)	1.70	3.74	(lb/h)
Input (kJ/h)	32,198	30,543	(Btu/h)

Test Load Weight (dry kg)	1.70	3.74	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	5		
Test Duration (h)	1.00		

Emissions	Particulate	CO
g/MJ Output	0.30	0.23
g/kg Dry Fuel	3.95	3.09
g/h	6.71	5.24
lb/MM Btu Output	0.69	0.54

Air/Fuel Ratio (A/F)	29.74
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578

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

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

Default Fuel Values

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

Test Duration: 60
 Output Category: High Burn Rate

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 3.92
 Burn Rate (dry kg/h): 1.70
 Total Particulate Emissions: 6.71 g

Fuel Data

Marth

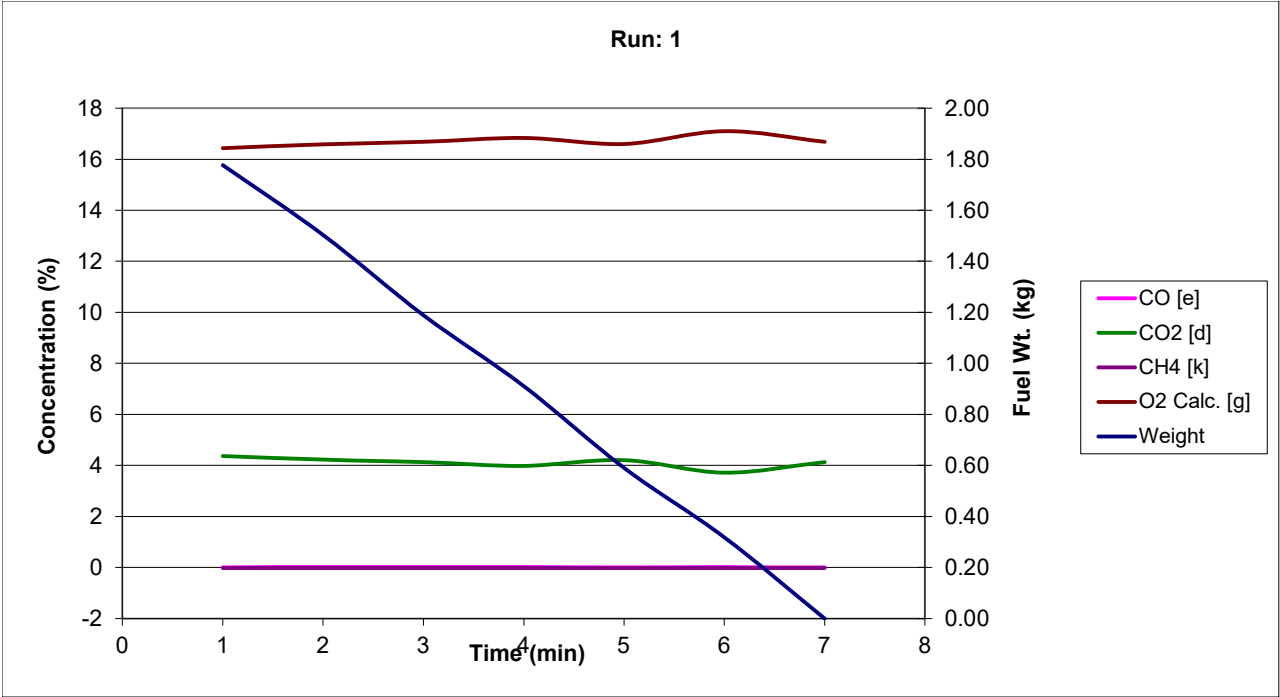
HHV	18,967	kJ/kg
%C	46.87	
%H	6.41	
%O	46.62	
%Ash	0.1	

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Averages 0.01 4.11 16.38 291.63 70.93

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Composition (%)			Temp. (°F)	
		CO	CO ₂	O ₂	Flue Gas	Room Temp
0	3.92	0.01	4.37	16.10	292.2	70.9
10	3.32	0.01	4.23	16.25	279.8	71.8
20	2.62	0.01	4.13	16.36	297.2	72.2
30	2.01	0.01	3.99	16.51	295.0	71.0
40	1.30	0.01	4.21	16.27	299.7	71.1
50	0.70	0.01	3.72	16.79	280.5	69.9
60	0.00	0.00	4.13	16.36	297.1	69.6

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

All data from a test run are entered on the "Data" sheet. The cells requiring data entry are highlighted. Please note that input data can be entered in either yard/pound or SI units. Select the units in cells F4 and F5 of the "Data" sheet.

Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 120
Output Category: Medium Burn Rate

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	69.4%	74.8%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70%	75.1%

Output Rate (kJ/h)	16,148	15,319	(Btu/h)
Burn Rate (kg/h)	1.17	2.58	(lb/h)
Input (kJ/h)	23,268	22,072	(Btu/h)

Test Load Weight (dry kg)	2.34	5.16	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	4		
Test Duration (h)	2.00		

Emissions	Particulate	CO
g/MJ Output	0.21	0.11
g/kg Dry Fuel	2.87	1.53
g/h	3.36	1.78
lb/MM Btu Output	0.48	0.26

Air/Fuel Ratio (A/F)	39.80
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578
 Test Duration: 120
 Output Category: Medium Burn Rate

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

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

Default Fuel Values

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

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 5.40
 Burn Rate (dry kg/h): 1.17
 Total Particulate Emissions: 6.71 g

Fuel Data

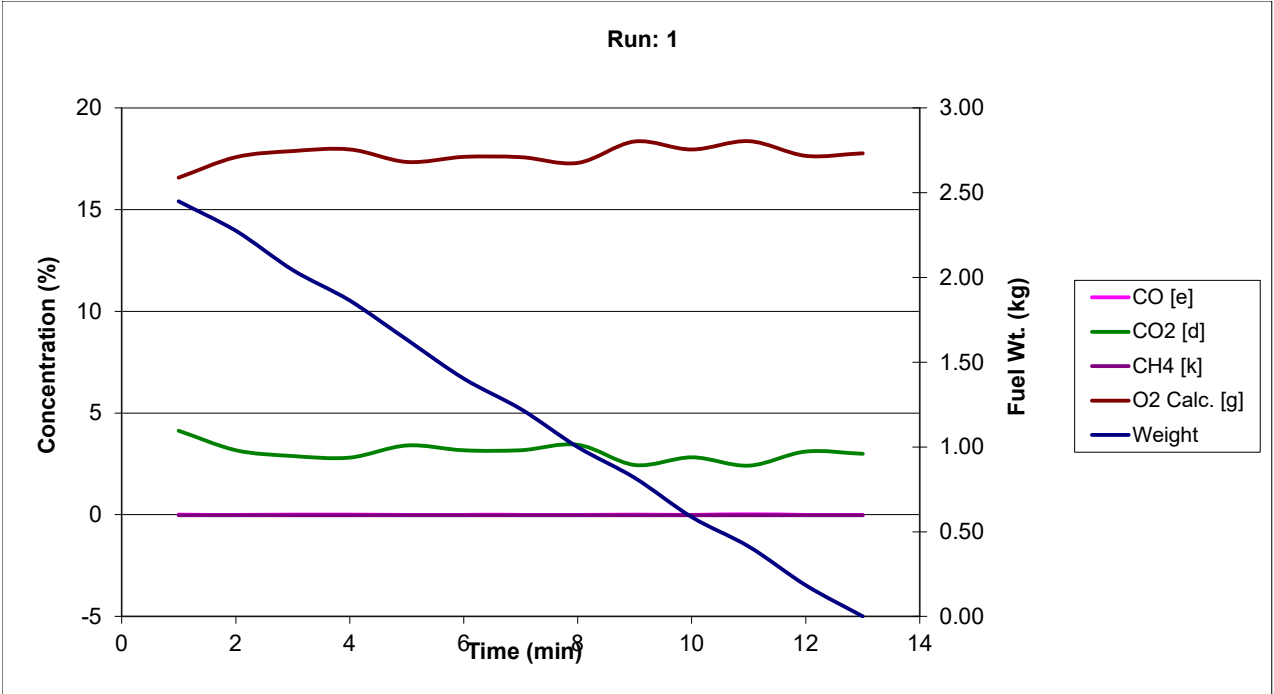
D. Fir	
HHV	19,887 kJ/kg
%C	50
%H	6.6
%O	42.9
%Ash	0.5

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Averages 0.00 3.08 17.43 247.86 69.23
 Temp. (°F)

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Composition (%)			Flue Gas Temp. (°F)	Room Temp
		CO	CO ₂	O ₂		
0	5.40	0.00	4.13	16.36	297.1	69.6
10	5.01	0.00	3.18	17.34	247.8	69.2
20	4.50	0.01	2.89	17.65	244.9	69.8
30	4.11	0.00	2.81	17.71	252.1	69.3
40	3.60	0.00	3.41	17.07	238.6	69.4
50	3.09	0.00	3.16	17.34	250.0	69.7
60	2.70	0.00	3.18	17.32	240.1	68.7
70	2.20	0.00	3.44	17.05	239.2	68.9
80	1.80	0.01	2.45	18.10	245.5	68.9
90	1.29	0.00	2.82	17.69	244.5	68.9
100	0.91	0.03	2.42	18.12	235.8	69.8
110	0.41	0.00	3.11	17.38	243.0	68.8
120	0.00	0.00	2.99	17.49	243.7	69.0



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

All data from a test run are entered on the "Data" sheet. The cells requiring data entry are highlighted. Please note that input data can be entered in either yard/pound or SI units. Select the units in cells F4 and F5 of the "Data" sheet.

Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 120
Output Category: Medium Burn Rate

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	69.7%	75.2%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	70%	75.6%

Output Rate (kJ/h)	15,471	14,676	(Btu/h)
Burn Rate (kg/h)	1.17	2.58	(lb/h)
Input (kJ/h)	22,192	21,051	(Btu/h)

Test Load Weight (dry kg)	2.34	5.16	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	3		
Test Duration (h)	2.00		

Emissions	Particulate	CO
g/MJ Output	0.22	0.11
g/kg Dry Fuel	2.87	1.42
g/h	3.36	1.67
lb/MM Btu Output	0.50	0.25

Air/Fuel Ratio (A/F)	39.80
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578
 Test Duration: 120
 Output Category: Medium Burn Rate

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

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

Default Fuel Values

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

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 5.40
 Burn Rate (dry kg/h): 1.17
 Total Particulate Emissions: 6.71 g

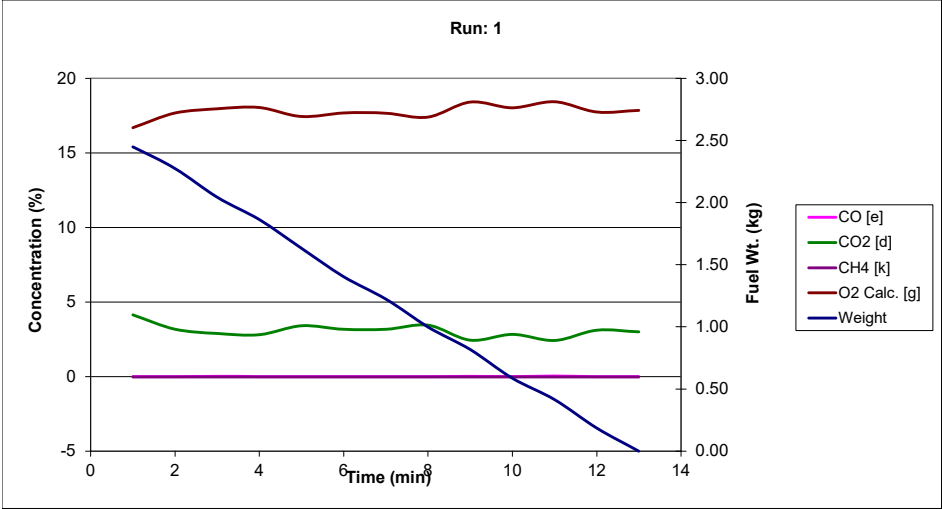
Fuel Data
 Marth
 HHV 18,967 kJ/kg
 %C 46.87
 %H 6.41
 %O 46.62
 %Ash 0.1

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Averages 0.00 3.08 17.43 247.86 69.23
 Temp. (°F)

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Composition (%)			Flue Gas Temp. (°F)	Room Temp
		CO	CO ₂	O ₂		
0	5.40	0.00	4.13	16.36	297.1	69.6
10	5.01	0.00	3.18	17.34	247.8	69.2
20	4.50	0.01	2.89	17.65	244.9	69.8
30	4.11	0.00	2.81	17.71	252.1	69.3
40	3.60	0.00	3.41	17.07	238.6	69.4
50	3.09	0.00	3.16	17.34	250.0	69.7
60	2.70	0.00	3.18	17.32	240.1	68.7
70	2.20	0.00	3.44	17.05	239.2	68.9
80	1.80	0.01	2.45	18.10	245.5	68.9
90	1.29	0.00	2.82	17.69	244.5	68.9
100	0.91	0.03	2.42	18.12	235.8	69.8
110	0.41	0.00	3.11	17.38	243.0	68.8
120	0.00	0.00	2.99	17.49	243.7	69.0



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

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Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 180
Output Category: Low Burn Rate

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	67.3%	72.5%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	68%	72.9%

Output Rate (kJ/h)	10,094	9,575	(Btu/h)
Burn Rate (kg/h)	0.75	1.66	(lb/h)
Input (kJ/h)	14,997	14,226	(Btu/h)

Test Load Weight (dry kg)	2.26	4.99	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	24		
Test Duration (h)	3.00		

Emissions	Particulate	CO
g/MJ Output	0.22	0.79
g/kg Dry Fuel	2.97	10.61
g/h	2.24	8.00
lb/MM Btu Output	0.51	1.84

Air/Fuel Ratio (A/F)	62.00
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578
 Test Duration: 180
 Output Category: Low Burn Rate

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

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

Default Fuel Values

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

Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 5.22
 Burn Rate (dry kg/h): 0.75
 Total Particulate Emissions: 6.71 g

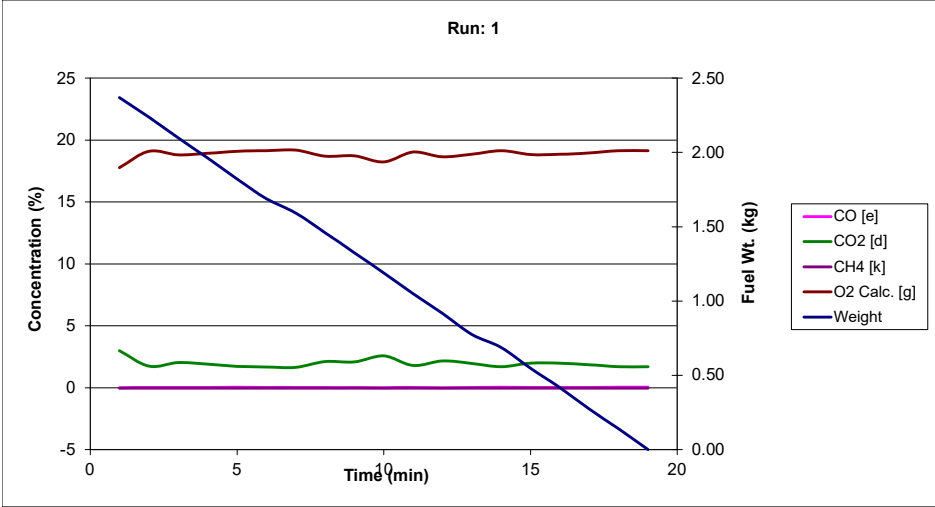
Fuel Data

D. Fir	
HHV	19,887 kJ/kg
%C	50
%H	6.6
%O	42.9
%Ash	0.5

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.

Elapsed Time (min)	Averages Fuel Weight Remaining (lb)	Averages Flue Gas Composition (%)			Averages Flue Gas Temp. (°F)	Averages Room Temp
		CO	CO ₂	O ₂		
0	5.22	0.00	2.99	17.49	243.7	69.0
10	4.93	0.01	1.74	18.82	203.8	69.0
20	4.62	0.00	2.02	18.52	203.9	68.4
30	4.32	0.02	1.90	18.67	201.4	69.0
40	4.01	0.03	1.73	18.82	186.4	68.6
50	3.72	0.02	1.68	18.87	189.1	69.7
60	3.51	0.03	1.65	18.91	188.3	69.1
70	3.22	0.00	2.11	18.40	194.5	68.7
80	2.92	0.00	2.08	18.45	194.8	68.8
90	2.62	0.00	2.56	17.95	197.7	68.9
100	2.31	0.03	1.79	18.76	196.3	69.0
110	2.02	0.00	2.16	18.36	188.4	69.8
120	1.71	0.01	1.96	18.57	187.3	69.4
130	1.51	0.03	1.69	18.88	186.6	69.4
140	1.21	0.00	1.99	18.55	186.0	69.4
150	0.92	0.02	1.97	18.57	198.5	69.3
160	0.60	0.01	1.86	18.69	186.4	68.3
170	0.31	0.03	1.69	18.88	196.4	69.0
180	0.00	0.04	1.69	18.88	189.9	69.0



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

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Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

Please report any errors or problems to Tony Joseph at CSA.

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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Intertek

Manufacturer: Ardisam
Model: Serenity
Date: 12/07/15
Run: 1
Control #: G102366578
Test Duration: 180
Output Category: Low Burn Rate

Technicians: KS

Test Results in Accordance with CSA B415.1-09

	HHV Basis	LHV Basis
Overall Efficiency	67.7%	73.0%
Combustion Efficiency	99.5%	99.5%
Heat Transfer Efficiency	68%	73.4%

Output Rate (kJ/h)	9,681	9,183	(Btu/h)
Burn Rate (kg/h)	0.75	1.66	(lb/h)
Input (kJ/h)	14,303	13,568	(Btu/h)

Test Load Weight (dry kg)	2.26	4.99	dry lb
MC wet (%)	4.49		
MC dry (%)	4.70		
Particulate (g)	6.71		
CO (g)	22		
Test Duration (h)	3.00		

Emissions	Particulate	CO
g/MJ Output	0.23	0.77
g/kg Dry Fuel	2.97	9.90
g/h	2.24	7.47
lb/MM Btu Output	0.54	1.79

Air/Fuel Ratio (A/F)	62.00
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VERSION:

2.2

12/14/2009

VERSION: 2.2 12/14/2009

Manufacturer: Ardisam
 Model: Serenity
 Date: 12/7/2015
 Run: 1
 Control #: G102366578
 Test Duration: 180
 Output Category: Low Burn Rate

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

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

Default Fuel Values

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

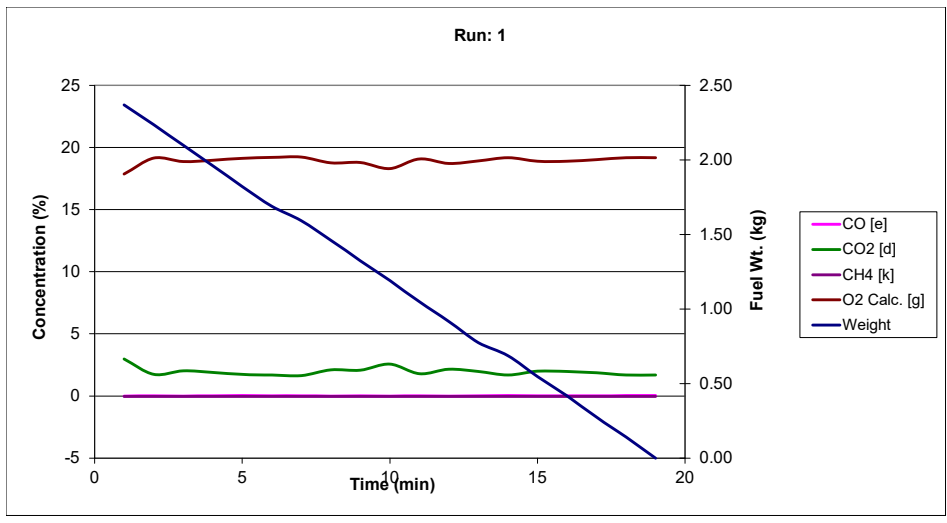
Wood Moisture (% wet): 4.49
 Load Weight (lb wet): 5.22
 Burn Rate (dry kg/h): 0.75
 Total Particulate Emissions: 6.71 g

Fuel Data
 Marth
 HHV 18,967 kJ/kg
 %C 46.87
 %H 6.41
 %O 46.62
 %Ash 0.1

Note 1: For other fuels, use the heating value and fuel composition determined by analysis of fuel sample in accordance with Clause 9.2.

Note 2: In cases where the "Fuel Weight Remaining" is the same for three or more readings in a row, a "divide by zero error" will occur in the calculation sheet. In such cases, adjust the weight values by interpolation between the first occurrence and the next reading showing a decrease in weight.

Elapsed Time (min)	Averages Fuel Weight Remaining (lb)	Averages Flue Gas Composition (%)			Averages Flue Gas Temp. (°F)	Averages Room Temp
		CO	CO ₂	O ₂		
0	5.22	0.00	2.99	17.49	243.7	69.0
10	4.93	0.01	1.74	18.82	203.8	69.0
20	4.62	0.00	2.02	18.52	203.9	68.4
30	4.32	0.02	1.90	18.67	201.4	69.0
40	4.01	0.03	1.73	18.82	186.4	68.6
50	3.72	0.02	1.68	18.87	189.1	69.7
60	3.51	0.03	1.65	18.91	188.3	69.1
70	3.22	0.00	2.11	18.40	194.5	68.7
80	2.92	0.00	2.08	18.45	194.8	68.8
90	2.62	0.00	2.56	17.95	197.7	68.9
100	2.31	0.03	1.79	18.76	196.3	69.0
110	2.02	0.00	2.16	18.36	188.4	69.8
120	1.71	0.01	1.96	18.57	187.3	69.4
130	1.51	0.03	1.69	18.88	186.6	69.4
140	1.21	0.00	1.99	18.55	186.0	69.4
150	0.92	0.02	1.97	18.57	198.5	69.3
160	0.60	0.01	1.86	18.69	186.4	68.3
170	0.31	0.03	1.69	18.88	196.4	69.0
180	0.00	0.04	1.69	18.88	189.9	69.0



Note: In the legend, [d], [e], [g], and [k] refer to their respective variables in Clauses 13.7.3 and 13.7.5

This Excel spreadsheet calculates solid fuel appliance efficiency and heat output in accordance with the procedure specified in CSA B415.1-09. In general the column headings correspond to the variables used in the Standard.

All data from a test run are entered on the "Data" sheet. The cells requiring data entry are highlighted. Please note that input data can be entered in either yard/pound or SI units. Select the units in cells F4 and F5 of the "Data" sheet.

Particulate emissions determined using the dilution tunnel method should be entered in cell C13 of the "Data" sheet as total grams of emissions.

Since oxygen concentrations are calculated for the efficiency determination, entry of measured oxygen data is optional. However, it might be useful to include the measured oxygen values for comparison to the calculated values for diagnostic purposes. A deviation of more than 1 or 2 percentage points can indicate inaccurate CO, CO₂, or fuel composition input data.

Selection of an appliance type in cell F2 of the "Data" sheet is needed for the air/fuel ratio calculation in accordance with Clause 16.3.5 of the Standard.

The "CSA B415.1 Calculations" and "Report" sheets include calculation of efficiencies based on the Lower Heating Value (LHV) of the fuel, which is not required in CSA B415.1-09. The LHV is calculated from the Higher Heating Value (HHV) and fuel composition data in accordance with ASTM E711.

The "CSA B415.1 Calculations" sheet is locked and password protected to prevent inadvertent modifications.

The "Chart" sheet includes a chart of flue gas composition data and fuel consumption. The range of cells in the "CSA B415.1 Calculations" sheet to be charted or plotted might need to be adjusted to correspond to the number of data points entered.

Please report any errors or problems to Tony Joseph at CSA.

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Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.
Version 2.2 14 December 2009

Room Temp		Bar Pressure		Relative Humidity		Air Velocity	
Before	After	Before	After	Before	After	Before	After
71	0	29.17	29.03	30.0	27.0	0	0
Average Dilution Tunnel Measurements						Sample Data	
Burn Time	Velocity (Ft/sec)	Flow Rate (dscf/min)	Temp (R)	Total Sample		Particulate Catch	
60	13.76	145.18	561.72	1	2	1	2
				14.06	14.18	0.00	2.10
Dilution Tunnel Dual Train Precision							
Sample Ratios		Total Emissions (g)					
Train 1	Train 2	Train 1	Train 2	Deviation (%)			
619.46	614.45	0.00	1.29	100.00%			
Burn Rate	Surface		Initial Draft	Run Time	Average Draft		
1.776	128.524		0.024	60.000	0.024		
Run	Date	Burn Rate	Emission				
1	12/7/2015	1.776	0.645				

Burn Rates (kg/hr)		
High	Medium	Minimum
1.78	#VALUE!	#VALUE!

Fuel consumed (lbs)	
High	Medium
3.92	Medium
#VALUE!	Minimum

Fuel Moisture (% Wet)
0.04494



E&E Boiler Tunnel Traverse Worksheet

Static Pressure: **0.168**
Barometer: 29.17

	TUNNEL VELOCITY	TUNNEL TEMP	SQUARE ROOT
A CENTER	0.048		0.2191
B CENTER	0.049		0.2214
A1	0.041		0.2025
A2	0.047		0.2168
A3	0.047		0.2168
A4	0.035		0.1871
B1	0.044		0.2098
B2	0.048		0.2191
B3	0.045		0.2121
B4	0.039		0.1975
AVERAGE		#DIV/0!	0.2102

PITOT
CONSTANT= 0.9545

E&E PELLET FUEL DATA SHEET

Brand of pellets used:

Moisture Content: Wet: Dry:

Weight used during Test: Lbs (wet) kg (dry)

Burn Rate:

Moisture Calculation:

<input type="text" value="0.89"/>	Before weight of pellets - Wet
<input type="text" value="0.85"/>	After weight of pellets - dry
<input type="text" value="0.04"/>	Weight of moisture removed from oven

Weight added to Scale:

Room Temp		Bar Pressure		Relative Humidity		Air Velocity	
Before	After	Before	After	Before	After	Before	After
71	69	29.17	29.03	30.0	27.0	0	0
Average Dilution Tunnel Measurements						Sample Data	
Burn Time	Velocity (Ft/sec)	Flow Rate (dscf/min)	Temp (R)	Total Sample		Particulate Catch	
360	13.55	145.82	550.60	1	2	1	2
				83.34	84.10	11.80	9.60
Dilution Tunnel Dual Train Precision							
Sample Ratios		Total Emissions (g)					
Train 1	Train 2	Train 1	Train 2	Deviation (%)			
629.93	624.20	7.43	5.99	10.73%			
Burn Rate		Surface		Initial Draft		Run Time	Average Draft
1.099		570.204		0.024		360.000	0.021
Run	Date	Burn Rate	Emission				
1	12/7/2015	1.099	1.119				

Burn Rates (kg/hr)		
High	Medium	Minimum
1.78	1.22	0.79

Fuel consumed (lbs)	
3.92	High
5.40	Medium
5.22	Minimum

Fuel Moisture (% Wet)
0.04494

Time	Flue Temp 1	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	DGM 1	DGM 1	Filter 1	DGM 2	DGM 2	Filter 2	Tunnel	CO	CO2	O2	scale	10.394991		21.02	15.62	10.39	
		Temp 2	Dry Bulb 3	Top 4	Back 5	Right 6	Left 7	Bottom 8	In 17	Out 18	19	In 20	Out 21	22	%	%	%	Lbs	Corrected Scale	Calculated Tunnel					
0.0	292.19	70.93	100.23	73.05	605.48	523.65	879.32	718.81	72.09	71.79	71.92	71.26	71.05	71.69	1.16	0.01	4.37	16.10	24.93	14.54	0.038961				
10.0	279.82	71.80	100.79	74.16	573.02	1300.59	827.53	972.29	72.67	71.77	78.95	72.15	71.15	81.20	1.17	0.01	4.23	16.25	24.33	13.94	0.043161				3.92
20.0	297.17	72.22	102.37	74.61	879.24	946.05	620.04	963.02	73.08	72.03	82.26	72.44	71.26	83.08	1.18	0.01	4.13	16.36	23.64	13.24	0.044383				3.32
30.0	294.95	70.95	102.16	74.41	804.09	1013.30	600.74	957.42	72.92	71.97	82.75	72.41	71.12	84.07	1.18	0.01	3.99	16.51	23.02	12.63	0.045962				2.62
40.0	299.69	71.07	102.62	73.60	777.79	706.58	841.61	974.78	73.01	72.16	83.95	72.74	71.46	84.56	1.17	0.01	4.21	16.27	22.32	11.92	0.042716				2.01
50.0	280.50	69.91	102.17	73.47	552.24	1113.43	911.17	965.45	73.14	72.37	82.94	72.86	71.67	85.47	1.16	0.01	3.72	16.79	21.72	11.32	0.041039				1.30
60.0	297.05	69.60	101.73	72.80	837.88	666.51	750.10	978.71	73.26	72.33	84.87	72.66	71.65	85.26	1.19	0.00	4.13	16.36	21.02	10.62	0.047145				0.70
70.0	247.76	69.16	95.59	71.65	220.37	1105.81	896.00	972.63	72.93	72.21	77.76	72.64	71.84	84.17	1.17	0.00	3.18	17.34	20.63	10.23	0.043051				0.00
80.0	244.85	69.75	94.26	72.41	208.05	1045.55	898.76	972.58	73.11	72.41	78.57	72.98	72.01	83.17	1.18	0.01	2.89	17.65	20.12	9.73	0.044731				5.40
90.0	252.14	69.25	93.39	70.66	528.52	624.08	674.54	992.36	72.92	72.48	79.12	72.61	71.71	82.43	1.18	0.00	2.81	17.71	19.72	9.33	0.044633				4.50
90.0	238.63	69.42	92.78	72.41	270.03	1169.94	564.36	946.34	72.93	72.59	79.19	72.80	72.09	82.33	1.17	0.00	3.41	17.07	19.21	8.82	0.043508				4.11
110.0	249.96	69.71	92.88	72.68	280.89	626.12	745.00	962.65	73.04	72.62	79.36	72.66	72.11	82.16	1.15	-0.01	3.16	17.34	18.71	8.31	0.038031				3.60
120.0	240.12	68.73	92.75	71.21	166.78	1047.42	850.19	942.57	73.08	72.81	79.45	72.87	72.28	81.98	1.17	-0.01	3.18	17.32	18.31	7.92	0.042603				3.09
130.0	239.24	68.88	92.71	72.03	169.08	1190.23	769.28	920.99	72.75	72.57	79.58	72.50	72.00	82.05	1.18	0.00	3.44	17.05	17.82	7.42	0.044136				2.70
140.0	245.45	68.93	92.87	71.37	264.31	935.02	474.71	935.99	73.07	72.85	79.95	72.88	72.25	81.89	1.19	0.01	2.45	18.10	17.42	7.02	0.046276				2.20
150.0	244.55	68.94	92.60	71.15	217.28	727.11	839.35	934.70	73.09	72.76	79.70	72.82	72.33	81.85	1.16	0.00	2.82	17.69	16.91	6.51	0.039653				1.80
160.0	235.80	69.78	91.98	71.28	258.34	1012.01	484.14	915.13	73.28	72.86	79.65	73.12	72.38	81.85	1.19	0.03	2.42	18.12	16.53	6.13	0.046377				1.29
170.0	242.95	68.75	92.33	71.20	250.04	949.25	466.54	906.98	73.18	72.77	79.85	72.83	72.15	81.63	1.17	-0.01	3.11	17.38	16.02	5.63	0.04196				0.91
180.0	243.74	69.03	92.47	71.62	284.46	873.27	468.15	901.06	73.25	72.77	80.12	72.89	72.41	81.94	1.16	-0.01	2.99	17.49	15.62	5.22	0.039433				0.41
190.0	203.76	68.98	87.41	69.98	201.07	1185.55	597.84	887.08	73.27	72.85	79.18	72.86	72.23	80.58	1.17	0.01	1.74	18.82	15.33	4.93	0.042576				0.00
200.0	203.85	68.38	85.77	69.87	287.24	564.61	650.92	932.04	72.96	72.81	78.59	72.79	72.45	79.96	1.18	0.00	2.02	18.52	15.02	4.62	0.044362				5.22
210.0	201.44	69.00	85.66	71.04	211.77	695.26	803.20	912.25	73.16	73.03	78.29	72.78	72.47	79.52	1.16	0.02	1.90	18.67	14.72	4.32	0.040735				4.93
220.0	186.37	68.60	84.59	70.78	198.61	1171.89	576.97	878.96	73.22	72.93	77.67	72.86	72.54	78.96	1.17	0.03	1.73	18.82	14.41	4.01	0.043408				4.62
230.0	189.05	69.69	85.27	71.57	151.53	1154.02	690.67	870.12	73.15	73.26	77.44	73.15	72.79	78.93	1.17	0.02	1.68	18.87	14.12	3.72	0.043548				4.01
240.0	188.30	69.13	84.77	71.35	249.04	1059.61	475.95	879.13	73.26	73.16	77.44	73.02	72.59	78.77	1.16	0.03	1.65	18.91	13.91	3.51	0.040156				3.72
250.0	194.49	68.68	83.88	70.92	316.20	583.15	515.30	896.25	73.01	73.09	77.08	72.81	72.66	78.33	1.16	0.00	2.11	18.40	13.61	3.22	0.039686				3.51
260.0	194.79	68.76	84.04	70.95	277.05	554.56	581.10	901.65	73.52	73.28	77.15	73.06	72.84	78.26	1.17	0.00	2.08	18.45	13.31	2.92	0.043527				3.22
270.0	197.72	68.91	84.29	71.03	286.96	556.96	540.99	900.51	73.33	73.15	76.79	72.79	72.59	78.35	1.17	-0.01	2.56	17.95	13.02	2.62	0.041609				2.92
280.0	196.34	69.00	84.11	71.44	228.82	571.40	682.36	892.31	73.08	73.18	76.91	73.04	72.86	78.11	1.16	0.03	1.79	18.76	12.71	2.31	0.04046				2.62
290.0	188.41	69.82	85.12	72.42	199.80	1114.99	487.33	858.99	73.09	72.93	76.86	73.01	72.63	78.11	1.17	0.00	2.16	18.36	12.42	2.02	0.042283				2.31
300.0	187.27	69.45	83.90	71.17	147.49	1137.89	667.90	844.86	73.13	73.22	76.98	72.94	72.62	78.14	1.17	0.01	1.96	18.57	12.10	1.71	0.043344				2.02
310.0	186.58	69.44	83.93	71.16	235.64	926.91	291.66	862.57	73.18	73.17	76.69	72.77	72.76	77.89	1.20	0.03	1.69	18.88	11.91	1.51	0.049181				1.71
320.0	185.95	69.40	83.78	71.61	145.99	948.07	769.41	860.25	73.03	73.10	76.68	72.77	72.94	77.96	1.15	0.00	1.99	18.55	11.60	1.21	0.038049				1.51
330.0	198.53	69.30	84.18	70.94	299.31	510.85	522.52	895.00	73.26	73.55	76.47	72.91	72.86	78.04	1.17	0.02	1.97	18.57	11.31	0.92	0.04281				1.21
340.0	186.38	68.26	83.80	69.67	171.47	1131.38	508.01	835.42	73.16	73.55	76.50	72.96	72.75	77.90	1.17	0.01	1.86	18.69	11.00	0.60	0.043441				0.92
350.0	196.44	69.01	84.31	70.55	295.54	703.00	293.93	851.78	73.44	73.30	76.38	72.96	72.74	77.94	1.17	0.03	1.69	18.88	10.70	0.31	0.043551				0.60
360.0	189.88	69.04	84.56	70.74	149.01	1125.21	527.60	824.22	73.30	73.49	76.53	72.93	72.76	78.00	1.18	0.04	1.69	18.88	10.39	0.00	0.045054				0.31



E&E Boiler Tunnel Traverse Worksheet

Static Pressure: **0.168**
Barometer: 29.17

	TUNNEL VELOCITY	TUNNEL TEMP	SQUARE ROOT
A CENTER	0.048		0.2191
B CENTER	0.049		0.2214
A1	0.041		0.2025
A2	0.047		0.2168
A3	0.047		0.2168
A4	0.035		0.1871
B1	0.044		0.2098
B2	0.048		0.2191
B3	0.045		0.2121
B4	0.039		0.1975
AVERAGE		#DIV/0!	0.2102

PITOT
CONSTANT= 0.9545

E&E PELLET FUEL DATA SHEET

Brand of pellets used:

Moisture Content: Wet: Dry:

Weight used during Test: Lbs (wet) kg (dry)

Burn Rate:

Moisture Calculation:

<input type="text" value="0.89"/>	Before weight of pellets - Wet
<input type="text" value="0.85"/>	After weight of pellets - dry
<input type="text" value="0.04"/>	Weight of moisture removed from oven

Weight added to Scale:

Manufacturer: ARDISAM
 Job # C102366578

Model: Screwity
 Run 1

Page 2 of 9
 Date 12-7-15
 Tech KS

DILUTION TUNNEL PARTICULATE SAMPLER DATA

FILTER TYPE: Gelman 47mm A/E

Pre-test Weight Record		SYSTEM 1			SYSTEM 2			SYSTEM 3			Temp °F	Humidity %
Date	Time	Probe & Housing Number	Front Filter + gasket Number	Back Filter + gasket Number	Probe & Housing Number	Front Filter + gasket Number	Back Filter + gasket Number	Probe & Housing Number	Front Filter + gasket Number	Back Filter + gasket Number		
12/4/15	8:30A	C 90. 8894	3.3082	3.2970	D 91. 0234	1.8422	3.2981	E 92. 5977	3.3054	3.2987	71	31
12/7/15	8:50A	C 90. 8892	3.3079	3.2967	D 91. 0232	1.8418	3.2979	E 92. 5976	3.3052	3.2983	B	30
		Total:	6.6046		Total:	5.1397		Total:	6.6035			

Post-test Weight Record		SYSTEM 1		SYSTEM 2		SYSTEM 3		Temp °F	Humidity %
Date	Time	Probe & Housing Number	Combined Filter/gasket Number	Probe & Housing Number	Combined Filter/gasket Number	Probe & Housing Number	Combined Filter/gasket Number		
12/7	4:30P	C 90. 8906	27+28 6.6174	D 91. 0243	29+30 5.1431	E 92. 5976	31+32 6.6119	79	27
12/8	8:30A	C 90. 8892	6.6164	D 91. 0232	5.1418	—	6.6110	69	32
12/11	8:40A	—	6.6164	—	5.1418	—	6.6110	68	25

Dry Down Weight

Date	Time	P1	F1	P2	F2	P3	F3	Gr/hr	Lb/MMbtu
12/7		1.4	12.8	1.1	3.4	0	8.4	1.343	
12/8		0	11.8	0	2.1	0	7.5	1.119	
12/11		0	11.8	0	2.1	0	7.5		

Manufacturer Ardisam
 Job # G102366578

Model Castle - Security
 Run 1

Page 3 of 9
 Date 12-7-15
 Tech KS

PRETEST DILUTION TUNNEL TRAVERSE RUN

Barometric pressure (P_{bar}) 29.17 (inches Hg.) Static pressure (P_q) 168 (inches w.c.)

Inside diameter: Port A in Port B in Tunnel cross sectional area: Ft²

Pitot tube type: Standard

Traverse Point	Position (inches)	Velocity Head Δ_p (inches H ₂ O)	Tunnel Temperature (°F)	$\sqrt{\Delta_p}$
A-Centroid	3.00	.048		
B-Centroid	3.00	.049		
A-1	0.50	.041		
A-2	1.50	.047		
A-3	4.50	.047		
A-4	5.50	.035		
B-1	0.50	.044		
B-2	1.50	.048		
B-3	4.50	.045		
B-4	5.50	.039		
		AVERAGE		

Adjustment factor application

Pitot correction

Where,

C_p = Pitot tube coefficient = 0.99 for standard pitot

Δ_p = manometer reading (inches H₂O)

T_s = average absolute dilution tunnel temperature (°F + 460)

P_s = absolute dilution tunnel gas pressure or $P_{bar} + P_g$

P_g = static pressure inches H₂O

M_s = 28.56, wet molecular weight of stack gas (alternatively, it may be measured)

Adjustment factor for alternative Pitot tube placement:

$$V_s = K_p C_p F_p (\sqrt{\Delta_p})_{AVG} \sqrt{\frac{T_s}{P_s M_s}} \quad V_s = K_p C_p (\sqrt{\Delta_p})_{avg} \sqrt{\frac{T_s}{P_s M_s}} \quad F_p = \frac{(\sqrt{\Delta_p})_{avg}}{(\sqrt{\Delta_p})_{centroid}}$$

K_p = 85.49 Pitot tube constant, (conversion factor for English units)

$(\sqrt{\Delta_p})_{avg}$ = Average of the square roots of the velocity heads (Δ_p) measured at each traverse point.

$(\sqrt{\Delta_p})_{centroid}$ = Average of the square roots of the velocity heads measured at the tunnel centroid (inches of H₂O)



Manufacturer Ardisam
Job # G102366578

Model Castle Screen:TY
Run 1

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Date 12-7-15
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Pre/Post Checks

	Pre-Test	Post-Test
Facility Conditions:		
Air Velocity.....	0 fpm	0 fpm
Smoke Capture Check.....	✓	✓

	Pre-Test	Post-Test
Wood Heater Conditions:		
Date Wood Heater Stack Cleaned.....	12-4-15	
Date Dilution Tunnel Cleaned.....	12-4-15	
Induced Draft Check.....	✓	✓
Tunnel Velocity.....	0	0

	Pre-Test	Post-Test
Pitot Leak Check:		
Side A.....	✓	✓
Side B.....	✓	✓

Temperature System:

Ambient (65°- 90°F)..... °F

Proportional Checks:	
CO Analyzer Drift Check.....	✓
CO ₂ Analyzer Check.....	✓
O ₂ Analyzer Check.....	✓
Thermocouple check.....	✓

	Train 1	Train 2	
Sampling Train ID Numbers:			
Probe.....	C	D	E
Filter Front.....	27	29	31
Filter Back.....	28	30	32
Filter Thermocouple.....	19	22	
Filter 5G-3 (<90°F).....			

mm



Manufacturer Ardisam
Job # G102366578

Model Castle Serenity
Run 1

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Tech KS

Pre-Test Scale Audit

Scale Type	Audit Weight	Measured Weight
Platform	25.0 lbs., Class F	25.0 lbs.
Wood	10.0 lbs., Class F	10.0 lbs.
Analytical	100.0 mg, Class S	100.0 mg.

LIMITS OF WEIGHT RANGES

ANALYTICAL SCALE: 50%-150% of dry filter weight, ± 0.1 mg
PLATFORM SCALE 20%-80% of ideal test load weight, ± 0.1 lbs. or 1%
WOOD SCALE 20%-80% of ideal test load weight, ± 0.1 lbs. or 1%



Manufacturer Ardisam
 Job # G102366578

Model Castle ScrenTy
 Run 7

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 Date 12-7-15
 Tech KS

CONTINUOUS ANALYZERS

Pre-Test (Adjust and Record)

	ZERO		SPAN		CAL. (Record Only)	
CO ₂	<u>0</u>	<u>0</u>	<u>24.55</u>	<u>24.55</u>	<u>4.90</u>	<u>5.00</u>
CO	<u>0</u>	<u>0</u>	<u>9.20</u>	<u>9.195</u>	<u>1.00</u>	<u>0.998</u>
O ₂	<u>0</u>	<u>0</u>	<u>22.00</u>	<u>22.00</u>	<u>4.97</u>	<u>5.00</u>
	Actual	Should Be	Actual	Should Be	Actual	Should Be

Post Test (Record Only)

	Zero	Span	Cal.	Zero Drift	Span Drift	Cal. Drift	OK?	Not OK*
CO ₂	<u>0</u>	<u>24.54</u>	<u>4.87</u>	<u>0</u>	<u>.01</u>	<u>.03</u>	<u>✓</u>	
CO	<u>.01</u>	<u>9.19</u>	<u>0.99</u>	<u>.01</u>	<u>.01</u>	<u>.01</u>	<u>✓</u>	
O ₂	<u>.04</u>	<u>22.02</u>	<u>5.00</u>	<u>.04</u>	<u>.02</u>	<u>.03</u>	<u>✓</u>	

* Greater than ± 5% of the range used.



Manufacturer Ardisam
 Job # G102366578

Model Castle Security
 Run 1

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SAMPLING EQUIPMENT CHECK OUT

Leakage Checks Tunnel Samplers

	SAMPLE 1		SAMPLE 2	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Unplugged Flow Rate = .25cfm				
Vacuum (inches Hg.)	10"	10"	10"	10"
Final 1 minute DGM (ft ³)	474.678	561.425	498.628	585.196
Initial 1 minute DGM (ft ³)	474.678	561.425	498.628	585.196
Change (C) (ft ³)	0	0	0	0
Allowable leakage .04 x Sample rate or .02cfm	0.0100	0.0100	0.0100	0.0100
Check OK	✓	✓	✓	✓

Leakage Checks Flue Gas Sampler

	Pre Test	Post Test
Plugged Probe		
Vacuum (inches Hg.)	10"	10"
Rotometer Reading (mm)	0	0
Flow Rate (CFM)	0	0
Allowable (.04 x Sample Rate)		
Check OK	✓	✓



Manufacturer Ardisam
Job # G102366578

Model Castle Serenity
Run 1

Page 8 of 9
Date 12-7-15
Tech KS

TEST DATA LOG

RAW DRY GAS METER READINGS

	System 1	System 2
Final (ft ³)	561.4107	585.180
Initial (ft ³)	474.678	498.628

AMBIENT CONDITIONS

	Start	End
Barometer. (inches Hg)	29.17	29.03
Temperature (°F)	72.7	78.7
Humidity (%)	30%	27



Manufacturer Ardisam
 Job # G102366578

Model Castle Security
 Run 1

Page 9 of 9
 Date 2-7-13
 Tech KS

READING #	REAL TIME	ELAPSED TIME	DGM 1	ROTOMETER 1	DGM 2	ROTOMETER 2	TUNNEL VELOCITY	DRAFT	SMOKE	MAX DGM PRESSURE
0		0	474.678	120	498.628	120		.024	C	
1		10	477.1		501.0			.024	C	
2		20	479.6		503.5			.024	C	
3		30	482.1		505.9			.024	C	
4		40	484.6		508.3			.024	C	
5		50	487.0		510.8			.024	C	
6		60	489.3		513.2			.024	C	
7		70	491.8		515.6			.024	C	
8		80	494.2		518.0			.023	C	
9		90	496.6		520.4			.023	C	
10		100	499.0		522.8			.023	C	
11		110	501.4		525.2			.023	C	
12		120	503.8		527.6			.023	C	
13		130	504.2		530.0			.023	C	
14		140	508.6		532.4			.023	C	
15		150	511.0		534.8			.023	C	
16		160	513.4		537.2			.023	C	
17		170	515.8		539.6			.023	C	
18		180	518.2		542.0			.023	C	
19		190	520.6		544.4			.021	C	
20		200	523.0		546.8			.020	C	
21		210	525.4		549.2			.020	C	
22		220	527.8		551.6			.020	C	
23		230	530.2		554.0			.019	C	
24		240	532.6		556.4			.019	C	
25		250	535.0		558.8			.019	C	
26		260	537.4		561.2			.019	C	
27		270	539.8		563.6			.019	C	
28		280	542.3		566.0			.019	C	
29		290	544.6		568.4			.019	C	
30		300	547.0		570.8			.019	C	
31		310	549.4		573.2			.019	C	
32		320	551.8		575.6			.019	C	
33		330	554.2		578.0			.019	C	
34		340	556.5		580.4			.019	C	
35		350	558.9		582.7			.019	C	
		360	561.407		585.180			.019	C	

Timber Products Inspection, Inc.

CERTIFICATE OF QUALIFICATION

This is to signify that

MARTH WOOD SHAVING SUPPLY, INC.

6752 State Highway 107 North
Marathon, WI 54448

Is hereby qualified as registration #16006
May 30, 2014

Marth Wood Shaving Supply, Inc. is compliant with the PFI Standards Program as audited by Timber Products Inspection and accredited by the American Lumber Standards Committee. In order to maintain compliance, the producer agrees to:

- ◆ Maintain complete and up to date Densified Fuel production records
- ◆ Produce and market quality products, which conform to PFI & ALSC program documents
- ◆ Apply the quality mark only to products which have been proven through applicable monitoring



Chris Wiberg, Densified Fuel Program Manager
Timber Products Inspection, Inc.
1641 Sigman Road, Conyers GA 30012 770.922.8000



Analytical Report
Report Number: 186096
Report Status: *Interim*

Brian Ziegler
Intertek
8431 Murphy Dr.
Middleton, WI 53562

Sample: Marth wood pellets

C	H	N	O
46.87 %	6.41 %	0.06 %	To Follow.
ROI	LOD		
< 0.1 %	4.32 %		



Analytical Report
Report Number: 186096
Report Status: *Interim*

Brian Ziegler
Intertek
8431 Murphy Dr.
Middleton, WI 53562

non-GMP Statement

All experimental work at Intertek Whitehouse is conducted under the auspices of a rigorous Quality Management System; however, the data presented in this report was generated using procedures that have not been validated in accordance with 21 CFR, parts 210 and 211.

Intertek makes no claims to the applicability of the data and the Client is solely responsible for determining whether the information provided in this report is suitable for the intended application.

From: John Zrucky <Zrucky@marthwood.com>
Sent: Thursday, October 7, 2021 11:02 AM
To: Andrew Reinemann <areinemann@marthwood.com>
Subject: RE: Marth pellet analysis

Andrew,

Yes, we are PFI Certified, our certification numbers are 16005 for Peshtigo and 16006 for Marathon. For cost reduction in printing of the bags, either facility can use either of the certification numbers. To differentiate, you need to look at the code dates stamped on the bag.

Stats for Marathon facility:

YTD average on BTU is 8160.

YTD average on ash is 56.3%.

We do not test for carbon, hydrogen or oxygen. This is not required by PFI or any other standard.

Thank you.

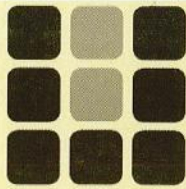
John Zrucky
Marth Wood Shavings
715-842-9200 x-10708
Zrucky@Marthwood.com



Appendix C

Calibration Documents

CALIBRATION SERVICE RECORD



**UNITED
SCALE**
& ENGINEERING
CORPORATION
A **TRANSCAT** Company

- 16725 W. Victor Road
New Berlin, Wisconsin 53151-4132
262-785-1733 • 800-236-1733
FAX 262-785-9754
- 1322 Russett Court
Green Bay, Wisconsin 54313-8999
920-434-2737 • 800-236-2737
FAX 920-434-9605
- 4123 Terminal Drive, Suite 230
McFarland, Wisconsin 53558-8701
608-838-8058 • 800-747-4474
FAX 608-838-9098

Traceability includes no less than: An unbroken chain of comparison, realization of SI units, measurement uncertainty, documentation, competence, periodic recalibration, and measurement assurance. United Scale documents the traceability of measurements to the SI units through the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC), or other recognized national measurement institutes (NMI's) or international standard bodies, or to measurable conditions created in our laboratory, or accepted fundamental and/or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Page 1 of 1

MODEL NO. <u>450</u>		SERIAL NO. <u>101722</u>		DEVICE ISO CODE: <u>008</u>	
CAL DATE: <u>8/19/15</u>	MANUFACTURER: <u>GSE</u>		TOLERANCE: <u># 18/14</u>	CAL LOCATION: <input checked="" type="checkbox"/> Customer <input type="checkbox"/> Other	
NEXT DUE: <u>2/2016</u>	CAPACITY X RESOLUTION: <u>100 LB X .01</u>		CUSTOMER: <u>INTERTEK</u>		
FREQ. <u>6mo</u>	CALIBRATION REASON: <input type="checkbox"/> Scheduled <input type="checkbox"/> Demand <input type="checkbox"/> Other		CERT/SO NBR.: <u>C750K</u>		
LOCATION: <u>Plant</u>			DESCRIPTION: <u>BENCH SCALE</u>		

Parameter Tested	Actual as Found	Deviation	Final Reading
<u>1 lb</u>	<u>1.00</u>	<u>0</u>	<u>1.00</u>
<u>5</u>	<u>5.00</u>	<u>0</u>	<u>5.00</u>
<u>10</u>	<u>10.00</u>	<u>0</u>	<u>10.00</u>
<u>50</u>	<u>49.98</u>	<u>-.02</u>	<u>50.00</u>
<u>100</u>	<u>99.96</u>	<u>-.04</u>	<u>100.00</u>

Shift Test

CORNER	LOAD	ERROR	FINAL READING
<u>1</u>	<u>25 lb</u>	<u>+.01</u>	<u>25.01</u>
<u>2</u>	<u>25</u>	<u>-.01</u>	<u>24.99</u>
<u>3</u>	<u>25</u>	<u>-.01</u>	<u>24.99</u>
<u>4</u>	<u>25</u>	<u>+0.02</u>	<u>25.02</u>

<u>1</u>	<u>2</u>
<u>4</u>	<u>3</u>

Were actual values within tolerance? Yes No

Was device adjusted? Yes No

Were final values within tolerance? Yes No

LABEL USED: Calibration / Tested Limited Calibration DO NOT USE - Out of Calibration Levelled: Yes No

United Scale's Operations Procedure P1511 is followed for device calibration. TEST WEIGHT STANDARDS USED (Test weights calibrated per NIST HANDBOOK 105-1):
MSC W84 89 241.02

UNCERTAINTY MEASUREMENT: 0.026 lb

COMMENTS:

TESTED BY: (Technician): [Signature] Date: 8/15/15

This calibration is accredited and meets the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board / ACLASS. Refer to certificate and scope to accreditation AC-1148. This certificate may not be reproduced except in full, without the written approval of Transcat, Inc.

Intertek Testing Services NA Inc.
Middleton, Wisconsin

Calibration Date: 9/1/2015

Next calibration due: 2/1/2016

Calibrated by: KS

SERIAL NUMBER: NA

USE PROCEDURE: MID-OE-LAB-027

Calibration Date of Asset # 713:

DESCRIPTION: Audit weights

Model: Ainsworth

SERIAL #: 39392

WHI#: 029

Weight (G)	Scale reading	Deviation G	Deviation %
0.003	0.003	0.0000	0.00%
0.01	0.0099	-0.0001	-1.00%
0.02	0.02	0.0000	0.00%
0.03	0.03	0.0001	0.33%
0.05	0.0501	0.0001	0.20%
0.1	0.1001	0.0001	0.10%
0.2	0.1999	-0.0001	-0.05%
0.3	0.2999	-0.0001	-0.03%
0.5	0.5	0.0000	0.00%
1	1.0001	0.0001	0.01%
2	2.0001	0.0001	0.01%
3	3.0003	0.0003	0.01%
5	5.0003	0.0003	0.01%
10	10.0003	0.0003	0.00%
20	20.0001	0.0001	0.00%
30	30.0004	0.0004	0.00%
50	50.0002	0.0002	0.00%
100	99.9997	-0.0003	0.00%

Average Deviation: 0.0000833
Standard Deviation: 0.000175734

Scale accuracy

0.0001
0.000437387

Total Uncertainty:

Reviewed by

KK

Date:

9/1/2015

Measurement Uncertainty is calculated using the following formula:

$$O.M.U. = k \cdot \sqrt{((A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2)}$$

O.M.U. = Overall Measurement Uncertainty

A.D. = Average Deviation of the difference of all measured results compared to the reference value.

S.D. = Standard Deviation of the difference of all measured results compared to the reference value.

k = Confidence Factor (2 for 95% confidence)

R.M.U. = Standard Measurement Uncertainty of Reference Measurement Equipment. R.M.U. is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in the calibration standard of the test equipment.

Intertek Testing Services NA Inc.

Middleton, Wisconsin

Calibration Date: 9/2/2015

Next calibration due: 2/2/2016

Calibrated by: KS

USING: #008 Platform scale and procedures located:

USE PROCEDURE: MID-OE-LAB-027

Calibration Date of Asset #008

DESCRIPTION:

Audit weights

Model:Rice Lake

SERIAL #:n/a

WHI#: 160

Weight designation		Scale reading	Deviation
A	5.00	5.00	0.00
B	10.00	10.00	0.00
C	10.00	10.00	0.00
D	25.00	25.00	0.00
E	25.00	25.00	0.00
F	25.00	25.00	0.00

Average Deviation: 0.0000000
Standard Deviation: 0

Scale accuracy: 0.01
Total Uncertainty: 0.01

Reviewed by

CMA

Date:

9/2/15

Measurement Uncertainty is calculated using the following formula:

$$O.M.U. = k \cdot \sqrt{(A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2}$$

O.M.U. = Overall Measurement Uncertainty

A.D. = Average Deviation of the difference of all measured results compared to the reference value.

S.D. = Standard Deviation of the difference of all measured results compared to the reference value.

k = Confidence Factor (2 for 95% confidence)

R.M.U. = Standard Measurement Uncertainty of Reference Measurement Equipment. R.M.U. is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in the calibration standard of the test equipment.

Intertek Testing Services NA Inc.

Middleton, Wisconsin

Calibration Date: 10-29-15

Next Calibration Due: 4-29-16

Calibrated by: RS

USING: Ice bath and boiling water in beakers

USE PROCEDURE: MID-OE-LAB-019

DESCRIPTION: E&E Thermocouple System Asset #: 500

Room Temperature 71.7 Baro: 28.38

Today's boiling point of water: 209.41 F°

Thermocouple # and location	Boiling Water	Ice Bath
1) Flue Gas	211.6	30.4
2) Room Temperature	212.3	31.2
3) Dry Bulb (Tunnel)	212.5	30.9
4) Unused	211.9	30.8
5) Unit Top	212.3	30.6
6) Unit Back	212.8	30.7
7) Unit Right Side	212.5	30.9
8) Unit Left Side	212.1	31.0
9) Unit Bottom	212.0	30.5
10) Catalyst Downstream	212.9	30.5
11) Catalyst Center	213.5	31.5
12) aux	213.3	31.7
13) aux	213.4	31.7
14) aux	213.1	31.8
15) aux	212.9	31.9
16) aux	211.9	31.2
17) DGM (in train 1)	212.2	32.1
18) DGM (out train 1)	213.4	31.8
19) Filter (train 1)	213.1	31.9
20) Filter (train 2)	212.4	32.1
21) DGM (in train 2)	213.5	31.9
22) DGM (out train 2)	212.7	31.7

Average Deviation: 3.24 -0.69 1.28

Standard Deviation: 0.5796 0.5773 0.58

Reviewed by Overall MU at 95% CL:

Date: 10/29/15 7

Measurement Uncertainty is calculated using the following formula:

$$O.M.U. = k \cdot \sqrt{((A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2)}$$

O.M.U. = Overall Measurement Uncertainty

A.D. = Average Deviation of the difference of all measured results compared to the reference value.

S.D. = Standard Deviation of the difference of all measured results compared to the reference value.

k = Confidence Factor (2 for 95% confidence)

R.M.U. = Standard Measurement Uncertainty of Reference Measurement Equipment. R.M.U. is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in the calibration standard of the test equipment.

Method required by The Environmental Protection Agency (Federal Registry method 5G3 and Method 28A)



Calibration Date: 10/14/2015 Calibration By: BZ

Calibration Due: ~~5/14/2015~~ *4/14/16 CMS*

Using: Omega - Model CL23A Calibrator #1240

Use Procedure: WI-L-AMER-Cali-1257

Description: Omega (Data acquisition system)

Serial: E10706227003

Model: 2289
Asset #: 986

All measurements are in °F

Calibrator	Computer	Deviation	Calibrator	Computer	Deviation
50	49.1	0.94	350	350.5	0.51
75	74.6	0.41	375	375.5	0.49
100	99.6	0.43	400	400.7	0.72
125	125.3	0.31	500	500.3	0.31
150	150.6	0.62	600	600.3	0.29
175	174.6	0.35	700.0	700.4	0.45
200	199.7	0.29	800.0	800.3	0.32
225	225.2	0.17	900.0	900.5	0.52
250	249.6	0.45	1000.0	1000.7	0.75
275	275.2	0.16	1100.0	1100.9	0.90
300	300.1	0.15	1200.0	1201.2	1.23
325	325.5	0.51	1300	1301.4	1.39
Average Deviation:					0.53
Standard Deviation:					0.3212

Uncertainty of Readings of #1240 at 95% CL	
Total Uncertainty:	1.24

Reviewed by: *K5*

Date: 10/14/2015

Measurement Uncertainty is calculated using the following formula:

$$O.M.U. = k \cdot \sqrt{(A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2}$$

O.M.U. = Overall Measurement Uncertainty

A.D. = Average Deviation of the difference of all measured results compared to the reference value.

S.D. = Standard Deviation of the difference of all measured results compared to the reference value.

k = Confidence Factor (2 for 95% confidence)

R.M.U. = Standard Measurement Uncertainty of Reference Measurement Equipment. R.M.U. is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in the calibration standard of the test equipment.

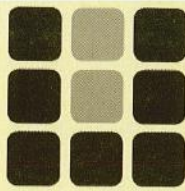
Gas Analyzers

Channel	Analyzer		Zero Gas	Span Gas	Cal Gas
26	CO	DAS	0.01	9.18	1
		Meter	0	9.15	1
		Deviation	-0.10%	-0.28%	0.00%
27	CO ₂	DAS	0.01	24.57	4.91
		Meter	0.02	24.55	4.91
		Deviation	0.10%	-0.08%	0.00%
28	O ₂	DAS	-0.01	22.07	5.03
		Meter	-0.01	22.06	5.02
		Deviation	0.00%	-0.05%	-0.20%

CO Stdev 0.001431773
CO₂ Stdev 0.000908908
O₂ Stdev 0.001044138

CO CO₂ O₂

CALIBRATION SERVICE RECORD



**UNITED
SCALE
& ENGINEERING
CORPORATION**
A **TRANSCAT** Company

- 16725 W. Victor Road
New Berlin, Wisconsin 53151-4132
262-785-1733 • 800-236-1733
FAX 262-785-9754
- 1322 Russett Court
Green Bay, Wisconsin 54313-8999
920-434-2737 • 800-236-2737
FAX 920-434-9605
- 4123 Terminal Drive, Suite 230
McFarland, Wisconsin 53558-8701
608-838-8058 • 800-747-4474
FAX 608-838-9098

Traceability includes no less than: An unbroken chain of comparison, realization of SI units, measurement uncertainty, documentation, competence, periodic recalibration, and measurement assurance. United Scale documents the traceability of measurements to the SI units through the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC), or other recognized national measurement institutes (NMI's) or international standard bodies, or to measurable conditions created in our laboratory, or accepted fundamental and/or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Page 1 of 1

MODEL NO. <u>300</u>		SERIAL NO. <u>1494600044</u>		DEVICE ISO CODE: <u>1134</u>	
CAL DATE: <u>8/19/15</u>		MANUFACTURER: <u>RICE LAKE</u>		TOLERANCE:	
NEXT DUE: <u>2/2016</u>		CAPACITY X RESOLUTION: <u>1000 Lb x .1</u>		CUSTOMER: <u>INTERTEK</u>	
FREQ. <u>6 mo</u>		CALIBRATION REASON: <input type="checkbox"/> Scheduled <input checked="" type="checkbox"/> Demand <input type="checkbox"/> Other		CERT/SO NBR.: <u>C750K</u>	
LOCATION: <u>PLANT UPPER LEVEL</u>			DESCRIPTION: <u>FLOOR SCALE</u>		

Parameter Tested	Actual as Found	Deviation	Final Reading
<u>1 Lb</u>	<u>1.0</u>	<u>0</u>	<u>1.0</u>
<u>10</u>	<u>10.0</u>	<u>0</u>	<u>10.0</u>
<u>50</u>	<u>50.0</u>	<u>0</u>	<u>50.0</u>
<u>500</u>	<u>498.6</u>	<u>-1.4</u>	<u>500.0</u>
<u>1000</u>	<u>997.2</u>	<u>-2.8</u>	<u>1000.0</u>

Shift Test

CORNER	LOAD	ERROR	FINAL READING
<u>1</u>	<u>500 Lb</u>	<u>0</u>	<u>500.0</u>
<u>2</u>	<u>500</u>	<u>0</u>	<u>500.0</u>
<u>3</u>	<u>500</u>	<u>0</u>	<u>500.0</u>
<u>4</u>	<u>500</u>	<u>0</u>	<u>500.0</u>

<u>1</u>	<u>2</u>
<u>4</u>	<u>3</u>

Were actual values within tolerance? Yes No

Was device adjusted? Yes No

Were final values within tolerance? Yes No

LABEL USED: Calibration / Tested Limited Calibration DO NOT USE - Out of Calibration Leveled: Yes No

United Scale's Operations Procedure P1511 is followed for device calibration. TEST WEIGHT STANDARDS USED (Test weights calibrated per NIST HANDBOOK 105-1):

MSC B578

UNCERTAINTY MEASUREMENT: .26 Lb

COMMENTS:

TESTED BY: (Technician) [Signature] Date: 8/19/15

This calibration is accredited and meets the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board / ACLASS. Refer to certificate and scope to accreditation AC-1148. This certificate may not be reproduced except in full, without the written approval of Transcat, Inc.



Certificate of Calibration

Architectural Testing
130 Derry Court
York, PA 17406



ACCREDITED
Certificate No. CL-118

Certificate Number: 00121205192015

MANUFACTURER: Cole Parmer
MODEL: 94440-10
DESCRIPTION: Timer
SERIAL NUMBER: 101587800
ASSET NUMBER: 001212
PROCEDURE NAME: Timer, 2 Timers
PROCEDURE REV.: 1.0

TEST RESULT: PASS
PERFORMED ON: 05/19/2015
DUE DATE: 5/19/2016
CALIBRATED BY: Ed Sullivan
DATA TYPE: AS-FOUND
TEMPERATURE: 72.30 F
HUMIDITY: 36 %

This calibration certificate has been approved by:

CUSTOMER: Christine Schultze
Intertek
LOCATION: 8431 Murphy Drive
Middleton, WI 53562

Digitally Signed by: Matthew Rosario

Matt Rosario
Senior Calibration Technician

Architectural Testing certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure unless otherwise noted. It has been calibrated using measurement standards traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques. This calibration complies with MIL-STD-45662A. Architectural Testing's Calibration Laboratory is accredited by the International Accreditation Service, Inc. (IAS) to ANS/ISO/IEC 17025:2005.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the calibration organization issuing this report.

Note: Any Test Uncertainty Ratio (TUR) that is less than four to one will appear under the "TUR" heading on the data record. If the TUR meets or exceeds four to one, the field is left blank.

Remarks:

Standards Used

Asset #	Description	Cal Date	Due Date
1185004	Fluke 5520A Multi-Product Calibrator	4/14/2015	4/14/2016
62320	Unknown Thermo-Hygrometer Pen-Type Temp. / Humidity	7/24/2014	7/24/2015
63254	Hewlett Packard 53131A Universal Counter	7/17/2014	7/17/2015

Test Results

Test Description	Test Value	Test Result	Lower limit	Upper limit	Units	Result	TUR
Visual		UUT Operates; No Damage					
Visual		UUT Operates; No Damage					
Timer 1							
0.30 Min	30000 milli sec	29672	29000	31000	milli sec	Pass	
0.30 Min	30000 milli sec	29672	29000	31000	milli sec	Pass	
1.00 Min	60000 milli sec	59734	59000	61000	milli sec	Pass	
1.00 Min	60000 milli sec	59734	59000	61000	milli sec	Pass	
2.00 Min	120000 milli sec	120239	119000	121000	milli sec	Pass	
2.00 Min	120000 milli sec	120239	119000	121000	milli sec	Pass	
3.00 Min	180000 milli sec	180022	179000	181000	milli sec	Pass	
3.00 Min	180000 milli sec	180022	179000	181000	milli sec	Pass	
5.00 Min	300000 milli sec	300033	299000	301000	milli sec	Pass	
5.00 Min	300000 milli sec	300033	299000	301000	milli sec	Pass	

Test Results

<u>Test Description</u>	<u>Test Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>Result</u>	<u>TUR</u>
Timer 2							
0.30 Min	30000 milli sec	29630	29000	31000	milli sec	Pass	
0.30 Min	30000 milli sec	29630	29000	31000	milli sec	Pass	
1.00 Min	60000 milli sec	60269	59000	61000	milli sec	Pass	
1.00 Min	60000 milli sec	60269	59000	61000	milli sec	Pass	
0.30 Min	120000 milli sec	119582	119000	121000	milli sec	Pass	
0.30 Min	120000 milli sec	119582	119000	121000	milli sec	Pass	
0.30 Min	180000 milli sec	180081	179000	181000	milli sec	Pass	
0.30 Min	180000 milli sec	180081	179000	181000	milli sec	Pass	
0.30 Min	300000 milli sec	299745	299000	301000	milli sec	Pass	
0.30 Min	300000 milli sec	299745	299000	301000	milli sec	Pass	

***** End of Certificate *****



Certificate of Calibration

Architectural Testing
130 Derry Court
York, PA 17406



ACCREDITED
Certificate No. CL-118

Certificate Number: 00121305192015

MANUFACTURER: Cole Parmer
MODEL: 94440-10
DESCRIPTION: Timer
SERIAL NUMBER: 101587793
ASSET NUMBER: 001213
PROCEDURE NAME: Timer, 2 Timers
PROCEDURE REV.: 1.0

TEST RESULT: PASS
PERFORMED ON: 05/19/2015
DUE DATE: 5/19/2016
CALIBRATED BY: Ed Sullivan
DATA TYPE: AS-FOUND
TEMPERATURE: 72.50 F
HUMIDITY: 36 %

This calibration certificate has been approved by:

CUSTOMER: Christine Schultze
LOCATION: Intertek
8431 Murphy Drive
Middleton, WI 53562

Digitally Signed by: Matthew Rosario

Matt Rosario
Senior Calibration Technician

Architectural Testing certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure unless otherwise noted. It has been calibrated using measurement standards traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques. This calibration complies with MIL-STD-45662A. Architectural Testing's Calibration Laboratory is accredited by the International Accreditation Service, Inc. (IAS) to ANS/ISO/IEC 17025:2005.

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Note: Any Test Uncertainty Ratio (TUR) that is less than four to one will appear under the "TUR" heading on the data record. If the TUR meets or exceeds four to one, the field is left blank.

Remarks:

Standards Used

Asset #	Description	Cal Date	Due Date
1185004	Fluke 5520A Multi-Product Calibrator	4/14/2015	4/14/2016
62320	Unknown Thermo-Hygrometer Pen-Type Temp. / Humidity	7/24/2014	7/24/2015
63254	Hewlett Packard 53131A Universal Counter	7/17/2014	7/17/2015

Test Results

Test Description	Test Value	Test Result	Lower limit	Upper limit	Units	Result	TUR
Visual		UUT Operates; No Damage					
Visual		UUT Operates; No Damage					
Timer 1							
0.30 Min	30000 milli sec	30484	29000	31000	milli sec	Pass	
0.30 Min	30000 milli sec	30484	29000	31000	milli sec	Pass	
1.00 Min	60000 milli sec	60163	59000	61000	milli sec	Pass	
1.00 Min	60000 milli sec	60163	59000	61000	milli sec	Pass	
2.00 Min	120000 milli sec	120591	119000	121000	milli sec	Pass	
2.00 Min	120000 milli sec	120591	119000	121000	milli sec	Pass	
3.00 Min	180000 milli sec	180418	179000	181000	milli sec	Pass	
3.00 Min	180000 milli sec	180418	179000	181000	milli sec	Pass	
5.00 Min	300000 milli sec	300361	299000	301000	milli sec	Pass	
5.00 Min	300000 milli sec	300361	299000	301000	milli sec	Pass	

Test Results

<u>Test Description</u>	<u>Test Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>Result</u>	<u>TUR</u>
Timer 2							
0.30 Min	30000 milli sec	30266	29000	31000	milli sec	Pass	
0.30 Min	30000 milli sec	30266	29000	31000	milli sec	Pass	
1.00 Min	60000 milli sec	59813	59000	61000	milli sec	Pass	
1.00 Min	60000 milli sec	59813	59000	61000	milli sec	Pass	
0.30 Min	120000 milli sec	119734	119000	121000	milli sec	Pass	
0.30 Min	120000 milli sec	119734	119000	121000	milli sec	Pass	
0.30 Min	180000 milli sec	180583	179000	181000	milli sec	Pass	
0.30 Min	180000 milli sec	180583	179000	181000	milli sec	Pass	
0.30 Min	300000 milli sec	300719	299000	301000	milli sec	Pass	
0.30 Min	300000 milli sec	300719	299000	301000	milli sec	Pass	

***** End of Certificate *****

Certificate of Calibration

Customer: INTERTEK MIDDLETON
8431 MURPHY DR.
MIDDLETON, WI, 53562
608-824-7422

P.O. Number:
ID Number: 1340

Description: PRECISION PSYCHROMETER
Manufacturer: EXTECH
Model Number: RH390
Serial Number: 13018340
Technician: RICHARD PANKEY

Calibration Date: 09/21/2015
Calibration Due: 09/21/2016
Procedure: TMI-M-HYGROTHERMOGRAPHS
Rev: 2/22/2011
Temperature: 67 F
Humidity: 35 % RH
As Found Condition: IN TOLERANCE
Calibration Results: IN TOLERANCE

On-Site Calibration:

Comments: Salts were used as an intrinsic standard

Limiting Attribute:

This instrument has been calibrated using standards traceable to the National Institute of Standards and Technology, derived from natural physical constants, ratio measurements or compared to consensus standards. Unless otherwise noted, the method of calibration is direct comparison to a known standard.

Reported uncertainties and "test uncertainty ratios" (TUR's) are expressed as expanded uncertainty values at approximately 95% confidence level using a coverage factor of K=2. A TUR of 4:1 is routinely observed unless otherwise noted on the certificate. Statements of compliance are based on test results falling within specified limits with no reduction by the uncertainty of the measurement.

TMI's Quality System is accredited to ISO/IEC 17025 and ANSI/NCSL Z540-1 by A2LA. ISO/IEC17025 is written in a language relevant to laboratory operations, meeting the principles of ISO 9001 and aligned with its pertinent requirements. The instrument listed on this certificate has been calibrated to the requirements of ANSI/NCSL Z540-1 and TMI's Quality Manual, QM-1.

Results contained in this document relate only to the item calibrated. Calibration due dates appearing on the certificate or label are determined by the client for administrative purposes and do not imply continued conformance to specifications.

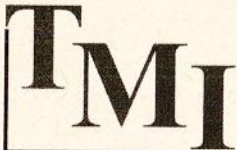
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ANTHONY ROGERS, BRANCH MANAGER

JACK SHULER, QUALITY MANAGER

Calibration Standards

<u>Asset Number</u>	<u>Manufacturer</u>	<u>Model Number</u>	<u>Date Calibrated</u>	<u>Cal Due</u>
Y3530060/Y4030007	VAISALA	HMP46/HMI41	9/4/2014	10/11/2015
RKFD100	FLUKE	9103	6/26/2015	2/26/2017



Technical Maintenance, Inc.

3248 FOREST VIEW ROAD, ROCKFORD, IL 61109

Phone: 779-774-3877 Fax 779-774-3884

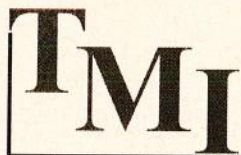
www.tmiclibration.com

ANSI/NCSL Z540-1-1994

Certificate of Calibration

Data Sheet

<u>Parameter</u>	<u>Nominal</u>	<u>Minimum</u>	<u>Maximum</u>	<u>As Found</u>	<u>As Left</u>	<u>Unit</u>	<u>ADJ/FAIL</u>
Temperature Accuracy, °F	80.0	78.2	81.8	79.8	79.8	°F	
Temperature Accuracy, °F	70.0	68.2	71.8	69.7	69.7	°F	
Temperature Accuracy, °F	60.0	58.2	61.8	59.6	59.6	°F	
Humidity Accuracy, (10-90% RH range)	11.0	9.0	13.0	11.6	11.6	%RH	
Humidity Accuracy, (10-90% RH range)	33.0	31.0	35.0	33.3	33.3	%RH	
Humidity Accuracy, (10-90% RH range)	75.0	73.0	77.0	75.8	75.8	%RH	



Technical Maintenance, Inc.

3248 FOREST VIEW ROAD, ROCKFORD, IL 61109

Phone: 779-774-3877 Fax 779-774-3884

www.tmiclibration.com

ANSI/NCSL Z540-1-1994

Appendix D

Unit Installation Manual



Operator's Manual

Serenity Pellet Stove

ENGLISH

FRANÇAIS

CAUTION

DO NOT DISCARD MANUAL!
IMPORTANT OPERATING AND
MAINTENANCE INSTRUCTIONS
INCLUDED.



SAVE THESE INSTRUCTIONS AND
LEAVE THIS MANUAL WITH ANY
PERSON RESPONSIBLE FOR USE AND
OPERATION.

ATTENTION NE PAS JETER!

IMPORTANTES INSTRUCTIONS
D'UTILISATION ET D'ENTRETIEN
INCLUSES.

CONSERVEZ CES INSTRUCTIONS
ET LAISSEZ CE MANUEL À TOUTE
PERSONNE RESPONSABLE
DE L'UTILISATION ET DU
FONCTIONNEMENT.

WARNING

PLEASE READ THIS ENTIRE
MANUAL BEFORE INSTALLATION
AND USE OF THIS PELLET
FUEL-BURNING ROOM HEATER.
FAILURE TO FOLLOW THESE
INSTRUCTIONS COULD RESULT
IN PROPERTY DAMAGE, BODILY
INJURY OR EVEN DEATH.

AVERTISSEMENT

VEUILLEZ LIRE CE MANUEL EN
ENTIER AVANT D'INSTALLER
ET D'UTILISER CET APPAREIL
DE CHAUFFAGE AUTONOME À
GRANULES, AFIN D'ÉCARTER LES
RISQUES DE DÉGÂTS MATÉRIELS,
DE BLESSURES CORPORELLES,
VOIRE DE MORT.



CAUTION

CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS
AND INSTALLATION INSPECTION REQUIREMENTS FOR YOUR AREA.

ATTENTION

CONSULTER LES SERVICES DU BÂTIMENT OU D'INCENDIE LOCAUX
CONCERNANT LES RESTRICTIONS ET LES EXIGENCES D'INSPECTION
D'INSTALLATION EN VIGUEUR.

Get parts online at
www.CastleStoves.com



P/N: 22020

ECN: 10766

REV5: 02/23/2015

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WARNINGS AND SAFETY PRECAUTIONS

Owner's Responsibility

- Accurate assembly and safe and effective use of the stove is the owner's responsibility.
- Read and follow all safety instructions.
- Carefully follow all assembly instructions.
- Maintain the stove according to directions and schedule included in this Castle operator's manual.
- Ensure that anyone who uses the stove is familiar with all controls and safety precautions.

Special Messages

Your manual contains special messages to bring attention to potential safety concerns, stove damage as well as helpful operating and servicing information. Please read all the information carefully to avoid injury and stove damage.

NOTE: General information is given throughout the manual that may help the operator in the operation or service of the stove.

IMPORTANT SAFETY PRECAUTIONS

Please read this section carefully. Operate the stove according to the safety instructions and recommendations outlined here and inserted throughout the text. Anyone who uses this stove must read the instructions and be familiar with the controls.



THIS SYMBOL POINTS OUT IMPORTANT SAFETY INSTRUCTIONS WHICH IF NOT FOLLOWED COULD ENDANGER YOUR PERSONAL SAFETY. READ AND FOLLOW ALL INSTRUCTIONS IN THIS MANUAL BEFORE ATTEMPTING TO OPERATE THIS EQUIPMENT.



DANGER

DANGER INDICATES A SERIOUS INJURY OR FATALITY WILL RESULT IF THE SAFETY INSTRUCTIONS THAT FOLLOW THIS SIGNAL WORD ARE NOT OBEYED.



WARNING

WARNING INDICATES A SERIOUS INJURY OR FATALITY COULD RESULT IF THE SAFETY INSTRUCTIONS THAT FOLLOW THIS SIGNAL WORD ARE NOT OBEYED.



CAUTION

CAUTION INDICATES YOU CAN OR YOUR EQUIPMENT CAN BE HURT IF THE SAFETY INSTRUCTIONS THAT FOLLOW THIS SIGNAL WORD ARE NOT OBEYED.



IMPORTANT

IMPORTANT INDICATES HELPFUL INFORMATION FOR PROPER ASSEMBLY, OPERATION, OR MAINTENANCE OF YOUR EQUIPMENT.



WARNING

YOU MUST READ, UNDERSTAND AND COMPLY WITH ALL SAFETY AND OPERATING INSTRUCTIONS IN THIS MANUAL BEFORE ATTEMPTING TO SETUP AND OPERATE YOUR STOVE.

FAILURE TO COMPLY WITH ALL SAFETY AND OPERATING INSTRUCTIONS CAN RESULT IN SERIOUS PERSONAL INJURY TO YOU AND/OR BYSTANDERS, AND RISK OF EQUIPMENT AND PROPERTY DAMAGE. THE TRIANGLE IN THE TEXT SIGNIFIES IMPORTANT CAUTIONS OR WARNINGS WHICH MUST BE FOLLOWED.



WARNING



PLEASE READ THIS ENTIRE MANUAL BEFORE INSTALLATION AND USE OF THIS PELLET FUEL-BURNING ROOM HEATER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN PROPERTY DAMAGE, BODILY INJURY OR EVEN DEATH.

DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN THE VICINITY OF THIS OR ANY OTHER APPLIANCE.

DO NOT OVERFIRE - IF ANY EXTERNAL PART STARTS TO GLOW, YOU ARE OVERFIRING. REDUCE FEED RATE. OVERFIRING WILL VOID THE WARRANTY.

COMPLY WITH ALL MINIMUM CLEARANCES TO COMBUSTIBLES AS SPECIFIED. FAILURE TO COMPLY MAY CAUSE A HOUSE FIRE.



WARNING



HOT SURFACE ! DO NOT TOUCH! SEVERE BURNS MAY RESULT. CLOTHING IGNITION MAY RESULT. GLASS AND OTHER SURFACES ARE HOT DURING OPERATION AND COOL DOWN.

KEEP CHILDREN AWAY.

CAREFULLY SUPERVISE CHILDREN IN SAME ROOM AS APPLIANCE.

DO NOT OPERATE WITH PROTECTIVE BARRIERS OPEN OR REMOVED.

KEEP CLOTHING, FURNITURE, DRAPERIES AND OTHER COMBUSTIBLES AWAY.



CAUTION

CHECK BUILDING CODES PRIOR TO INSTALLATION. CONTACT THE REGULATING AUTHORITY PRIOR TO INSTALLATION TO DETERMINE THE NEED FOR A PERMIT.

INSTALLATION MUST COMPLY WITH LOCAL, REGIONAL, STATE AND NATIONAL CODES AND REGULATIONS

CONSULT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION REQUIREMENTS IN YOUR AREA.

TESTED AND APPROVED FOR PELLET FUEL. BURNING ANY OTHER TYPE OF FUEL VOIDS WARRANTY.



CAUTION



DO NOT DISCARD

IMPORTANT OPERATING AND MAINTENANCE INSTRUCTIONS INCLUDED.

READ, UNDERSTAND AND FOLLOW THESE INSTRUCTIONS FOR SAFE INSTALLATION AND OPERATION.

LEAVE THIS MANUAL WITH PARTY RESPONSIBLE FOR USE AND OPERATION.



WARNING

WARNING INDICATES A SERIOUS INJURY OR FATALITY COULD RESULT IF THE SAFETY INSTRUCTIONS THAT FOLLOW THIS SIGNAL WORD ARE NOT OBEYED.

READ THIS ENTIRE MANUAL BEFORE YOU INSTALL AND USE YOUR NEW PELLET STOVE. FAILURE TO FOLLOW INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY, OR EVEN DEATH.

CHILDREN AND ADULTS SHOULD BE ALERTED TO THE HAZARDS OF HIGH SURFACE TEMPERATURES AND SHOULD STAY AWAY TO AVOID CONTACT TO SKIN AND/OR CLOTHING.

YOUNG CHILDREN SHOULD BE CAREFULLY SUPERVISED WHEN THEY ARE IN THE SAME ROOM AS THE STOVE.

CLOTHING AND OTHER FLAMMABLE MATERIALS SHOULD NOT BE PLACED ON OR NEAR THIS UNIT.

FLAMMABLE OR EXPLOSIVE LIQUIDS SUCH AS GASOLINE, NAPHTHA, ALCOHOL, OR ENGINE OIL MUST NEVER BE USED IN OR AROUND STOVE. THESE LIQUIDS MUST BE STORED IN A SEPARATE ROOM AS THE OPEN FLAME IN THE FIRE BOX COULD IGNITE THE FUMES OF SUCH LIQUIDS.

DO NOT BURN GARBAGE IN THIS UNIT. THE BURNING OF OTHER SOLID FUELS SUCH AS CORD WOOD OR WOOD CHIPS IN THIS STOVE IS NOT PERMITTED. ANY FUELS NOT CERTIFIED BY CASTLE PELLET STOVES WHICH ARE BURNED IN THIS STOVE WILL VOID THE WARRANTY.

DO NOT ROUTE POWER CORD IN HIGH TRAFFIC AREAS. A POWER SURGE PROTECTOR PLUGGED INTO A GROUNDED 120 VOLT POWER SOURCE IS REQUIRED.



WARNING

DO NOT INSTALL A FLUE DAMPER IN THE EXHAUST VENTING SYSTEM OF THIS UNIT.

DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVICING ANOTHER APPLIANCE.

DO NOT INSTALL IN A SLEEPING ROOM.

DO NOT CONNECT TO ANY AIR DISTRIBUTION DUCT OR SYSTEM.

- **DO NOT CONNECT DIRECTLY TO A MASONRY CHIMNEY.**

- **DO NOT TERMINATE VENT IN ANY ENCLOSED OR SEMI-ENCLOSED AREA, SUCH AS; CARPORTS, GARAGE, ATTIC, CRAWL SPACE, UNDER A SUN DECK OR PORCH, NARROW WALKWAY OR CLOSED AREA, OR ANY LOCATION THAT CAN BUILD UP A CONCENTRATION OF FUMES SUCH AS A STAIRWELL, COVERED BREEZEWAY ETC.**

- **NEVER TOUCH DOOR LATCHES WHILE STOVE IS IN OPERATION; THEY GET EXTREMELY HOT.**

PROPER INSTALLATION OF THIS STOVE IS NECESSARY FOR SAFE AND EFFICIENT OPERATION. INSTALLING THIS PRODUCT IMPROPERLY MAY RESULT IN A HOUSE FIRE AND PERSONAL INJURY.

ALL APPLICABLE BUILDING CODES FOR YOUR LOCATION MUST BE FOLLOWED. IN AREAS WHERE BUILDING CODES REQUIRE ADDITIONAL STEPS TO THE INSTALLATION OF THIS PRODUCT NOT INCLUDED IN THIS MANUAL, THE BUILDING CODES WILL TAKE PRECEDENT AND MUST BE FOLLOWED. CONTACT YOUR LOCAL BUILDING INSPECTOR TO OBTAIN ANY NECESSARY PERMITS OR INSPECTION GUIDELINES BEFORE INSTALLING THE PRODUCT.



Serenity Pellet Stove

ENGLISH



CAUTION

ALL APPLICABLE BUILDING CODES FOR YOUR LOCATION MUST BE FOLLOWED. IN AREAS WHERE BUILDING CODES REQUIRE ADDITIONAL STEPS TO THE INSTALLATION OF THIS PRODUCT NOT INCLUDED IN THIS MANUAL, THE BUILDING CODES WILL TAKE PRECEDENT AND MUST BE FOLLOWED. CONTACT YOUR LOCAL BUILDING INSPECTOR TO OBTAIN ANY NECESSARY PERMITS OR INSPECTION GUIDELINES BEFORE INSTALLING THE PRODUCT.

CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION REQUIREMENTS IN YOUR AREA.

CONTACT YOUR LOCAL AUTHORITY (SUCH AS MUNICIPAL BUILDING DEPARTMENT, FIRE DEPARTMENT, FIRE PREVENTION BUREAU, ETC.) TO DETERMINE THE NEED FOR A PERMIT.

THE CASTLE PELLET STOVES PELLET STOVE IS DESIGNED TO BURN PELLET FUEL ONLY.

A WORKING SMOKE DETECTOR IS REQUIRED AND MUST BE INSTALLED IN THE SAME ROOM AS THE STOVE.

THIS STOVE IS NOT INTENDED FOR USE IN COMMERCIAL APPLICATIONS.

DOOR AND ASH PAN MUST BE CLOSED AND LATCHED DURING OPERATION.

NOTIFY YOUR INSURANCE COMPANY OF PELLET STOVE INSTALLATION.

THIS INSTALLATION MUST CONFORM WITH LOCAL CODES. IN THE ABSENCE OF LOCAL CODES YOU MUST COMPLY WITH ASTM E1509, (UM) 84-HUD, ULC/ORDC-1482, AND UCL S627-2000.

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

KEEP COMBUSTIBLE MATERIALS (SUCH AS GRASS, LEAVES, ETC.) AT LEAST THREE FEET AWAY FROM THE FLUE OUTLET ON THE OUTSIDE OF THE BUILDING.

THIS STOVE SHOULD NOT BE USED AS THE ONLY SOURCE OF HEAT IN THE HOUSE. POWER OUTAGES AND PERIODIC MAINTENANCE WILL RESULT IN A TOTAL LOSS OF HEAT.

DO NOT LEAVE HOPPER DOOR OPEN.



CAUTION

INSTALLATION AND REPAIR OF THIS PELLET STOVE SHOULD BE DONE BY A QUALIFIED SERVICE PERSON. THE APPLIANCE SHOULD BE INSPECTED BEFORE USE AND AT LEAST ONCE A YEAR BY A QUALIFIED SERVICE PERSON. IT IS IMPERATIVE THAT THE CONTROL COMPARTMENTS, FIRE BOX, AND THE CIRCULATING AIR PASSAGEWAYS OF THE STOVE BE KEPT CLEAN.

THE OPERATION OF EXHAUST FANS SUCH AS BATHROOM FANS, ATTIC FANS, ETC. MIGHT STARVE THE PELLET STOVE OF COMBUSTIBLE AIR CREATING A NEGATIVE PRESSURE IN THE ROOM. PROVIDE ADEQUATE VENTILATION OF THE ROOM ACCOMPANYING THE PELLET STOVE. IF NOT, THE PRESSURE SWITCH MAY SHUT OFF OPERATION OF THE PELLET STOVE.

THE MOVING PARTS OF THIS STOVE ARE PROPELLED BY HIGH TORQUE ELECTRIC MOTORS. THESE PARTS CAN CAUSE SEVERE DAMAGE TO BODY PARTS THAT GET NEAR THEM. KEEP ALL BODY PARTS AWAY FROM AUGER AND FANS WHILE THE STOVE IS PLUGGED INTO AN ELECTRICAL OUTLET. THESE MOVING PARTS MAY BEGIN TO MOVE AT ANY TIME THE STOVE IS PLUGGED IN.

THE VENT SURFACES CAN GET HOT ENOUGH TO CAUSE BURNS IF TOUCHED. NONCOMBUSTIBLE SHIELDING OR GUARDS MAY BE REQUIRED.

INSTALL VENT AT CLEARANCES SPECIFIED BY THE VENT MANUFACTURER.

ALL VENTING JOINTS, WHETHER VERTICAL OR HORIZONTAL, SHOULD BE MADE GAS-TIGHT WITH RECOMMENDED SEALANTS SPECIFIED BY VENT MANUFACTURER.

ACCORDING TO HUD (HOUSING & URBAN DEVELOPMENT) REQUIREMENTS, WHEN INSTALLED IN A MOBILE HOME, THIS STOVE MUST BE GROUNDED DIRECTLY TO THE STEEL CHASSIS OF THE MOBILE HOME AND BOLTED TO THE FLOOR. DIRECT AIR ACCESS MUST BE PROVIDED, USE A FRESH AIR KIT.

FOR USE IN THE UNITED STATES AND CANADA. APPROVED FOR INSTALLATION IN MOBILE HOMES.

CASTLE PELLET STOVES, PRODUCER OF THIS APPLIANCE, RESERVES THE RIGHT TO ALTER ITS PRODUCTS, SPECIFICATIONS AND/OR PRICE WITHOUT NOTICE.



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Serenity Pellet Stove

INTRODUCTION

Congratulations on your investment in quality. Thank you for your purchase on a Castle Pellet Stove. We have worked to ensure that this pellet stove meets the highest standards for usability and durability. With proper care, your stove will provide many years of dependable service. Please read entire manual before installation and use.

Burning Pellet Fuel

Ashes need to be removed from the stove periodically. See "Normal Care and Maintenance" section for cleaning procedure. Due to the nature of pellet fuels, this stove will require attention periodically. Regular cleaning is an important part of burning pellet fuel.

Pellets

- This pellet stove is designed and approved to burn wood pellets, that comply with pellet fuels industry standards. Minimum of 40 lbs. density per cubic foot, 1/4" to 5/16" in diameter, with a maximum length of 1-1/2", and less than 1% ash.
- The performance of your pellet stove is greatly affected by the type and quality of wood pellets. As the heat output of various quality wood pellets differ, so will the performance and heat output of the pellet stove.
- Wood pellets are generally produced out of wood waste such as sawdust and shavings. The raw material is dried, mechanically fractioned to size and extruded into pellets under high pressure. Wood pellets need to be protected from direct exposure to water. Water from sources such as condensation and humidity causes pellets to expand and break down into unusable fuel. Keep fuel dry.
- It is important to select and use only pellets that are dry and free from dirt and debris. Dirty fuel will adversely affect the operation and performance of the unit and will void the warranty. The Pellet Fuel Institute (PFI) has established standards for wood pellet manufacturers. Only use pellets that meet or exceed PFI standards for premium fuel pellets. Pellets that contain colored paper, cardboard, solvents, trash, garbage, or other non-woody waste material should be avoided.

Do Not Burn: Garbage; Lawn clippings or yard waste; materials containing rubber, including tires; materials containing plastic; waste petroleum products, paints or paint thinners, or asphalt products; materials containing asbestos; construction or demolition debris; railroad ties or pressure-treated wood; manure or animal remains; paper products, cardboard, plywood, or particleboard.

Clinkers

- Impurities, such as silica (clinkers), will need to be regularly cleaned and removed from the pellet stove. Clinkers will form a hard mass and block airflow through the pot liner. High quality fuels will result in fewer clinkers.

Automatic Safety Features

Power Outage

During a power outage, the stove will shutdown safely. Do not open the main door or ash door. During a power failure the exhaust fan will not run. Keeping the doors sealed will allow the exhaust vent to draft out naturally. When the power is restored, the stove will not restart. If the exhaust temperature is still 120 degrees Fahrenheit when power is restored, the exhaust and room fans will continue to run until the stove cools. See "Operation" section for instructions on restarting the stove.

Overheating

Over Fire Protection: If the stove is being over fired or burning too hot, the high limit switches will automatically shut down the stove to avoid damage to components. The exhaust fan will continue to run until the proof of fire switch cools. Allow stove to cool before attempting to re-ignite. See the "Operation" section for more information.

	WARNING
IF THE ELECTRICAL POWER FAILS ANY TIME WHEN THE STOVE IS HOT, KEEP ALL STOVE DOORS CLOSED. THE AUTOMATIC SAFETY FEATURES MUST NOT BE BYPASSED.	

	CAUTION
BURNING WOOD PELLETS ACCORDING TO RECOMMENDATIONS WILL ASSURE LONGER STOVE LIFE AND LESS FUEL RELATED PROBLEMS. THE USE OF GRATES OR OTHER METHODS OF SUPPORTING THE FUEL IN THIS STOVE IS PROHIBITED AND WILL VOID ALL WARRANTIES.	



Serenity Pellet Stove

ENGLISH

SPECIFICATIONS

Model Number	Serenity
BTU/hour input (1)	4.0 lbs/hr
Heating Capacity (2)	1,500 sq. ft.
Electrical Rating (3)	120 Volts, 60 Hz
Power Consumption	402 Watts ignition 77 Watts operating
Fuel Storage Capacity	40 lb
Flue Size (4)	3 in.
Width	18.25 in.
Height	34 in.
Depth	23.75 in.
Weight	186 lb

- (1) Heat output will vary, depending on the brand, type and quality of fuel and the moisture content. Consult your dealer for best results.
- (2) Based on post 1982 home construction, requiring 35 BTU/Hr. per Sq. Ft.
- (3) Install per NFPA 70 and follow all state and local codes, contact licensed electrical contractor for assistance.
- (4) Install per NFPA 211 and follow all state and local codes, contact licensed installers for assistance.

Listing label:



Tested to the following standards: UL1482, ASTM E1509, ULC/ORD-C1482-M1990, UCL S627-2000, and E2779

Glass Specifications:

This stove is equipped with 5 mm ceramic glass. Replace glass only with Castle Pellet Stoves ceramic glass. Call your servicing dealer or Castle at 1-800-345-6007 for replacement parts.



CAUTION

THIS INSTALLATION MUST CONFORM WITH LOCAL CODES. IN THE ABSENCE OF LOCAL CODES YOU MUST COMPLY WITH ASTM E1509, (UM) 84-HUD, ULC/ORD-C-1482 AND AND UCL S627-2000.

CASTLE PELLET STOVES, MANUFACTURER OF THIS APPLIANCE, RESERVES THE RIGHT TO ALTER ITS PRODUCTS AND/OR THEIR SPECIFICATIONS WITHOUT NOTICE.

MAKE SURE THE HOPPER IS FREE OF ALL FOREIGN MATTER BEFORE FILLING WITH FUEL. FOREIGN MATERIAL WILL CAUSE AUGER JAMS AND WILL VOID STOVE WARRANTY.

COMPLIANCE NOTE

The Serenity pellet heater, by Castle, meets the U.S. Environmental Protection Agency's emission limits for pellet heaters sold after May 15, 2015, as well as those for pellet heaters sold after May 15, 2020.

This wood heater needs periodic inspection and repair for proper operation. It is against federal regulations to operate this wood heater in a manner inconsistent with operating instructions in this manual. 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.

UNPACKING

Your Castle Serenity will come fully assembled. Remove all packing material and tape from the inside of the firebox. Remove any tape on the outside of the glass. Open the hopper, remove all packing material and power cord.

INSTALLATION

It is recommended the stove be installed and serviced by authorized professionals who are certified by the National Fireplace Institute (NFI) as NFI Pellet Specialists.

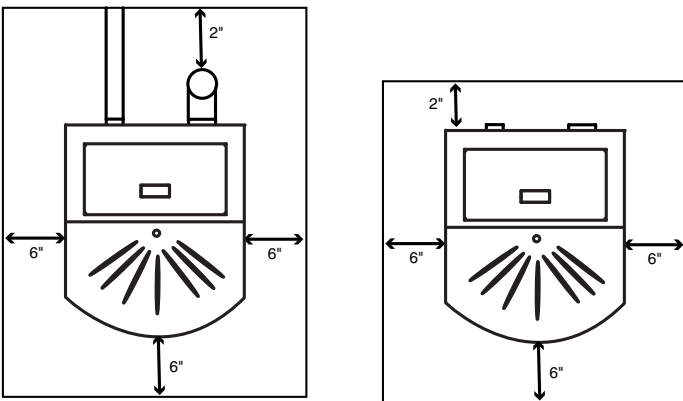
Proper installation of this stove is necessary for safe and efficient operation. Installing this product improperly may result in a house fire and personal injury. All applicable building codes for your location must be followed. In areas where building codes require additional steps to the installation of this product not included in this manual, the building codes will take precedent and must be followed. Contact your local building inspector to obtain any necessary permits or inspection guidelines before installing the product.

Stove Placement

Sketch out a plan for installing the stove including dimensions before permanent placement. When determining the location for the stove, wall stud location is critical. You may need to adjust the location of the stove to avoid trying to vent through a wall stud. Before placing the pellet stove, connect the vent and allow for minimum clearance to combustible walls.

Floor Protection Requirements

The stove must be installed on a noncombustible floor, with proper floor protection, or on a masonry hearth. When a clean out t-vent is installed in the inside of a home, the floor protector must extend 2" beyond rear of t-vent. **SEE FIGURE 1.** When stove is vented straight through the wall and the clean out t-vent is on the exterior of the home, the minimum clearance is 2" from the back of the stove to the wall. **SEE FIGURE 2.** The minimum floor protector material is 24 GA sheet metal.



Figures 1 And 2: Pellet Stove Floor Pad Clearances



WARNING

READ THIS ENTIRE MANUAL BEFORE YOU INSTALL AND USE THIS STOVE. FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN PROPERTY DAMAGE, BODILY INJURY, OR EVEN DEATH.

DO NOT INSTALL A FLUE DAMPER IN THE EXHAUST VENTING SYSTEM OF THIS UNIT.

DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.

CHILDREN AND ADULTS SHOULD BE ALERTED TO THE HAZARDS OF HIGH SURFACE TEMPERATURES AND SHOULD STAY AWAY TO AVOID BUMPS TO SKIN AND/OR CLOTHING.

YOUNG CHILDREN SHOULD BE CAREFULLY SUPERVISED WHEN THEY ARE IN THE SAME ROOM AS THE STOVE.

CLOTHING AND OTHER FLAMMABLE MATERIALS SHOULD NOT BE PLACED ON OR NEAR THIS UNIT.



CAUTION

THIS STOVE SHOULD NOT BE USED AS THE ONLY SOURCE OF HEAT IN THE HOUSE. POWER OUTAGES AND PERIODIC MAINTENANCE WILL RESULT IN A TOTAL LOSS OF HEAT.

CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION REQUIREMENTS IN YOUR AREA.

CONTACT YOUR LOCAL AUTHORITY (SUCH AS MUNICIPAL BUILDING DEPARTMENT, FIRE DEPARTMENT, FIRE PREVENTION BUREAU, ETC.) TO DETERMINE THE NEED FOR A PERMIT.

KEEP COMBUSTIBLE MATERIALS (SUCH AS GRASS, LEAVES, ETC.) AT LEAST 3 FEET AWAY FROM THE FLUE OUTLET ON THE OUTSIDE OF THE BUILDING.

INSTALLATION AND REPAIR OF THIS PELLET STOVE SHOULD BE DONE BY A QUALIFIED SERVICE PERSON. THE APPLIANCE SHOULD BE INSPECTED BEFORE USE AND AT LEAST ANNUALLY BY A QUALIFIED SERVICE PERSON. IT IS IMPERATIVE THAT CONTROL COMPARTMENTS, FIRE BOX, AND CIRCULATING AIR PASSAGeways OF THE STOVE BE KEPT CLEAN.

Clearances To Combustibles

NOTE: These are minimum clearances to combustible walls established by the ASTM testing lab. (SEE FIGURES 3, 4, 5, & 6.)

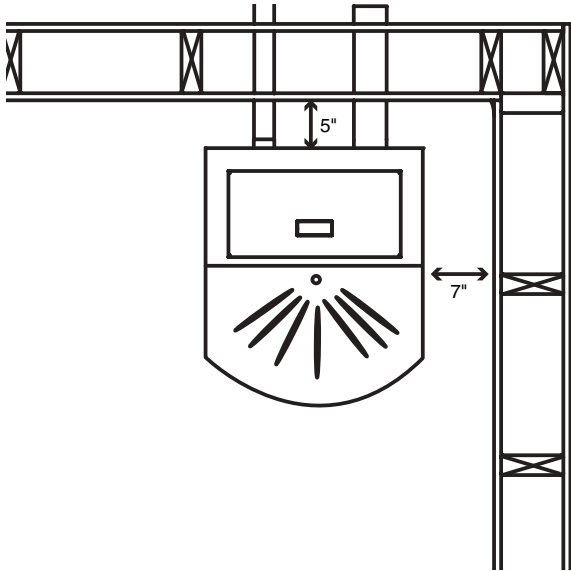


Figure 3: Straight Installation Through Wall

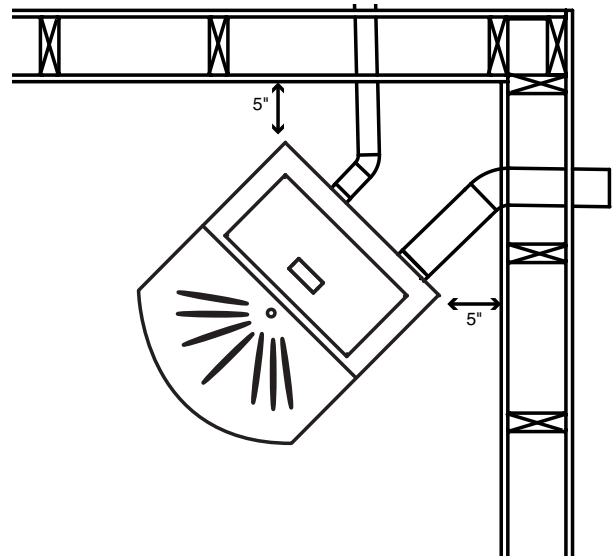


Figure 4: Corner Installation Through The Wall Vents

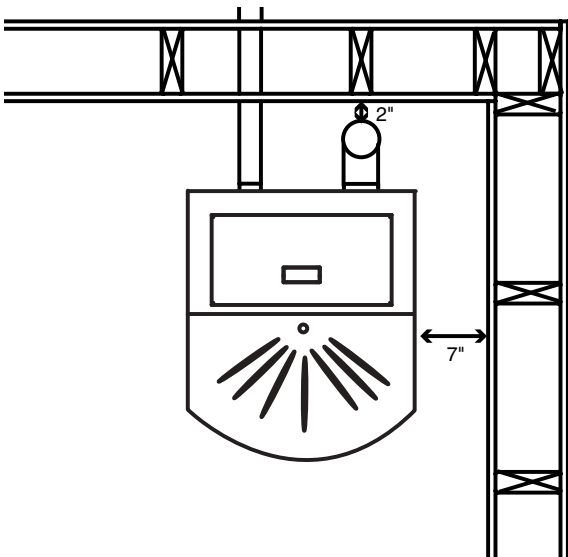


Figure 5: Straight Installation Interior Vertical Vents

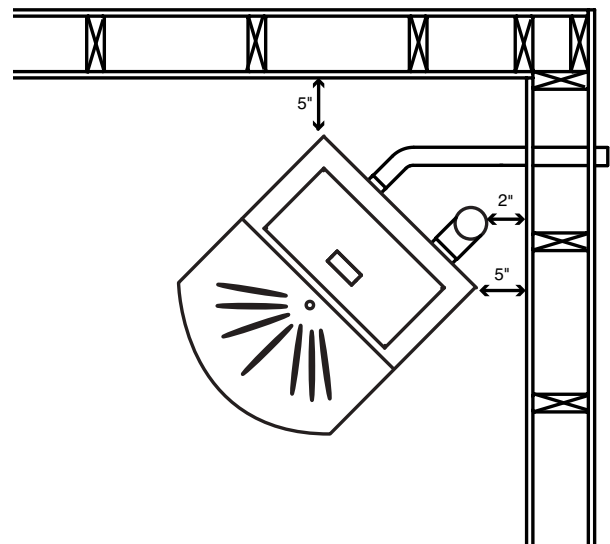


Figure 6: Corner Installation Interior Vertical Vents

NOTE: When interior vent is installed vertically, the clearance to the back wall is determined by the vent size used. Install vent at clearance specified by the vent manufacturer. Take into consideration any upward turning elbows or tees.

Venting

Before venting, consult vent manufacturer's specifications and recommendations for all venting installations.

The following installation guidelines must be followed to ensure conformity with both the safety listing of this stove and to local building codes.

Note: Where passage through a wall, or partition of combustible construction is desired, the installation shall conform to CAN/CSA -8365.

Type Of Vent

The pellet venting pipe (also known as L vent) is constructed of two layers with air space between the layers. This air space acts as an insulator and reduces outside surface temperature of pipe to allow a clearance to combustibles.

A UL listed 3" or 4" type L pellet vent exhaust system must be used for installation and attached to the pipe connector provided on the back of the stove. Use a 3" to 4" adapter for 4" pipe. A cap must be used at the termination of type L vent chimneys. For elevations above 2,500 feet above sea level, a 4" L is required.

Pellet Stove Vent Installation

Vent termination **MUST** exhaust above air inlet elevation.

It is required to install at least three feet (3') of vertical pellet vent pipe. This vertical pipe will create some natural draft to prevent the possibility of smoke or odor during appliance shutdown and will keep exhaust from causing a nuisance or hazard from exposure to high temperatures.

The installation must include a clean out tee to enable collection of fly ash and to permit periodic cleaning of the exhaust system.

Total length of horizontal vent must not exceed 10 feet. The maximum recommended vertical venting height is 18 feet.

All joints for pellet vent are required to be fastened with at least three screws and all pellet vent connections (including adapters, elbows, etc.) should be sealed airtight by injecting 500° F. RTV silicone into the gap between sections.



The area where the vent pipe goes through to the exterior of the home must be sealed with silicone or other means to maintain the vapor barrier between the exterior and the interior of the home.



CAUTION

DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE.

DO NOT INSTALL A FLUE DAMPER IN THE EXHAUST VENTING SYSTEM OF THIS UNIT.

DO NOT CONNECT DIRECTLY TO A MASONRY CHIMNEY.

DO NOT TERMINATE VENT IN ANY ENCLOSED OR SEMI-ENCLOSED AREA, SUCH AS; CARPORTS, GARAGE, ATTIC, CRAWL SPACE, UNDER A SUN DECK OR PORCH, NARROW WALKWAY OR CLOSED AREA, OR ANY LOCATION THAT CAN BUILD UP A CONCENTRATION OF FUMES SUCH AS A STAIRWELL, COVERED BREEZEWAY ETC.



WARNING

VENT SURFACES CAN GET HOT ENOUGH TO CAUSE BURNS IF TOUCHED. NONCOMBUSTIBLE SHIELDING OR GUARDS MAY BE REQUIRED.

PELLET VENT MUST MAINTAIN MINIMUM CLEARANCES SPECIFIED BY VENT MANUFACTURER FOR CLEARANCE TO ANY COMBUSTIBLES.

INSTALL VENT AT CLEARANCES SPECIFIED BY THE VENT MANUFACTURER.

ALL VENTING, WHETHER VERTICAL OR HORIZONTAL, JOINTS SHOULD BE MADE GAS-TIGHT WITH RECOMMENDED SEALANTS.

Preferred Pellet Vent Termination Clearances

- The stove vent must terminate on the outside of the building. Horizontal terminations must extend a minimum of 12" from the wall. Vertical terminations must protrude a minimum 24" from the roof surface. **In addition, all clearances listed below must be met. SEE FIGURE 7.**
- Must have an approved cap (to prevent water from entering) or a 45° downturn with rodent screen.
- If the termination is located on a windy side of the house, we suggest using an approved house shield to prevent soot from building up on the side of the house.
- A vent must not be located where it will become plugged by snow or other material.

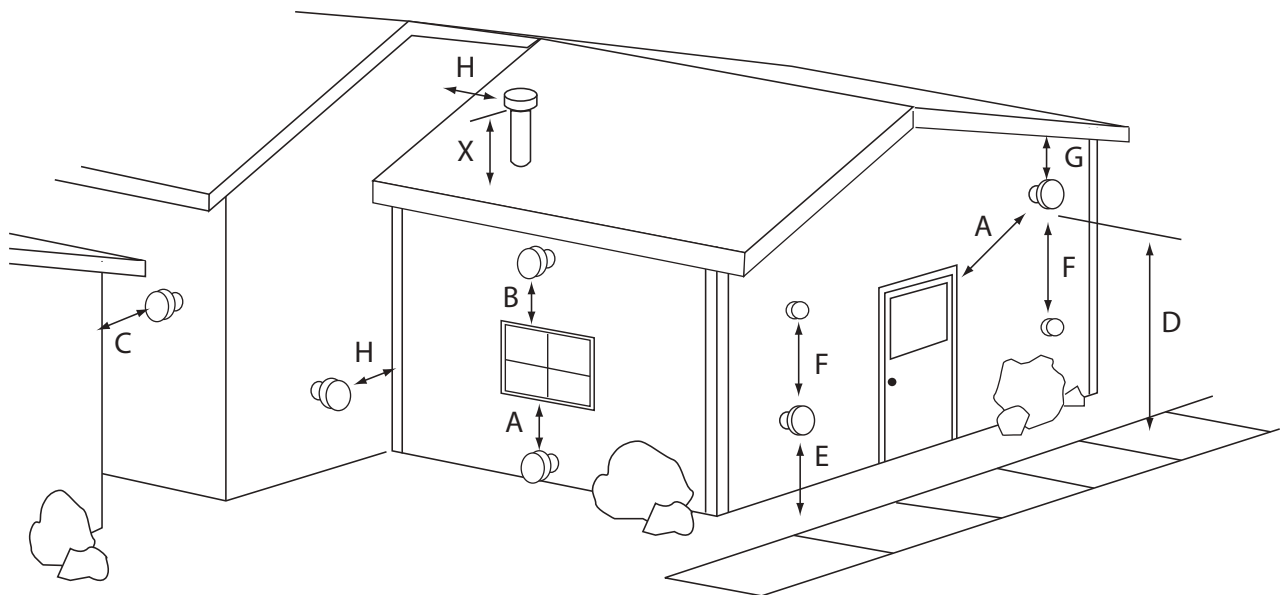


Figure 7: Vent Termination

- A: A Minimum 4' clearance below or beside any door or window that opens. (This clearance may be reduced to 18" if using outside air). We recommend the door or window be kept closed during operation. Minimum 1' clearance below or beside any window that does not open.
- B: Minimum 1' clearance above any door or window that opens.
- C: Minimum 2' clearance from any adjacent building.
- D: Minimum 7' clearance above any grade when adjacent to public walkways.
- NOTE: Vent may not terminate in covered walkway or breezeway.**
- E: Minimum 2' clearance above any grass, plants, or other

combustible materials.

- F: Minimum 3' clearance from any forced air intake of any other appliance.
- G: Minimum 2' clearance below eaves or overhangs.
- H: Minimum 1' clearance horizontally from combustible wall.
- X: Must be a minimum of 2' above the roof.

Venting The Pellet Stove (See Figures 8 through 16.)



CAUTION

MAKE SURE PELLET STOVE IS VENTED CORRECTLY. DO NOT INSTALL FLUE DAMPER IN THE EXHAUST VENTING SYSTEM OF THIS UNIT.

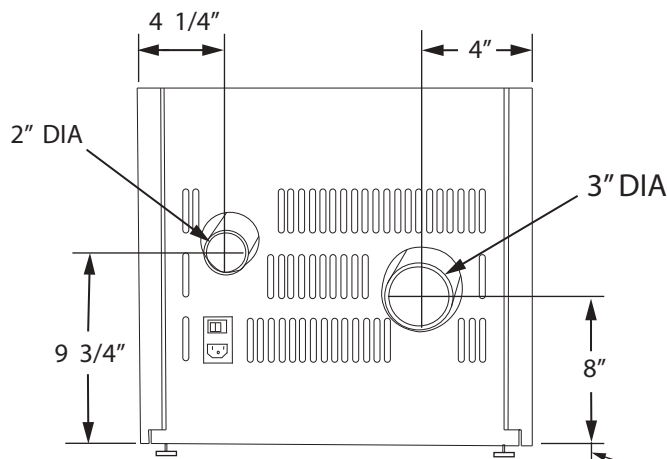
USE AN APPROVED WALL THIMBLE WHEN PASSING THE VENT THROUGH WALLS. USE A CEILING SUPPORT/FIRE STOP SPACER WHEN PASSING THE VENT THROUGH CEILINGS (MAKE SURE TO MAINTAIN CLEARANCE TO ANY COMBUSTIBLES.)

IF USING MORE THAN ONE TEE AND 180° OF ELBOWS, YOU MUST USE 4" VENTING PIPES.

The vent must have a support bracket every 5' of pellet vent when on the exterior of the structure.

The vent height and run must not exceed the distance as illustrated in the diagram below.

Venting into this (the lighter) shaded area may require combustion motor voltage adjustments and/or inlet air adjustments (intake). **SEE FIGURE 9.**



NOTE: THE ADJUSTABLE FOOT PAD CAN ADD UP TO 1 INCH TO HEIGHT MEASUREMENTS DEPENDING ON YOUR INSTALLATION LEVELING REQUIREMENTS. THIS DIMENSION MUST BE ADDED TO THE HEIGHT FOR PROPER INSTALLATION OF VENT PIPES.

Figure 8: Intake and Exhaust Positions

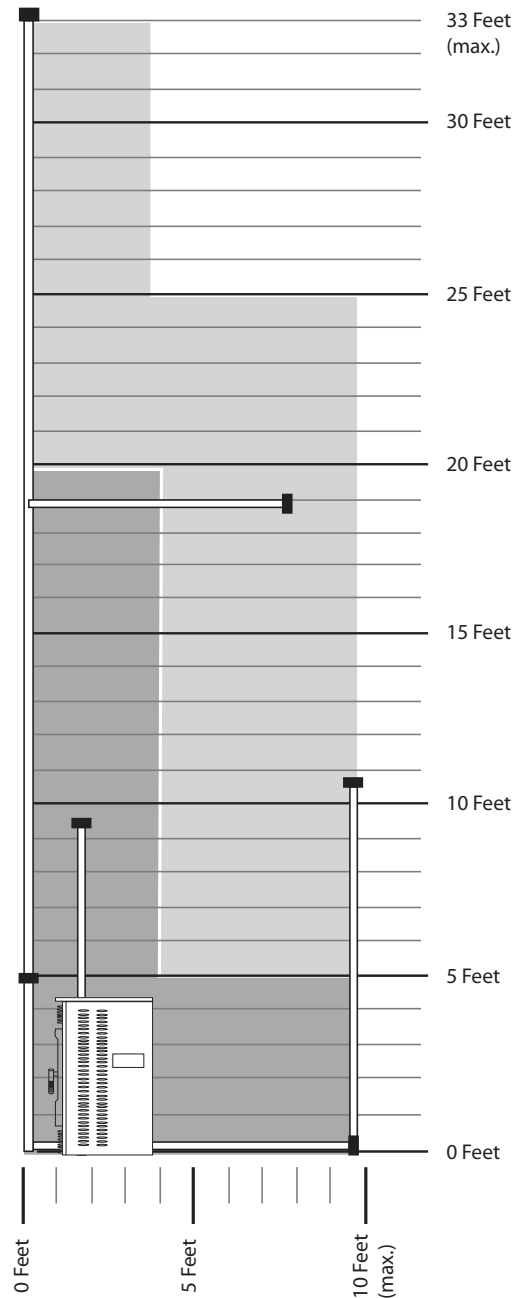


Figure 9: Venting and Combustion Motor Voltage Adjustment Chart



Serenity Pellet Stove

Outside Air Connection

Connection from the intake pipe (2" diameter pipe in rear of stove, See Figure 8) to the outside of the house is **REQUIRED** for mobile home installation. It is recommended in tightly sealed homes with exhaust fans such as kitchen or bathroom fans. This will eliminate poor performance due to negative pressure.

Only noncombustible pipe 2" (or greater) in diameter is approved to use for outside air connections (straight or flexible).

NOTE: PVC pipe is NOT approved and should NEVER be connected to the stove.

HINT: A Castle Pellet Stove air inlet will accept automotive exhaust pipes and couplers

If the air inlet is connected to the outside, it **MUST** be terminated with a vertical 90° bend (down) or with a wind hood. Failure to do so could result in a burn back during high winds blowing directly up the air inlet during a simultaneous power failure.

Blockage, excessive length, or extra bends in the air intake pipe will starve the stove of combustion air. A 90° bend is equivalent in restriction to approximately 30" of straight inlet pipe.

Mobile Home

Installation in a mobile home should be in accordance with the manufactured home and safety standard. *Department of Housing and Urban Development (HUD) CITE: 24CFR3280.707* stating this stove must be vented to the outside. In addition to the standard installation instructions, the following requirements are mandatory for installation in a mobile home:

1. The stove must be permanently attached to the floor.
2. Stove must have an outside air source.
3. Stove must be electrically grounded to the steel chassis of the mobile home.
4. All vertical chimney vents must have wall supports.
5. All exhaust systems must have a spark arrestor.
6. Check with local building officials to see if other codes may apply.



WARNING

CARBON MONOXIDE POISONING HAZARD. DO NOT CONNECT TO ANY AIR DISTRIBUTION DUCT OR SYSTEM. DO NOT INSTALL IN A SLEEPING ROOM.



CAUTION

THE OPERATION OF EXHAUST FANS SUCH AS BATHROOM FANS, ATTIC FANS, ETC. MIGHT STARVE THE PELLETT STOVE OF COMBUSTIBLE AIR CREATING A NEGATIVE PRESSURE IN THE ROOM. PROVIDE ADEQUATE VENTILATION IN THE ROOM ACCOMPANYING THE PELLETT STOVE. IF NOT, THE PRESSURE SWITCH MAY SHUT OFF OPERATION OF THE PELLETT STOVE.

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

SIMPLE STOVE VENTILATION EXAMPLES

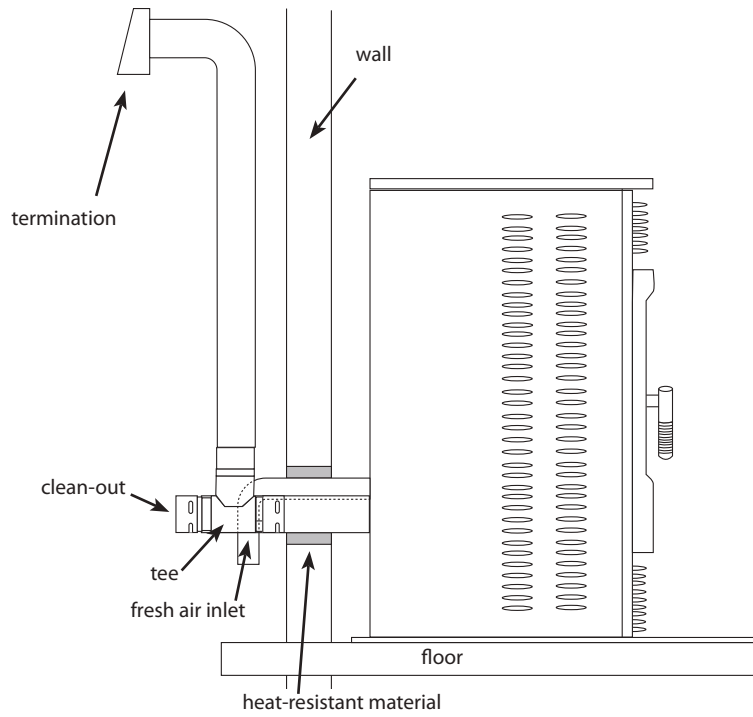


Figure 10: Straight Installation—Outside Vertical Rise, Horizontal Termination

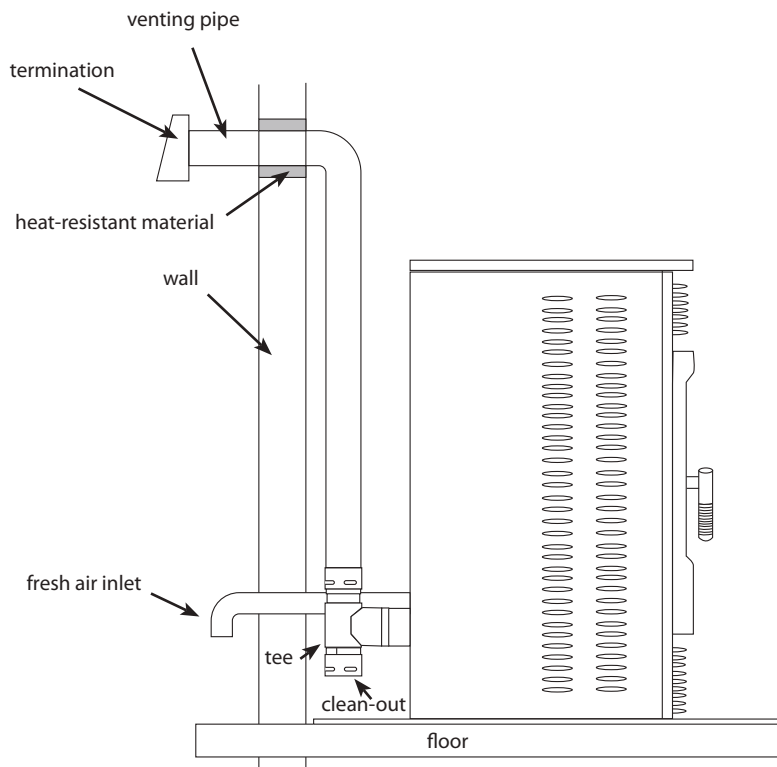
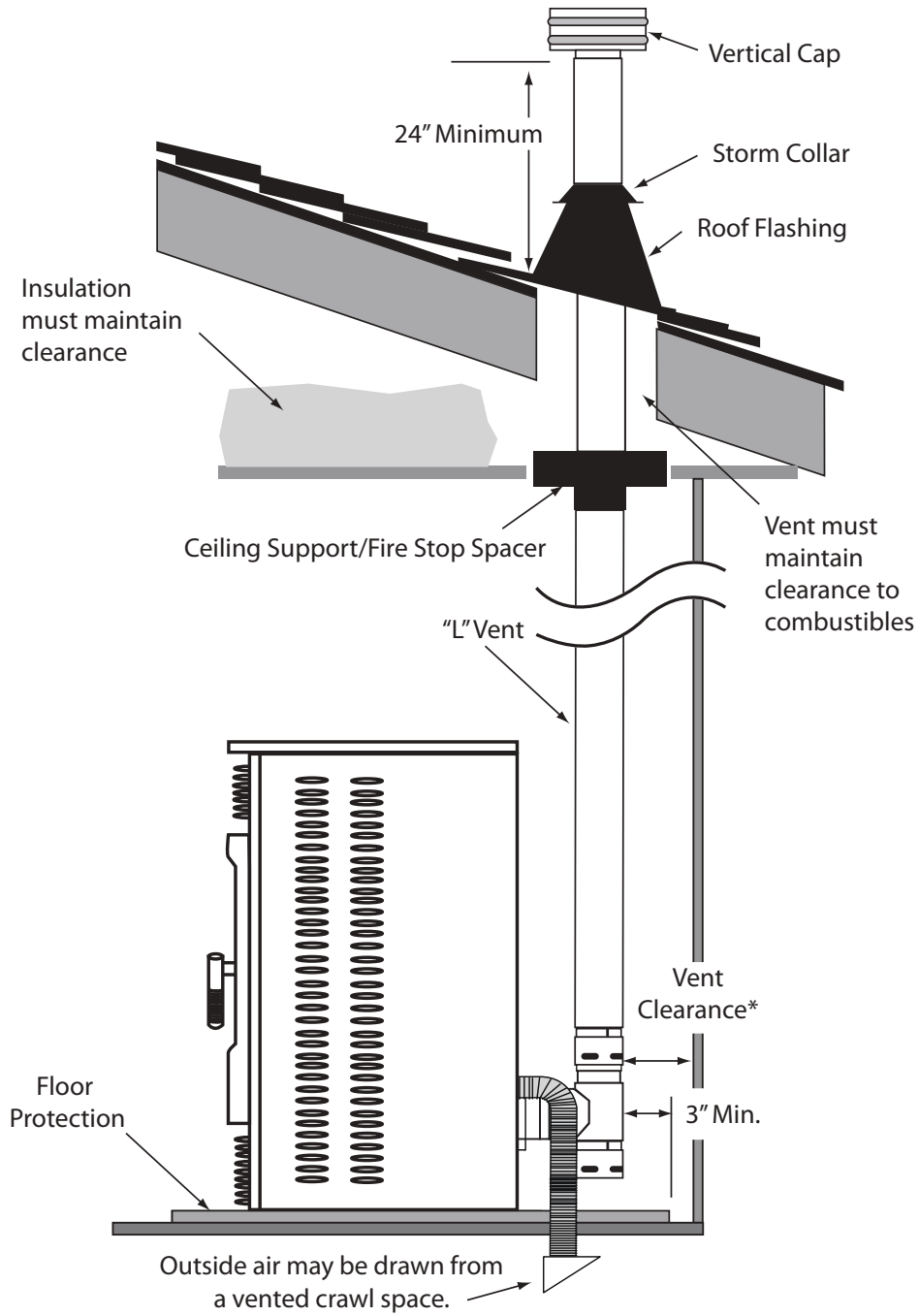


Figure 11: Straight Installation—Inside Vertical Rise, Horizontal Termination

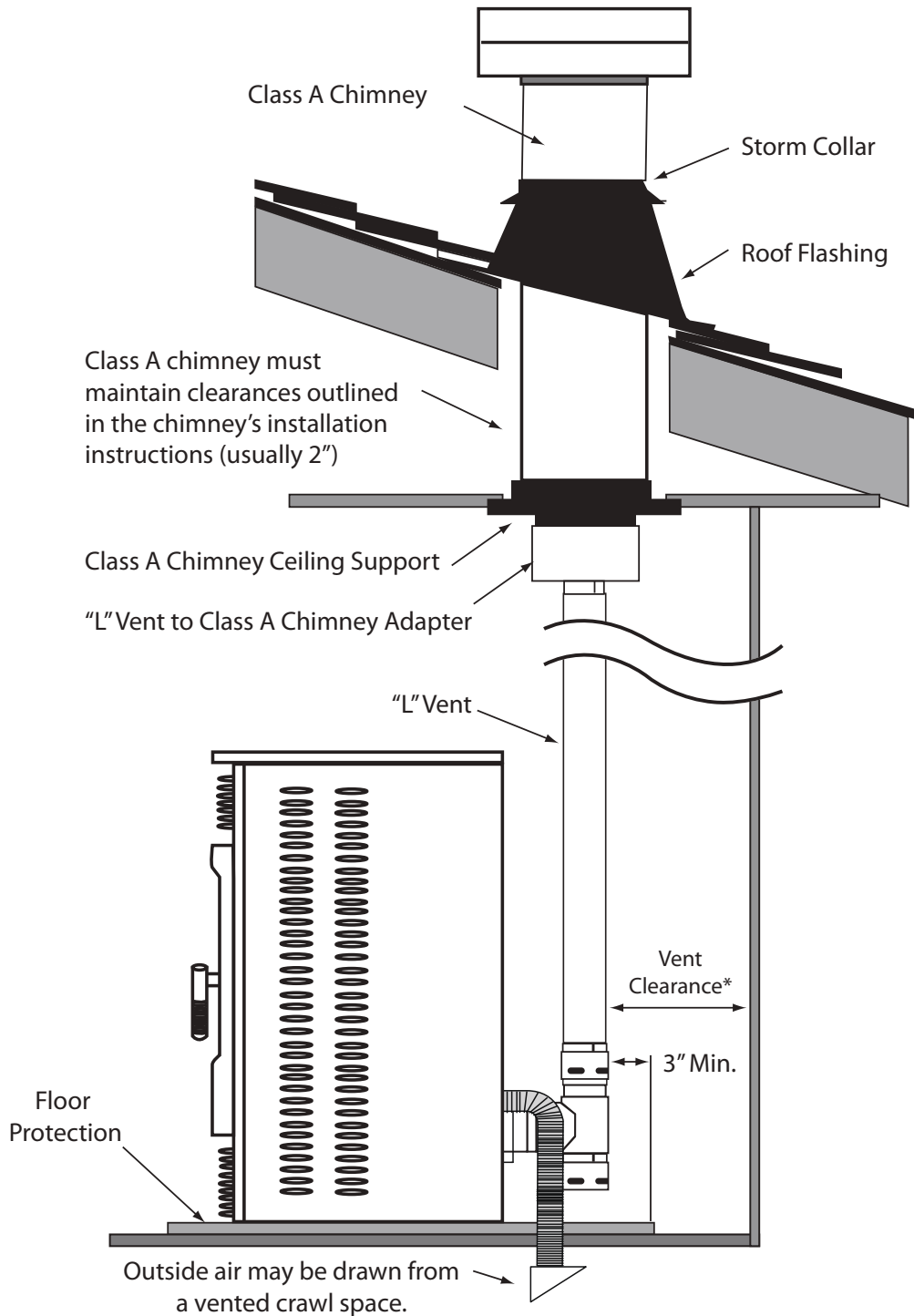
COMPLEX STOVE VENTILATION EXAMPLES



* Install a vent at clearance specified by the vent manufacturer

Figure 12: Interior Vertical Installation

CLASS A CHIMNEY RETROFIT



* Install a vent at clearance specified by the vent manufacturer

Figure 13: Class A Chimney Retrofit

MASONRY FIREPLACE HEARTH STOVE

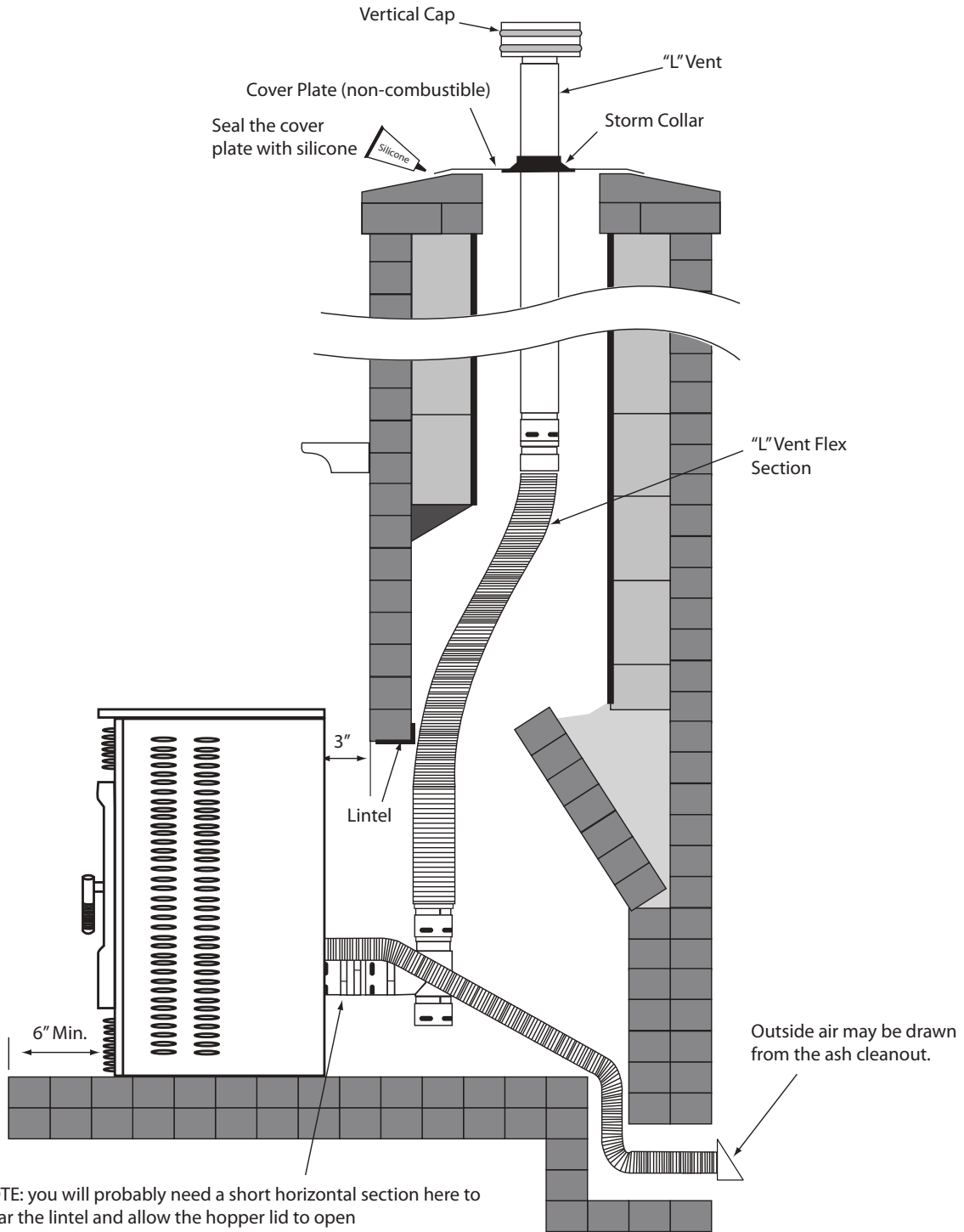


Figure 14: Masonry Fireplace Hearth Stove

ZERO-CLEARANCE (METAL) FIREPLACE HEARTH STOVE

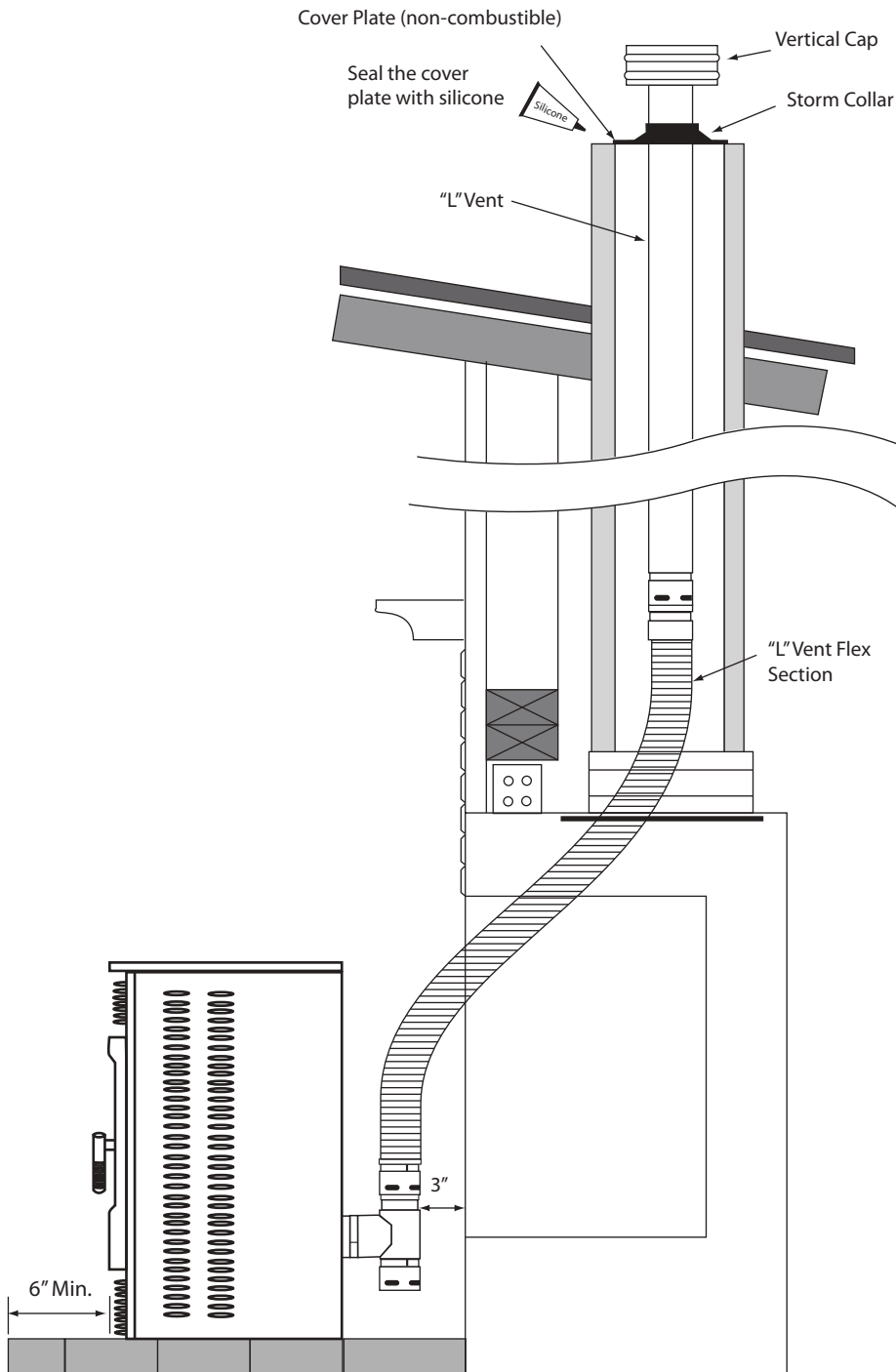


Figure 15: Zero-Clearance (Metal) Fireplace Hearth Stove

FREESTANDING MASONRY CHIMNEY

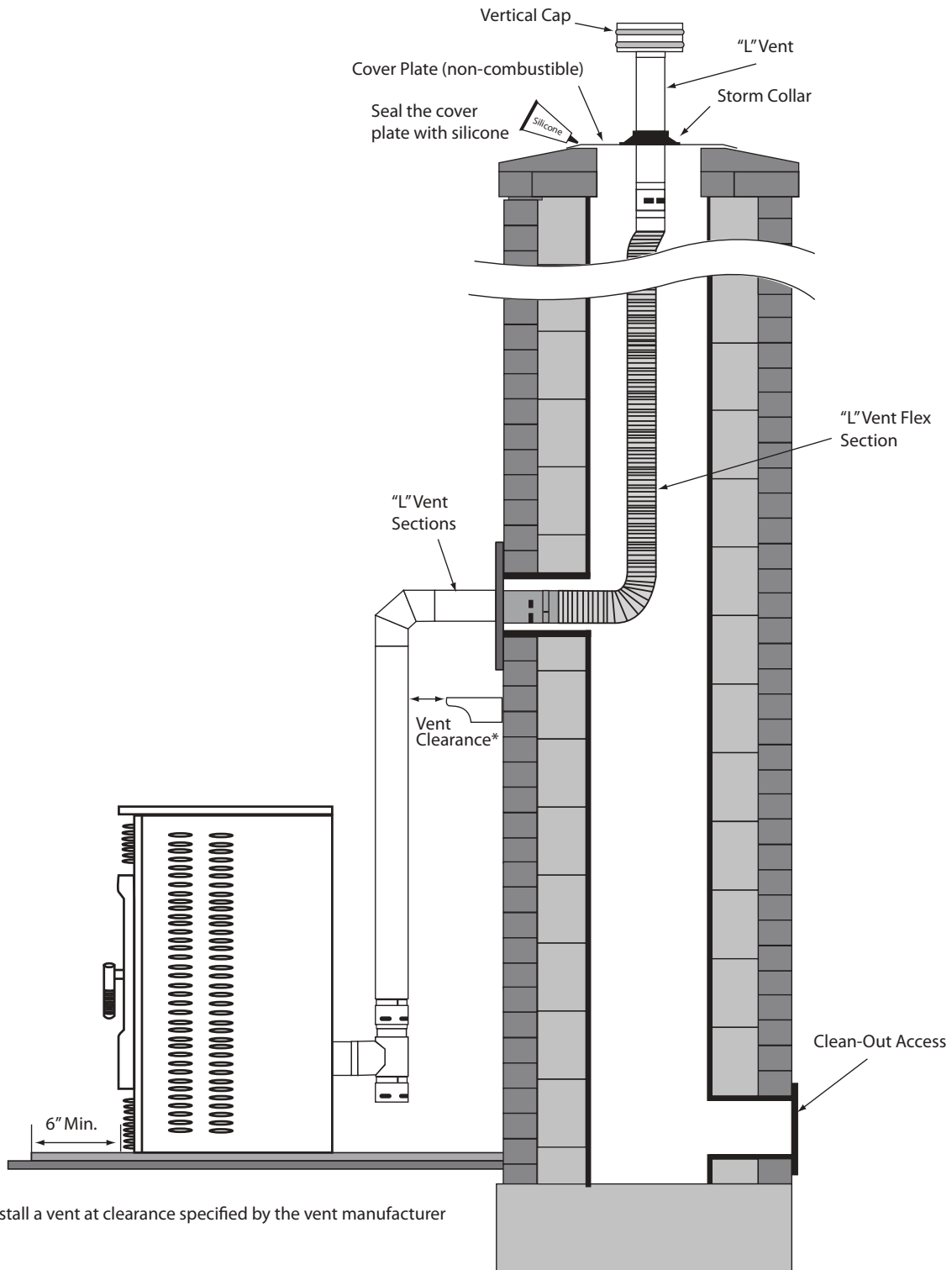


Figure 16: Freestanding Masonry Chimney

UNDERSTANDING YOUR STOVE

Your Castle Pellet Stove utilizes a vertical auger fuel feed system that is operated by a microprocessor controlled digital circuit board. The digital circuit board allows the vertical auger fuel system to run in a timer based, non-continuous cycle; this cycling allows the auger to run for a predetermined amount of time. The auger pushes pellets up a chute located in the hopper. The pellets will then turn and fall through another chute into the burn pot. Your stove is equipped with an automatic ignition system that should ignite the fuel within 3-5 minutes of pressing the On/Off button. As pellets fill the burnpot and ignite, outside air is drawn across the fuel and heated during the combustion process which is then pulled across the heat exchanger by the exhaust motor or the draft fan. As the stove reaches operating temperature, room air is then circulated around the heat exchanger by a room air blower, distributing warm air into the room.

The amount of heat that is produced by the stove is proportional to the rate of fuel that is burned.

Because a forced draft pressure is required for the combustion process inside your stove, it is extremely important that the exhaust system be properly installed and maintained. Also, the doors must remain closed while in operations and the seals on the doors must be properly maintained.

BECOMING FAMILIAR WITH YOUR CONTROLLER

Controller Buttons (SEE FIGURE 17 & 18)

1. **Infrared Receiver:** Receives signal from remote control.
2. **Power Indicator** - Illuminates when the main power switch is on.
3. **Alarm Light** - Illuminates if stove is not operating properly.
4. **On/Off Button** - Starts and stops operation of stove.
5. **Timer Button** - Allows you to choose the start time or shutdown time of the unit.
6. **Mode Transfer Button** - Allows you to set the unit to one of three main mode settings: Manual, Temp, and Weekly.
7. **Hold Button** - Pressing the "Hold" button in weekly mode after raising the "Call To" temperature will maintain that temperature until the button is pressed again or the stove is shut down.
8. **Scroll Up Button** - Allows you to scroll up to choose items in the menu.
9. **Exit Button:** Takes you out of current selection and returns to previous option and/or screen. When entering data, pressing the EXIT button will also delete your entries.

10. **Scroll Down Button** - Allows you to scroll down to choose items in the menu.
11. **Enter Button** - Pressing "Enter" button allows you to adjust and select data on the screen. Pressing the ENTER button for two seconds will take you to a main menu screen in which you'll have the ability to change the time, date, temperature display, weekly operation schedule (for Weekly Mode only) and combustion motor and voltage settings.
12. **Controller Lock Out Mode** - By pushing 8 and 10 simultaneously, the controller key pad can be locked. In the lock mode the stove cannot be adjusted or turned **ON** or **OFF**. Activation is indicated by a small key icon in the upper right corner of the controller display.



Figure 17: Control Pad Key



Figure 18: Control Pad Location

MAIN OPERATION CONTROLLER SCREEN DISPLAY

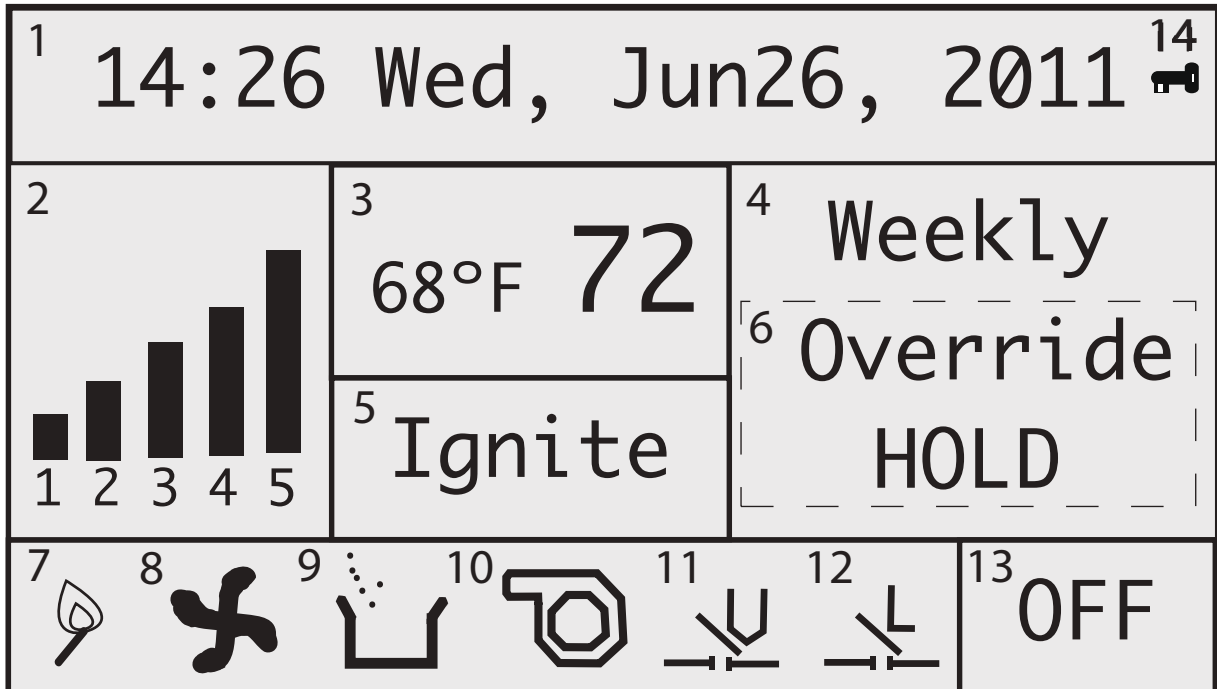


Figure 19: Main Operation Controller Screen Display

1. **Date and Time:** Displays time and date.
2. **Heating Power Level:** Indicates the level of power at which the stove is currently heating.
3. **Current Room Temperature/Call To Temperature:** Displays current room temperature and, in the thermostat mode, the "call to" temperature.
4. **Main Mode:** Displays operation mode--weekly, thermostat (temperature) and manual.
5. **Work Stage:** Displays operational stage in which the stove is currently operating (i.e. ignite, heating room).
6. **Additional Control Mode:** Only appears if weekly temp setting is changed manually.
7. **Igniter Indicator:** Indicates ignition cycle/burning cycle is currently happening.
8. **Exhaust Blower Indicator:** Indicates combustion blower is running to feed air to the firebox.
9. **Auger Indicator:** Indicates auger is feeding pellets.
10. **Room Blower Indicator:** Indicates room blower is running and the fan is heating the room.
11. **Vacuum Switch Indicator:** Indicates there is vacuum pressure in the stove.
12. **Hopper Lid Open Indicator (Limit Indicator):** If lit, indicates the hopper lid is closed. When hopper lid is open, this will disappear.
13. **On/Off State Indicator:** Indicates if the stove is on and in operational mode or if it is in the process of shutting down.
14. **Controller Lockout Mode Activated**

NOTE: During stove operation number 11 and 12 must be displayed or the stove will not feed pellets.

PRE-OPERATION

Once the stove has been properly installed and plugged into a grounded surge protector you are ready to begin operation.

Mounting Your Controller

Mount the controller and the controller bracket to top and back of your stove using the hardware that accompanied the controller. **SEE FIGURE 18.**

Prior To Starting

Turn on the main power switch located on the back of the stove. **SEE FIGURE 20A.**

NOTE: If for some reason the stove does not appear to be powering on, there is a fuse located just below the power switch that can be checked. SEE FIGURE 20B. There is a spare fuse located in the fuse holder.

Make sure the hopper is clean and free of foreign matter including pellet fines and dust.

Fill the hopper with wood pellets, making sure that NO parts of the bag or any foreign objects enter the hopper as this may cause harm to the auger feed system. **SEE FIGURE 21.**

Also take care in making sure there is no pellet material in the hopper lid seating surfaces.

Close the lid. This stove has a safety switch that will not allow pellets to feed with the hopper door open.

Make sure the main glass door is closed. The stove has a safety switch that will not allow the stove to feed fuel unless there is negative draft pressure inside the stove.

Before starting your Castle Stove, you will need to determine in which mode you would like to run the stove. The Serenity can operate in three modes:

1. **Manual:** Under this mode, you can personally adjust and set the heating phase to control the heat level.
2. **Thermostat Control (Temperature):** Under his mode, you can set the room temperature and the stove will automatically run to ensure the room is at that temperature.
3. **Weekly:** Under this mode, the stove will work automatically during days and times you designate. You can have a program for each of the seven days of the week and four periods during the day.

You must select your mode before turning on the stove.

Selecting a mode while the stove is burning can cause the stove to shut down and may force a 30-minute delay in restarting.

You do not need to start operation of the stove to select your mode. To choose the mode, select the mode transfer button (6, Fig. 17). Pressing the mode button once selects the thermostat setting; pressing it twice will bring you to the weekly mode.



WARNING

NEVER USE FLAMMABLE LIQUIDS SUCH AS GASOLINE, GASOLINE TYPE LIGHTER FUEL, CHARCOAL LIGHTER FUEL OR FIRE STARTING GELS IN OR AROUND THIS STOVE. KEEP ALL SUCH LIQUIDS WELL AWAY FROM THE STOVE WHEN IT IS IN USE.

NEVER OPEN SIDE PANELS OR MAIN DOOR WHEN STOVE IS IN OPERATION.

NEVER TOUCH DOOR LATCHES WHILE IN OPERATION, THEY GET EXTREMELY HOT. NEVER OPEN GLASS DOOR WHILE STOVE IS OPERATING OR WHILE STOVE IS HOT.

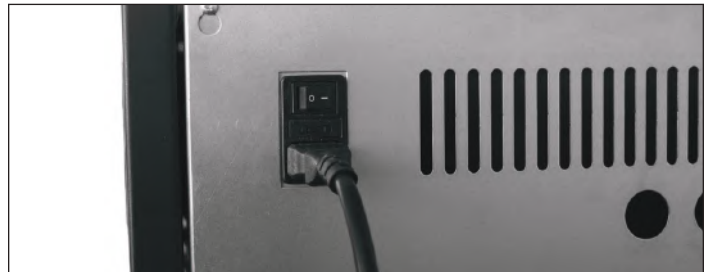


Figure 20a: Main power switch




Figure 20b: Main power switch



Figure 21: Pellet load

OPERATION

After you have chosen the mode in which to operate your stove, press the **ON/OFF** button  (4, Fig. 17) to start the stove ignite cycle.

Start Up

When the stove turns on, the ignition indicator and the exhaust blower indicator will appear on the screen (7 and 8, Fig. 19).



“Ignite” will also appear in the work stage box (5, Fig. 19) on the screen. After approximately four seconds, the vacuum switch indicator (11, Fig. 19) will appear. Also note that the hopper lid open indicator (limit indicator) (12, Fig. 19) will appear anytime the stove’s hopper lid is properly shut and sealed.

The stove exhaust blower will continue to run for three minutes, then the auger indicator (9, Fig. 19) will flash on the screen, indicating that the auger is feeding pellets into the stove. Within three to five minutes of the auger feeding pellets, a fire should ignite. Once a fire is lit, the work stage box on the screen will read “Heating Room”.

Working in the Different Operation Modes:

Manual Mode

The Manual Mode is the default mode setting if no other mode is chosen before the stove is turned on. In the manual mode, you have the ability to change the heat levels, which will increase or decrease the amount of heat that the stove puts out.

To change the power level in manual mode, use the scroll down or scroll up buttons   on the control pad. (See buttons 8 and 10 on Figure 17.) Pressing either of these buttons once will move the power level up or down one level.

NOTE: *This mode does not allow you to directly adjust specific temperatures. The manual mode simply allows you to dictate the level of heat the stove is pushing out.*

Thermostat/Temperature Control Mode

The Thermostat Mode allows you to set the temperature of the room. The stove will increase or decrease the level of heat it puts out automatically to keep the room at the set temperature.

To increase or decrease the “call to” temperature, use the **SCROLL UP** or **SCROLL DOWN** button (8 and 10, Fig. 17). The current room temperature will be displayed in the temperature display box (3, Fig. 19) on the screen, as will the “call to” temperature.

NOTE: *Thermostat mode does not turn the stove off when the call to temperature is met. Thermostat mode will only regulate between low and high settings.*



WARNING

NEVER SHUT THE STOVE DOWN BY UNPLUGGING IT FROM THE POWER SOURCE.
NEVER SHUT THE STOVE DOWN BY SWITCHING OFF THE MAIN POWER SWITCH ON THE REAR OF THE STOVE.
NEVER OPEN SIDE PANELS OR MAIN DOOR WHEN STOVE IS IN OPERATION.
NEVER TOUCH GLASS DOOR AND ASH PAN LATCHES WHILE IN OPERATION, THEY GET EXTREMELY HOT AND WILL BURN YOU.

If the room temperature falls below the “call to” temperature, the stove’s heat power level indicator will automatically rise to five. When the temperature has been reached, the heat power level will return to one and it will stay there until more heat is needed.


Note: *In thermostat mode, the stove will not go into standby. It will simply idle and continue to produce a fire until the room is no longer at the set “call to” temperature. When it is idling, the stove will read at power level one in the power level box on the display screen.*

Weekly Mode

The Weekly Mode allows an Serenity user to control and schedule the stove operation during set times and days throughout the week. You can select four different operation times for each of the seven days of the week.

IMPORTANT: Remember to set your weekly schedule in Weekly Mode before igniting a fire. If you try to set the stove schedule and weekly mode while running in Manual or Thermostat modes, the weekly schedule will not set, and the screen will prompt you to wait until you have turned the stove off and it has cooled down before setting the schedule.

To Set Weekly Schedule:

1. Press and hold the **ENTER**  button (11, Fig. 17) until the “Set Data” menu appears on the screen. Using the **SCROLL DOWN** button (10, Fig. 17), select “Set Weekly.” Press **ENTER**. This will take you into the “Weekly Schedule” screen. **SEE FIGURE 22.**

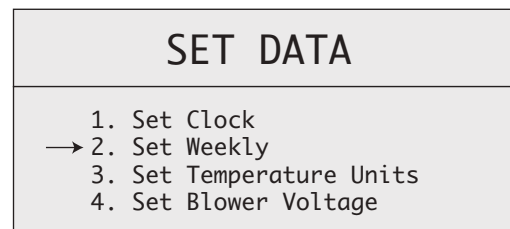


Figure 22: Set Data

Serenity Pellet Stove

- In the **"WEEKLY SCHEDULE"** screen, you can begin with setting the operation times for Sunday. Press **ENTER** to highlight the hour and use the **SCROLL UP** and **SCROLL DOWN** buttons until you reach your desired hour of start time. Press **ENTER** again to highlight the minutes and use **SCROLL UP** and **SCROLL DOWN** until you've reached your desired minute of start. **SEE FIGURE 23.**

NOTE: Your Serenity controller uses 24 hour time to set your weekly schedule.

- Pressing **ENTER** again will allow you to set the stop time of your stove. Use the same procedure for setting your stove's start time for selecting when you would like the stove to stop. Once you've selected the stop time, press **ENTER**.
- Next you will have the opportunity to set the desired temperature. Use the **SCROLL UP** or **SCROLL DOWN** keys until you've reached the appropriate temperature for the times you have selected. Press **ENTER**.
- "Yes"** will now be highlighted. If you have set this particular time correctly, press **ENTER**. This will take you out of your first set time.

If you wish to erase a scheduled time, use your **ENTER** key to highlight **"YES"** on the screen for that scheduled time. Select **"No"** using your **SCROLL UP** or **SCROLL DOWN** key. With **"No"** highlighted, press **ENTER** to erase the data.

- To set another time for that particular day, press **SCROLL DOWN** and continue by repeating steps 2-5 as appropriate.

NOTE: You must set your times in chronological order. The first schedule slot of one day MUST be earlier in the day than the second schedule slot on your weekly schedule list, etc.

- Once you have set all times for Sunday, **SCROLL DOWN** to **"NEXT"**. Pressing **ENTER** once will highlight **"NEXT"**. Pressing **ENTER** again will take you to the following day. Proceed with setting a schedule for the rest of the week using the preceding instructions.

SET WEEKLY			
Sun. Weekly Set			
1:	1:15~ 7:00	67°F	Yes
→ 2:	17:00~23:45	72°F	Yes
3:	--:--~--:--	--°F	No
4:	--:--~--:--	--°F	No
5:	--:--~--:--	--°F	No
Next	All		

Figure 23

NOTE: Along with the "Next" option on the screen, there is also an "All" Option. After you have set a particular time for a day, if you wish to set that time for every day of the week, scroll down to "Next" and press ENTER. Press the SCROLL DOWN key to select and highlight "All." Pressing ENTER will then select that scheduled time and apply it to each day of the week.

TIP: If at any point you need to leave the weekly schedule screen or once you have finished with setting all of your times, select the EXIT button (9, Fig. 17) to return to the previous menu.

- Once you've finished setting your schedule, without any of the options highlighted, press the **EXIT** button. This will save your schedule.
- With a schedule set, make sure that the main display screen on the controller reads **"WEEKLY"** (for operating in the Weekly Mode) and that the unit is turned on. The schedule will not take effect unless the unit is turned on in the Weekly Mode. (13, Fig. 19).

Setting Other Data On Your Controller

Setting The Time And Date

- Press and hold the **ENTER** button. This will take you to the **"SET DATA"** screen.
- Press **ENTER** again to enter the **"SET CLOCK"** screen. **SEE FIGURE 24.**
- To change the hour, press **ENTER**. This will highlight the hour. Use your **SCROLL UP** and **SCROLL DOWN** buttons to choose the appropriate time. Press **ENTER** to select the correct hour, and then press **ENTER** a second time to begin setting the minutes.
- Continue this process for selecting and setting the day, month, date and year.
- When finished, and with nothing highlighted on the screen, press the **EXIT** button.

SET CLOCK
10:45 Fri. May 20, 2011

Figure 24

Setting The Temperature Units

1. Press and hold the **ENTER** button. This will take you to the “**SET DATA**” screen.
2. Using the **SCROLL DOWN** key, move down to option 3: “**SET TEMPERATURE UNITS**”. Press **ENTER** again to move into the “**SET TEMPERATURE UNITS**” screen. **SEE FIGURE 25.**
3. In the set temperature units menu, press the **ENTER** button to highlight the units. Use the **SCROLL UP** and **SCROLL DOWN** buttons to choose either Celsius (C°) or Fahrenheit (F°).
4. When finished, press **ENTER**. With nothing highlighted on the screen, press the **EXIT** button.

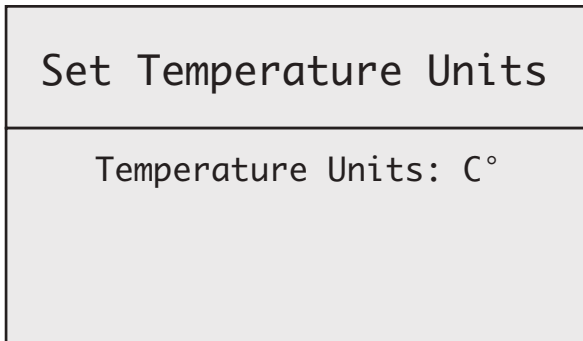


Figure 25

Setting The Room Blower Voltage

The blower voltage (controlling the room fan) can be turned up or down for each power level to regulate the amount of heat circulated into a room during stove operation. Some fuels radiate heat better than others. You have the ability to speed up or slow down the room fan to extract the optimum amount of heat without blowing cold air.

Increasing the room blower voltage causes the room motor to run faster, extracting more heat from the unit.

NOTE: If having issues with the stove overtemping in any setting, increase the blower voltage.

Decreasing the blower voltage allows you to slow the exchange of heat from the stove so it blows less cold air.

To Set The Room Blower Voltage:

1. Press and hold the **ENTER** button. This will take you to the “**SET DATA**” screen.
 2. Using the **SCROLL DOWN** key, move down to option 4: “**SET BLOWER VOLTAGE**”. Press **ENTER** again to move into the “**SET BLOWER VOLTAGE**” screen. **SEE FIGURE 26.**
 3. Select the stall (or heating power level) for the voltage you'd like to change by scrolling up or down and pressing **ENTER**. The voltage amount will automatically be highlighted.
 4. Using the **SCROLL UP** or **SCROLL DOWN** keys, select the appropriate voltage.
- NOTE: Voltage can be decreased or increased only in increments of five (5 volts).**
5. Press **ENTER** to finalize your changes. Repeat steps 2-4 for the other stalls if you so desire.

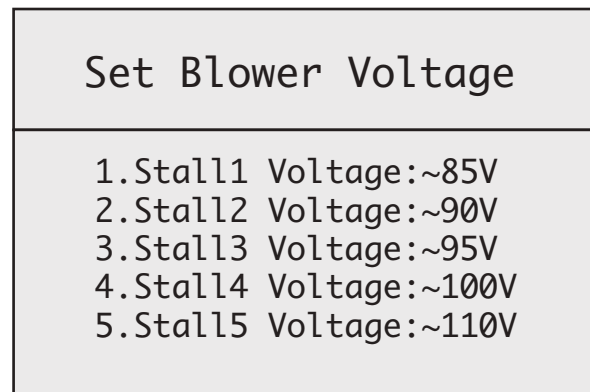


Figure 26

Setting The Exhaust Voltage

IMPORTANT NOTE:

ADJUST THE AIRFLOW GATE BEFORE INCREASING THE EXHAUST VOLTAGE. If you are having issues with getting enough air to your fire, **FIRST** try to adjust the air flow gate. SEE FIGURE 27. This will also adjust the air flow to the stove. In most installations, the air flow gate should be 1/2 open. this is best viewed from the front of the stove with the fire pot removed.

The exhaust voltage (controlling the exhaust motor) allows you to adjust the stove for the fuel you are burning or compensate for inadequate ventilation situations. In less than optimum venting situations, you can increase the exhaust speed for additional air circulation through the stove should ventilation be an issue.

IMPORTANT NOTE:

Changing the exhaust voltage does NOT change the feed rate. Therefore, on high heat power levels where the feed rate is faster, a low voltage level will not push out enough air and the stove may overheat and pellets may back up into the pot. Decreasing exhaust voltage will increase the amount of heat coming into the room. Do not adjust the exhaust voltage too low, as it can cause pellets to backup in the burn pot.

Increasing the exhaust voltage, and thereby increasing the amount of air in the burn pot, will also assist in burning lower-quality fuels that may otherwise cause unwanted buildup.

NOTE: Be sure to visually watch the burn rate if the exhaust voltage is decreased, as to not cause pot overloading. Exhaust voltage should ONLY be adjusted to get the optimum performance out of the fuel you are burning. Setting the exhaust voltage too high will increase the amount of fly ash being pushed out of the vent.

To Set The Exhaust Blower Voltage:

1. Press and hold the **ENTER** button. This will take you to the "SET DATA" screen.
2. Using the **SCROLL DOWN** key, move to option 4: "**Set Exhaust Voltage**". Press **ENTER** again to move into the "**SET EXHAUST VOLTAGE**" screen. **SEE FIGURE 28.**
3. Select the stall (heating level) for the voltage you'd like to change by scrolling up or down and pressing **ENTER**. The voltage amount will automatically be highlighted.
4. Using the **SCROLL UP** or **SCROLL DOWN** keys, select the appropriate voltage.

NOTE: Voltage can only be decreased or increased in increments of five (5 volts).

5. Press **ENTER** to finalize your changes. Repeat steps 2-4 for the other stalls if you so desire.

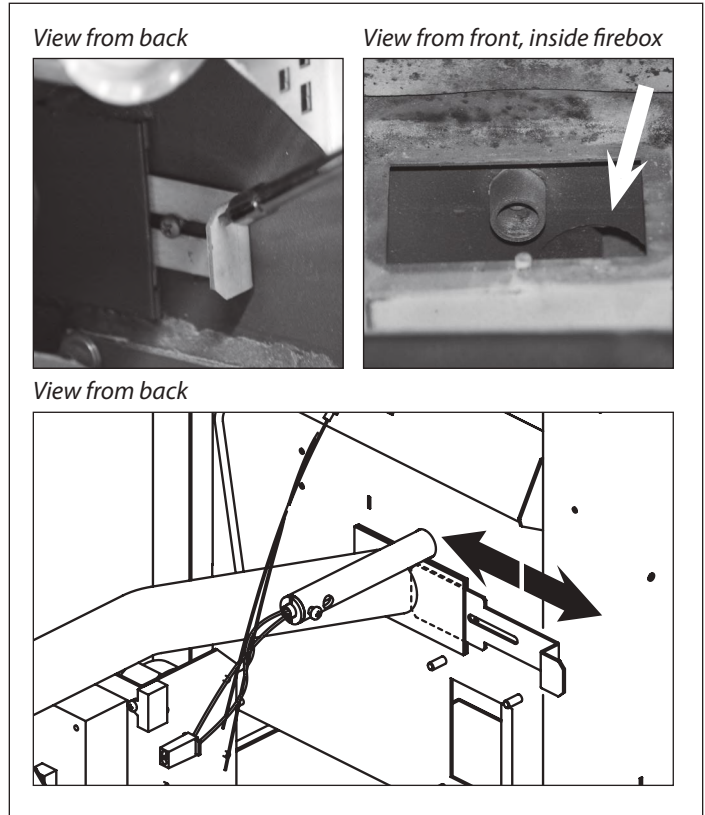



Figure 27

Set Exhaust Voltage	
1. Stall1	Voltage: ~80V
2. Stall2	Voltage: ~85V
3. Stall3	Voltage: ~90V
4. Stall4	Voltage: ~95V
5. Stall5	Voltage: ~100V

Figure 28

DIAGNOSTICS

Your Castle Stove's controller comes equipped with an on-board diagnostics option that will let you test some components of your stove.



WARNING

NEVER OPERATE THE STOVE IN DIAGNOSTIC MODE. DIAGNOSTIC MODE IS TO TEST AND CONFIRM THE OPERATION OF INDIVIDUAL COMPONENTS ONLY. OPERATION IN DIAGNOSTIC MODE WILL CREATE AN UNSAFE CONDITION AND CAUSE INJURY TO PEOPLE AND DAMAGE TO EQUIPMENT.

NOTE: You will only be able to enter the diagnostic screen when the stove is turned OFF.

To get into the diagnostics screen:

1. Press and hold the **ENTER** button. This will take you to the "SET DATA" screen.
2. Using the **SCROLL DOWN** key, move to option 6, "DIAGNOSTICS". Press **ENTER**. This will take you to the "DIAGNOSTICS" screen. **SEE FIGURE 29.**

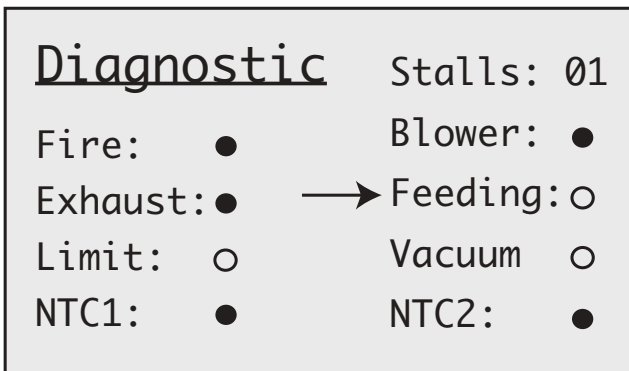



Figure 29

If all components are working properly, the circles next to the components will be shaded.

- Stalls:** Changing the stall will allow you to test the component in the various heating power levels.
- Fire:** Indicates whether the igniter is working properly.
- Exhaust:** Indicates whether the exhaust motor and exhaust system is working properly.

- Limit:** Indicates the hopper lid is properly shut.
- Blower:** Indicates whether the room fan/blower is working properly.
- Feeding:** Indicates if the auger is properly feeding pellets.
- Vacuum:** Indicates there is sufficient vacuum and suction.
- NTC1:** Indicates the proof of fire switch is properly working.
- NTC2:** Indicates temperature being read by room temp sensor.
(Temperature is in Celsius)

SHUT DOWN PROCEDURE

Press the  button on the control pad to initiate the shut down mode. The On/Off indicator on the screen will read **OFF**. The auger will stop feeding pellets, but the room blower and exhaust blower will continue to operate. Once the stove has cooled down, the screen light will turn off.

Shut down times will vary.

MAINTENANCE

Normal Care and Maintenance

Due to differences in fuel, stove cleaning intervals will vary. The cleaner the stove is, the more efficiently it will burn.

Cleaning the Firepot

Remove and clean the burn pot/firepot daily. Make sure all holes in the burn pot are unobstructed. Use a small metal pick or drill bit to keep these holes clean. **SEE FIGURE 30.**

Firepot Remains

Every time the hopper is filled with fuel, the firepot should be emptied. To empty the firepot, lift it out of the pot holder and dump it directly into the ash pan. Be sure any build-up is removed and that the holes are clean.

Cleaning the Glass

Only clean the glass when the glass is cool. Wipe glass off frequently. Wipe the glass clean with a dry or damp rag. If this does not clean the glass, use any non-abrasive cleaner. Using ceramic stove top cleaner can be helpful in removing soot from the glass. Inspect gaskets around the door periodically. Replace any worn, frayed or compacted gaskets. Replace broken glass only with high temperature ceramic glass, available from Castle Pellet Stoves. **SEE FIGURE 31.**

Stove Emissions

Stove emissions should be visually checked on a regular basis. Emission visibility is an indicator of inefficient combustion. In order to minimize impact on the environment, maintenance costs, and fuel consumption, this pellet heater should be operated in a manner that minimizes emission visibility.

Interior Chamber

Clean the interior chamber with an ash vacuum. Ash vacuums are specially designed to contain soot and have a metal exterior. This should be done weekly.

WARNING

HOT SURFACES CAN CAUSE BURNS. NEVER PERFORM CLEANING OR MAINTENANCE ON A HOT STOVE. ALLOW UNIT TO COOL FOR A MINIMUM OF TWO HOURS. NEVER PERFORM SERVICE WITH POWER SUPPLIED TO THE UNIT. INJURY TO PERSONEL OR DAMAGE TO EQUIPMENT CAN OCCUR.



Figure 30: Fire pot clean



Figure 31: Wipe glass and inspect gasket

Daily Maintenance

The surfaces of the stove may be hot. Always wear a protective glove, even when the stove is cool to the touch. Be sure to shut the stove off and allow to cool for one hour before performing any maintenance or service tasks.

Empty firepot of ashes. Lift the firepot from the holder and dump it directly into the ash pan. **SEE FIGURE 32.**

Remove any build-ups and be sure all of the holes are clean.

Dump the ash pan into a metal container with a tightly fitting lid. The closed-container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials, pending final disposal. The ash dumping will be determined by the amount of fuel burned. It may need to be done once or twice a week.

Weekly Maintenance

Ash Pan Removal

1. Turn off the stove and allow it to cool for one hour prior to cleaning.
2. Open the front door. Using a cleaning brush, brush any ash build-up on the ash deflector into the ash pan below.
3. Lift the ash deflector and hook it to the retainer pin located on the inside back wall. Do this for the left and right side of the ash pan. **SEE FIGURE 33.** This will allow the ash pan to be easily removed.
4. Remove the ash pan by lifting straight up and out the front door. **SEE FIGURE 34.**

Disposal of Ash

Dump the ash pan regularly. Ashes should be contained in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non combustible floor or on the ground, well away from all combustible materials. If ashes are disposed of by burial or otherwise locally dispersed, they should be retained in the closed container until all cinders have been cooled.

Soot and Fly Ash

The products of combustion will contain small particles of fly ash. The fly ash will collect in the exhaust venting system and restrict the flow of the flue gases. Incomplete combustion, such as occurs during startup, shutdown, or incorrect operation of the room heater will lead to some soot formation which will collect in the exhaust venting system. The exhaust venting system should be inspected at least once per month to determine if cleaning is necessary. If cleaning is necessary, disassemble the exhaust vent and clean the individual parts. **When cleaning ash, use an approved ash vacuum. See a dealer for more details.**

Check clean out tees regularly to determine the required cleaning interval. Use a 3" or 4" chimney cleaning brush to clean the exhaust venting. Plugged venting will effect the quality of the fire. Make sure to clean any screens in the venting regularly. A plugged screen will shut off combustion air and cause the fire to die or burn poorly.

⚠ WARNING

HOT SURFACES CAN CAUSE BURNS. NEVER PERFORM CLEANING OR MAINTENANCE ON A HOT STOVE. ALLOW UNIT TO COOL FOR A MINIMUM OF TWO HOURS. NEVER PERFORM SERVICE WITH POWER SUPPLIED TO THE UNIT. INJURY TO PERSONEL OR DAMAGE TO EQUIPMENT CAN OCCUR.



Figure 32: Empty Firepot

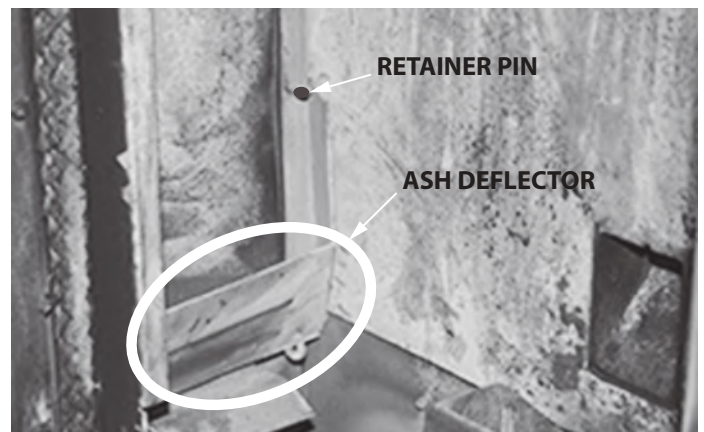


Figure 33: Ash Pan Dump



Figure 34: Dump Ash Pan

In addition to daily maintenance tasks, use an ash vacuum to clean the inside of the firebox.

Remove the firepot from the pot holder and vacuum beneath. Be sure to remove any ash from the incoming igniter tube. **SEE FIGURE 34.**

Monthly Maintenance

The exhaust venting system should be inspected at least once per month to determine if cleaning is necessary.

Annually/ Biannually

Remove and clean the exhaust venting.

Remove and clean the exhaust motor, housing and impellers.

To remove the exhaust motor, you will have to remove the side panel on the stove. To remove the panel:

Remove four screws, two at the top and two at the bottom of the panel. **SEE FIGURE 35.**

Pivot rear panel outward and push front of panel inward to release and remove panel.

Once you've removed the side panel, you can remove and clean the exhaust motor, housing and impellers. **SEE FIGURE 36.**



Figure 34: Remove ash from igniter tube (underneath firepot)

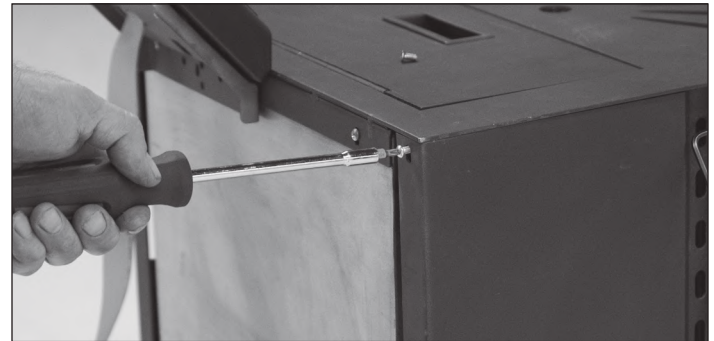


Figure 35: Remove (2) screws from rear of side panel, at the top and bottom of the panel. Remove (2) screws from the front face of the side panel, at the top and bottom of the panel.

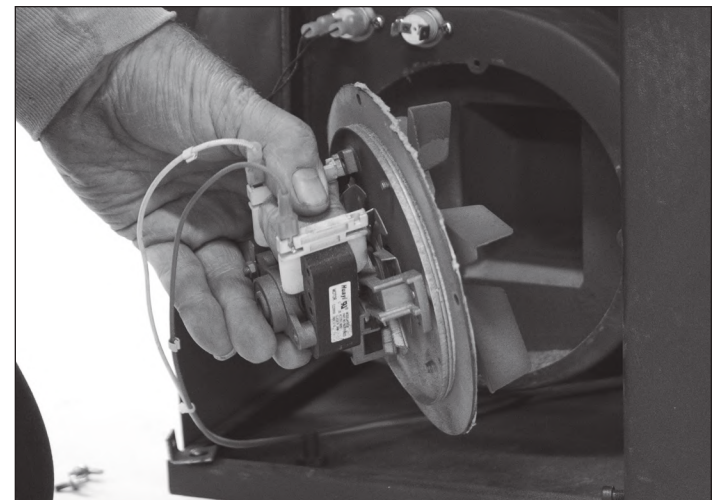


Figure 36: Remove exhaust motor and clean



TROUBLESHOOTING AND REPAIR

At Castle, we build quality and durability into the design of our products; but no amount of careful design by us, and careful maintenance by you, can guarantee a repair-free life for your stove. Most repairs will be minor, and easily fixed by following the suggestions in the troubleshooting guide in this section.

The guide will help you pinpoint the causes of common problems and identify remedies.

For more complicated repairs, you may want to rely on your authorized dealer or Castle. A parts catalog is included in this section.

We will always be glad to answer any questions you have, or help you find suitable assistance. To order parts or inquire about warranty, call or e-mail us as found below.

ORDERING REPLACEMENT PARTS

Parts can be obtained from the store where the stove was purchased or direct from the factory. To order from the factory, call or e-mail:

Castle Stoves
1-800-345-6007

E-mail: info@castlestoves.com

Please include the following information with your order:

1. Model number and serial number
2. Part description
3. Quantity
4. Part numbers

See warranty section of this manual for more information on warranty-related claims and repairs.

WARNING

WHEN PERFORMING ANY INTERNAL MAINTENANCE.

DO NOT OPERATE UNIT WITH PANELS REMOVED OR OPEN. MOVING PARTS INSIDE OF THE CABINET MAY CAUSE INJURY.

USE THE CORRECT PERSONAL PROTECTION, PARTS ARE HOT. DO NOT OPERATE THE UNIT WITH PANEL OPEN.

DISCONNECT POWER BEFORE SERVICING UNIT. RISK OF ELECTRIC SHOCK.

USE ONLY ORIGINAL FACTORY EQUIPMENT WHEN REPLACING PARTS.

CAUTION

THIS IS A MINIMUM REQUIREMENT FOR SOOT AND FLY ASH REMOVAL. ASHES SHOULD BE PLACED IN A METAL CONTAINER WITH A TIGHT FITTING LID. THE CONTAINER SHOULD BE PLACED ON A NON-COMBUSTIBLE FLOOR, WELL AWAY FROM COMBUSTIBLE MATERIALS, PENDING FINAL DISPOSAL. IF ASHES ARE DISPOSED OF BY BURIAL IN SOIL OR OTHERWISE LOCALLY DISPERSED, THEY SHOULD BE RETAINED IN THE CLOSED CONTAINER UNTIL ALL CINDERS ARE THOROUGHLY COOL.

DO NOT OPERATE STOVE WITH BROKEN GLASS.

DO NOT SLAM THE DOOR SHUT.

DO NOT STRIKE GLASS.

DO NOT USE ABRASIVE CLEANERS.

DO NOT CLEAN HOT GLASS.

REPLACE CERAMIC GLASS WITH FACTORY AUTHORIZED REPLACEMENT PARTS ONLY.

THE CLINKER WILL REMAIN HOT FOR SEVERAL MINUTES AFTER IT IS PULLED OUT OF THE FIRE POT.

TROUBLESHOOTING GUIDE

WARNING

UNPLUG STOVE AND LET COOL BEFORE PERFORMING ANY MAINTENANCE. HOT PARTS CAN CAUSE BURNS. NEVER TEST OR CHECK ELECTRICAL COMPONENTS UNLESS THE STOVE IS UNPLUGGED FROM POWER SUPPLY. ELECTRICAL SHOCK CAN OCCUR.

WARNING

NEVER SERVICE OR TOUCH THE FEED AUGER WITH THE STOVE PLUGGED IN.

NEGATIVE PRESSURE IN A HOME IS A SERIOUS ISSUE. IF THERE IS A PROBLEM, THE STOVE SHOULD BE INSTALLED WITH A FRESH AIR KIT (NOT INCLUDED).

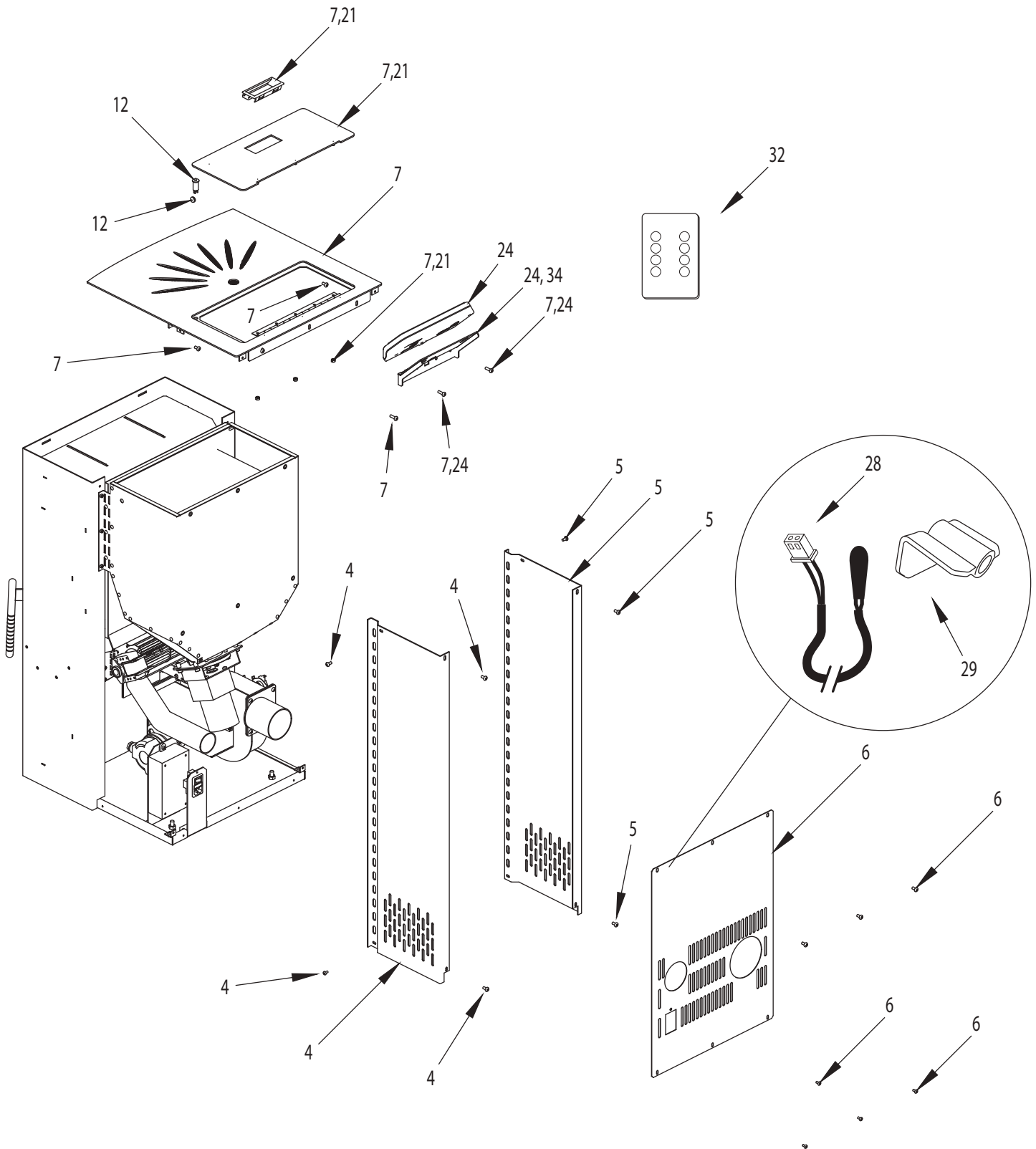
PROBLEM	CAUSE	SOLUTION
Fault light comes on	Fire goes out	Control reads out of fuel, check burn pot. Add fuel to the hopper. If the hopper is full, relight if it continues to give that signal. Then enter the diagnostic area of the controller. A circle next to "NTC1" should be highlighted. If not, replace the 52C proof of fire switch. Check pigtail leads, replace spade terminals as necessary.
Fault light is on	Overtemp	The room fan can be tested by highlighted the circle next to "Blower". Allow stove to cool and restart. Check exhaust pipe for obstructions. Increase blower voltage, through controller, in each stall.
Fuel not feeding, no vacuum signal on the control	Main door or ash pan not sealed. No negative pressure in fire chamber Piping or stove may be plugged with ash Exhaust Motor has failed	The pressure sensor shuts off the feed auger when there is no negative pressure in fire chamber. Check door seals. Check viewing glass seals. Clean venting and stove. Verify exhaust motor is turning. Enter the diagnostic area on the controller and highlight the circle next to feeding; this should cycle the auger and feed pellets. Then highlight the circle next to "exhaust". The exhaust motor should turn on and within 20 seconds, the vacuum signal should also become highlighted.



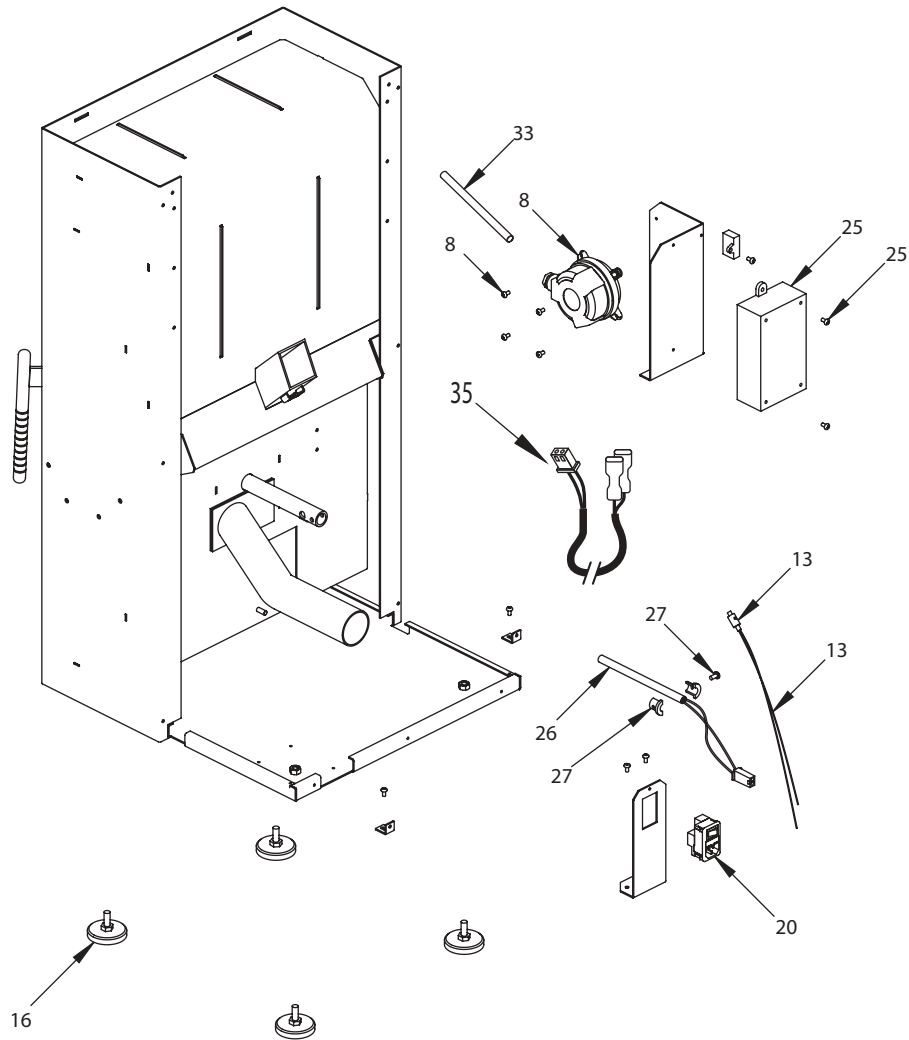
Serenity Pellet Stove

PROBLEM	CAUSE	SOLUTION
Fuel not feeding, vacuum and hopper lid signal present on the control.	Auger is obstructed Auger not working	Remove auger from housing and clean obstruction first. Enter the diagnostic area in the controller and highlight the circle next to "feeding". This should cycle the auger and feed pellets. Replace auger if necessary
Fuel not feeding, no hopper lid signal on control	Hopper lid is open Hopper lid switch not functioning correctly	Close hopper door. Enter the diagnostic area on the controller; circle next to "limit" should be highlighted when the hopper lid is closed. The circle will be unshaded if the hopper lid is opened. Check hopper door seal. Replace hopper safety switch if not operating properly.
PROBLEM	CAUSE	SOLUTION
Fire burns lazy and smoky	Stove is dirty Poor quality fuel	Clean fire pot. Clean ash pan. Clean exhaust vent system. Clean stove through cover plate clean-out hole. Increase exhaust motor voltage.
PROBLEM	CAUSE	SOLUTION
Feeds fuel will not light all; control indicators are on	Igniter tube or burn pot plugged with ash, Faulty igniter	Clean fire pot, clean igniter tube. Verify igniter adjustment. Only the wire leads should be out of the igniter retainer. Enter the diagnostic area in the controller and test the igniter by highlighting "fire". You should feel heat coming from the igniter holder within two minutes. Replace if necessary

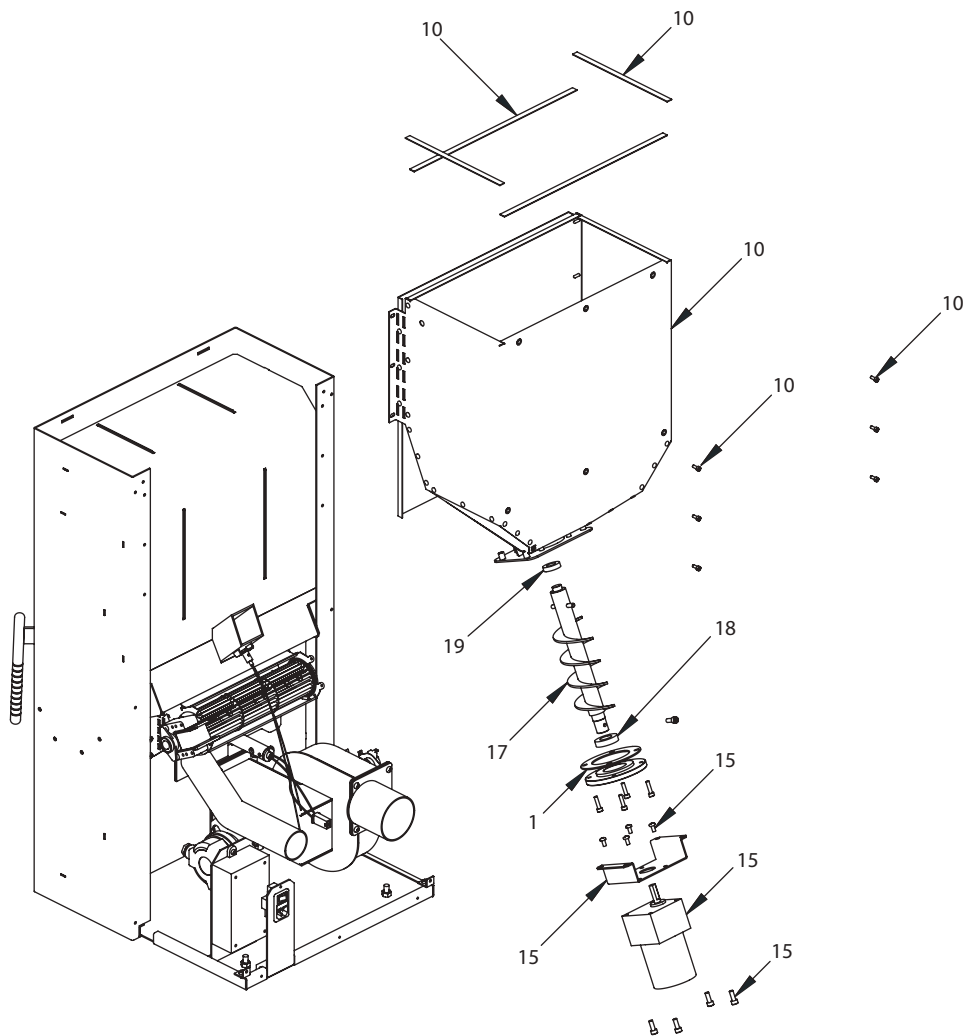
ILLUSTRATED PARTS BREAKDOWN



ILLUSTRATED PARTS BREAKDOWN



ILLUSTRATED PARTS BREAKDOWN

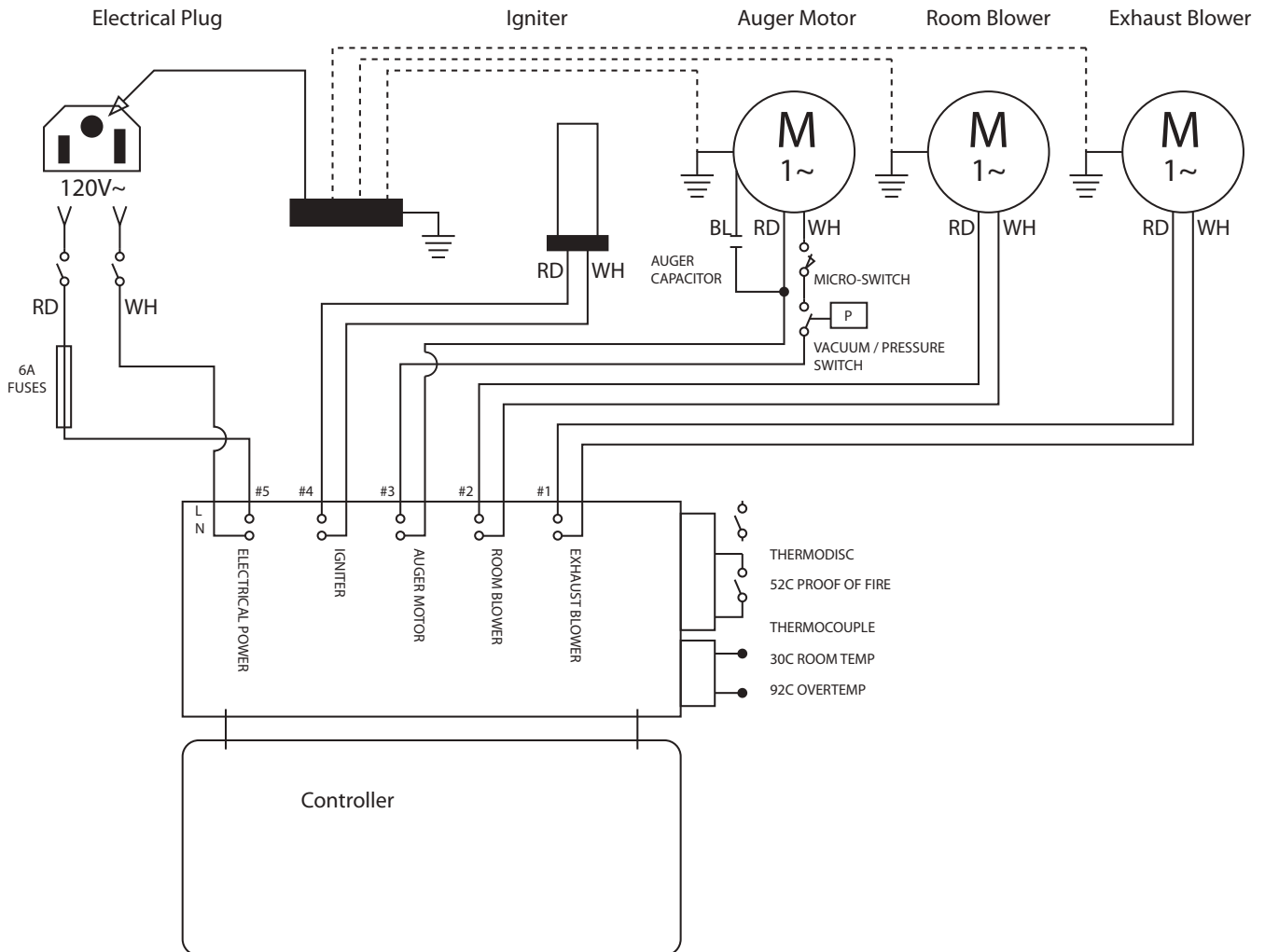




ILLUSTRATED PARTS BREAKDOWN

ITEM #	PART #	DESCRIPTION	QTY.
1	12225	GASKET AUGER HOUSING HPS FEED SYSTEM	1
2	720110	EXHAUST BLOWER	1
3	16135	ASH PAN WELDMENT	1
4	16278	PANEL RIGHT REPLACEMENT KIT	1
5	16279	PANEL LEFT REPLACEMENT KIT	1
6	16280	PANEL BACK REPLACEMENT KIT	1
7	16281	TOP AND HOPPER WELDMENT LID REPLACEMENT KIT	1
8	720238	VACUUM SWITCH	1
9	720103	52C SENSOR REPLACEMENT	1
10	16284	KIT HOPPER ASSEMBLY REPLACEMENT	1
11	21565	ROOM BLOWER REPLACEMENT KIT	1
12	720055	HOPPER LID SWITCH	1
13	720106	SENSOR TEMPERATURE 92 DEG C	1
14	720204	DOOR ASSEMBLY REPLACEMENT KIT	1
15	720107	AUGER MOTOR HPS & SERENITY	1
16	720216	ADJUSTABLE FOOT	4
17	720219	WELDMENT AUGER FEED SYSTEM	1
18	720220	BEARING LOWER AUGER	1
19	720221	BEARING UPPER AUGER	1
20	720227	POWER SUPPLY SWITCH REPLACEMENT KIT	1
21	720229	HOPPER HANDLE REPLACEMENT	1
22	720235	FIREPOT WELDMENT	1
23	18522	EXHAUST MOTOR GASKET KIT	1
24	720298	CONTROL HEAD REPLACEMENT KIT	1
25	720304	INTERFACE MODULE REPLACEMENT KIT	1
26	720307	IGNITER REPLACEMENT KIT	1
27	720308	COLLAR IGNITER RETAINER REPLACEMENT KIT	1
28	13512	LEAD, PIGTAIL, 30C ROOM SENSOR	1
29	13513	BRACKET, HOLDER 30C ROOM SENSOR	1
30	720242	GLASS HPS10 & SERENITY	1
31	11090	PIGTAIL LEAD 52 FOR 10IC SERENITY	1
32	11721	REMOTE CONTROL	1
33	12283	TUBE VACUUM SWITCH PORT	1
34	12429	BRACKET CONTROLLER	1
35	11392	PIGTAIL LEAD VACUUM SWITCH	1

WIRING DIAGRAM





Serenity Pellet Stove

ENGLISH

Efficiency

Efficiency is the measure of an appliance's efficacy in converting energy input in the form of fuel to energy output in the form of heat. Discrepancies in heating efficiency in the marketplace are not uncommon. When determining efficiency values for wood heaters, higher heating value (HHV) is preferred to lower heating value (LHV) which ignores the heat of vaporization of the water vapor that is inherent to the combustion of wood fuel.

Your Serenity™ pellet heater's efficiency will be influenced by factors such as where it is installed, what fuels are used, and how it is operated. To maximize the efficiency of your Serenity™ pellet heater, the following recommendations should be followed:

- Select fuels that are low in moisture. Burning fuels high in moisture draws heat from the fuel and tends to cool the appliance, robbing heat from your home. Pellets that meet or exceed PFI Premium Grade standards are recommended, in part, because they have a low moisture content.

- The efficient combustion of any fuel source is reliant on a proper balance of fuel and oxygen. This principle holds true for your Serenity™ wood heater and the wood pellets that it burns. Burning at a low setting inherently limits oxygen supply. Constant operation at the lowest burn setting will result in a lower efficiency than if the stove were operated at medium and high burn rates.
- This wood heater is most efficient when installed in a main living area. Installation in basement locations will result in some heat being lost to the surrounding earth through foundation walls. Outdoor installation or installation in unenclosed rooms where heat is readily lost to the environment is discouraged.

EPA Certified Emissions:	1.119 grams / hr.
*HHV Tested Efficiency:	69.8%
**BTU Output Range:	9,575 to 22,226 / hr.
***BTU Input:	31,960 / hr.
Fuel:	Wood Pellets (PFI Premium or better)
* Weighted average HHV efficiency using data collected during EPA emission test.	
** A range of BTU outputs based on measured efficiency and burn rates from EPA testing at low and high burn rate settings using HHV.	
*** Based on tested per-hour feed rate on high setting multiplied by tested 8528 BTU/hr. content of pellets used for emissions testing.	

Fire Safety

Carbon monoxide (CO) is a potentially deadly gas that results from unideal combustion. CO is generated when fuels have insufficient air available to completely combust a fuel source. To minimize the production of CO, ensure that your Serenity™ wood heater is properly cleaned and maintained, that the air intake damper is set properly (not too wide or too open), and that the air intake remains free from obstructions.

Make sure your home has working smoke and CO detectors. These detectors should be installed and maintained in accordance with manufacturer's recommendations. Additionally, it is recommended that CO monitors be located in areas that are expected to generate CO. Such areas include heater fueling areas, pellet fuel bulk storage areas, sheds containing hydronic heaters, and rooms where heaters are located.

Burn Rate (kg/hr) (Dry)	CO Emissions (g/hr)	Heating Efficiency (% HHV)	Heat Output (Btu/hr)
High - 1.70	5.61	69.5	22,266
Medium - 1.17	1.78	69.4	15,319
Low - 0.75	8.00	67.3	9,575
Overall - 1.05	5.37	69.8	13,831

SERENITY™ BY CASTLE™ PRODUCT WARRANTY: LIMITED ONE-YEAR WARRANTY

Ardisam Inc., a manufacturing company, warrants this Castle Pellet stove to be free from defects in the material and workmanship for a period of one year. During that one-year period, Ardisam Inc. will, at their discretion, furnish parts to correct any defect caused by faulty material or workmanship. For other warranty repairs, please read the one-year warranty listed below.

All electrical components, such as but not limited to blowers, wiring, vacuum switches, speed controls, control boxes, switches, pilot assemblies, thermostats and igniters, are covered under this one-year warranty. All warranty replacement of parts is the owner's responsibility.

The manufacturer makes no written or implied performance warranty, having no control of fuel type, installation or daily operation and maintenance. Specifically there is no warranty on the paint, glass, burn pot, fire brick, seals or gaskets.

All cost of removal, shipment to and from the dealer or manufacturer, any loss during shipment and reinstallation and any other losses due to the stove being removed shall be the owner's responsibility.

THIS WARRANTY IS LIMITED TO DEFECTIVE PARTS AND DOES NOT COVER DAMAGE TO PARTS CAUSED BY IMPROPER INSTALLATION, IMPROPER MAINTENANCE OR THE LACK OF, AND IMPROPER USE OR OVER FIRING. REPAIR AND/OR REPLACEMENT IS AT THE DISCRETION OF ARDISAM, INC. AND EXCLUDES ANY INCIDENTAL AND CONSEQUENTIAL DAMAGES CONNECTED THEREWITH.

This warranty is not transferable and supersedes all other warranties either expressed or implied and all other obligations to liabilities on our part. Ardisam Inc. does not assume, and does not authorize any other person to assume for us, any liability in connection with the sale of our products. The warranty applies only to products which have not been subjected to negligent use, misuse, alteration, or accident. This guarantee is void unless the warranty card is properly filled out and returned to Ardisam Inc. Cumberland, WI, within 30 days of purchase. To obtain warranty service and/or replacement instructions, contact the customer service department at 800-345-6007 Monday through Friday from 8 a.m. to 5 p.m. or visit www.castlepelletstoves.com. If you choose to ship your product to Ardisam™ for warranty repair, you must first have prior approval from Ardisam™ by calling our customer service department at 800-345-6007 for a return material authorization number (RMA#). Under these circumstances, all items must be shipped pre-paid. Ardisam™ will at no charge, repair or replace, at their discretion, any defective part which falls under the conditions stated above. Ardisam™ retains the right to change models, specifications and price without notice. Ardisam shall not be obligated to ship any repair or replacement product to any location outside of the United States of America or Canada. Some states and countries do not allow the limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state and country to country.



Castle Stoves™, Division of Ardisam, Inc.

1160 8th Avenue, PO Box 666

Cumberland, WI 54829

800-345-6007 | Fax 715-822-2223

E-mail: info@castlestoves.com

PELLET FUEL ROOM HEATER

"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 operating instructions in the owner's manual."

"U.S. ENVIRONMENTAL PROTECTION AGENCY Certified to comply with 2020 particulate emissions standards using pellet fuel."

Conforms To: ASTM E2779-2010 & ASTM E2515-2011

This appliance requires the use of
"Premium Quality" Wood Pellet fuel.

Model: Serenity Emission: 1.119 g/hr



Date of Manufacture:	
Manufactured By:	
Serial Number:	

Appendix E

Dry Gas Meter Calibration Data



Calibration Date: 7/20/2015 Calibration By: KS Calibration Due: 1/20/2016

Using:
 Use Procedure: W/L-AMER-Call-1141
 Description:
 Serial:

Model: Rockwell
 WHI#: 12

Run Number	Meter Initial	Barometric Pressure	Spirometer Temperature	Vapor Pressure of H ₂ O (Hg)	Meter Temperature	Meter Pressure	Measurement Inches	Spirometer Volumn	Meter Final	Y
1	695.888	28.78	80.3	1.0322	73.2	0.3	23.3750	1.0625	696.903	0.9960
2	696.903	28.78	80.9	1.0526	73.7	0.3	23.5000	1.0682	697.919	0.9994
3	697.920	28.78	80.5	1.0390	74.2	0.3	23.3750	1.0625	698.936	0.9963
								0.3447	AVERAGE	0.9972
								0.5970	STDEV	0.0019
									MU of Y	0.004

Reviewed by: *RS*

Date: 7/20/15

0.739

Measurement Uncertainty is calculated using the following formula:
 $O.M.U. = k \cdot \sqrt{(A.D.)^2 + (S.D.)^2} + (R.M.U./2)$
 O.M.U. = Overall Measurement Uncertainty
 A.D. = Average Deviation of the difference of all measured results compared to the reference value.
 S.D. = Standard Deviation of the difference of all measured results compared to the reference value.
 k = Confidence Factor (2 for 95% confidence)
 R.M.U. = Standard Measurement Uncertainty of Reference Measurement Equipment. R.M.U. is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in t



Calibration Date: 7/20/2015 Calibration By: KS Calibration Due: 1/20/2016

Using: WI-L-AMER-Call-1141
 Description:
 Serial:

Model: Rockwell
 WHI#: 13

Run Number	Meter Initial	Barometric Pressure	Spirometer Temperature	Vapor Pressure of H ₂ O (Hg)	Meter Temperature	Meter Pressure	Measurement Inches	Spirometer Volumn	Meter Final	Y
1	722.513	28.78	81.2	1.0630	76.5	0.3	23.6250	1.0739	723.527	1.0111
2	723.528	28.78	80.9	1.0526	76.7	0.3	23.6250	1.0739	724.549	1.0054
3	724.550	28.78	81.2	1.0630	76.5	0.3	23.5625	1.0710	725.566	1.0064
								0.3447	AVERAGE	1.0076
								0.5970	STDEV.	0.003
									MU of Y	0.0061

Reviewed by:

Date: 7/20/15 0.739

Measurement Uncertainty is calculated using the following formula:

$$O.M.U. = k \cdot \sqrt{(A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2}$$

$$O.M.U. = \text{Overall Measurement Uncertainty}$$

A.D. = Average Deviation of the difference of all measured results compared to the reference value.

S.D. = Standard Deviation of the difference of all measured results compared to the reference value.

k = Confidence Factor (2 for 95% confidence)

R.M.U. = Standard Measurement Uncertainty of Reference Measurement Equipment. R.M.U. is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in it

Appendix F

Unit Conditioning Documentation

Stove 1
 WHI005370
 S/N: 012328010210801150930

Date:2015/11/10
 Time:13:50:50
 Interval:00:30:00

	Flue temp	Unit	Type	Date	Time	Fuel
0 min	72.6	F	T	11/10/2015	13:50:50	40.0lbs Indeck premium hardwood @ start
30	248.8	F	T	11/10/2015	14:20:50	
60	264.8	F	T	11/10/2015	14:50:50	
90	271.9	F	T	11/10/2015	15:20:50	
120	272	F	T	11/10/2015	15:50:50	
150	284.1	F	T	11/10/2015	16:20:50	Add 4.2lbs @ 16:30
180	266.7	F	T	11/10/2015	16:50:50	
210	277.1	F	T	11/10/2015	17:20:50	
240	287.3	F	T	11/10/2015	17:50:50	
270	276.5	F	T	11/10/2015	18:20:50	
300	286.8	F	T	11/10/2015	18:50:50	
330	284.3	F	T	11/10/2015	19:20:50	
360	289.8	F	T	11/10/2015	19:50:50	
390	295.4	F	T	11/10/2015	20:20:50	
420	293.9	F	T	11/10/2015	20:50:50	
450	296.7	F	T	11/10/2015	21:20:50	
480	294.7	F	T	11/10/2015	21:50:50	
510	294	F	T	11/10/2015	22:20:50	
540	299.2	F	T	11/10/2015	22:50:50	
570	298	F	T	11/10/2015	23:20:50	
600	301.6	F	T	11/10/2015	23:50:50	
630	302.6	F	T	11/11/2015	0:20:50	
660	308.5	F	T	11/11/2015	0:50:50	
690	303.5	F	T	11/11/2015	1:20:50	
720	309.9	F	T	11/11/2015	1:50:50	
750	311.3	F	T	11/11/2015	2:20:50	
780	307.5	F	T	11/11/2015	2:50:50	
810	307.6	F	T	11/11/2015	3:20:50	
840	304.8	F	T	11/11/2015	3:50:50	
870	307.6	F	T	11/11/2015	4:20:50	
900	302.1	F	T	11/11/2015	4:50:50	
930	298.2	F	T	11/11/2015	5:20:50	
960	306.1	F	T	11/11/2015	5:50:50	
990	301.4	F	T	11/11/2015	6:20:50	
1020	240.1	F	T	11/11/2015	6:50:50	
1050	156.3	F	T	11/11/2015	7:20:50	Add 36.25lbs
1080	295.9	F	T	11/11/2015	7:50:50	
1110	297.2	F	T	11/11/2015	8:20:50	
1140	299.8	F	T	11/11/2015	8:50:50	
1170	310.5	F	T	11/11/2015	9:20:50	
1200	295.9	F	T	11/11/2015	9:50:50	
1230	299.1	F	T	11/11/2015	10:20:50	
1260	299.4	F	T	11/11/2015	10:50:50	
1290	306.1	F	T	11/11/2015	11:20:50	
1320	302.8	F	T	11/11/2015	11:50:50	
1350	295.5	F	T	11/11/2015	12:20:50	
1380	301	F	T	11/11/2015	12:50:50	
1410	300.6	F	T	11/11/2015	13:20:50	
1440	307.5	F	T	11/11/2015	13:50:50	
1470	304.3	F	T	11/11/2015	14:20:50	
1500	301.9	F	T	11/11/2015	14:50:50	
1530	304.6	F	T	11/11/2015	15:20:50	
1560	304.1	F	T	11/11/2015	15:50:50	
1590	306.8	F	T	11/11/2015	16:20:50	Add 27.8 lbs@ 16:30
1620	214.8	F	T	11/11/2015	16:50:50	

1650	299.8 F	T	11/11/2015	17:20:50	
1680	293.9 F	T	11/11/2015	17:50:50	
1710	293 F	T	11/11/2015	18:20:50	
1740	294.5 F	T	11/11/2015	18:50:50	
1770	295.7 F	T	11/11/2015	19:20:50	
1800	295.1 F	T	11/11/2015	19:50:50	
1830	287 F	T	11/11/2015	20:20:50	
1860	293.5 F	T	11/11/2015	20:50:50	
1890	295 F	T	11/11/2015	21:20:50	
1920	297.9 F	T	11/11/2015	21:50:50	
1950	288.4 F	T	11/11/2015	22:20:50	
1980	295.6 F	T	11/11/2015	22:50:50	
2010	297.5 F	T	11/11/2015	23:20:50	
2040	298.5 F	T	11/11/2015	23:50:50	
2070	293.1 F	T	11/12/2015	0:20:50	
2100	296.9 F	T	11/12/2015	0:50:50	
2130	296.5 F	T	11/12/2015	1:20:50	
2160	304.6 F	T	11/12/2015	1:50:50	
2190	293.5 F	T	11/12/2015	2:20:50	
2220	303.9 F	T	11/12/2015	2:50:50	
2250	303.8 F	T	11/12/2015	3:20:50	
2280	302.1 F	T	11/12/2015	3:50:50	
2310	303.8 F	T	11/12/2015	4:20:50	
2340	300.8 F	T	11/12/2015	4:50:50	
2370	297.3 F	T	11/12/2015	5:20:50	
2400	267.8 F	T	11/12/2015	5:50:50	
2430	234.9 F	T	11/12/2015	6:20:50	
2460	162.8 F	T	11/12/2015	6:50:50	
2490	86.5 F	T	11/12/2015	7:20:50	Add 37.4 lbs@ 7:30
2520	273.6 F	T	11/12/2015	7:50:50	
2550	300.1 F	T	11/12/2015	8:20:50	
2580	308.6 F	T	11/12/2015	8:50:50	
2610	306.6 F	T	11/12/2015	9:20:50	
2640	303.7 F	T	11/12/2015	9:50:50	
2670	310.9 F	T	11/12/2015	10:20:50	
2700	308.2 F	T	11/12/2015	10:50:50	
2730	313.3 F	T	11/12/2015	11:20:50	
2760	314.9 F	T	11/12/2015	11:50:50	
2790	310.8 F	T	11/12/2015	12:20:50	
2820	317.2 F	T	11/12/2015	12:50:50	
2850	304.4 F	T	11/12/2015	13:20:50	
2880	310.7 F	T	11/12/2015	13:50:50	
2910	313.3 F	T	11/12/2015	14:20:50	
2940	316.9 F	T	11/12/2015	14:50:50	
2970	315.8 F	T	11/12/2015	15:20:50	
3000	318.1 F	T	11/12/2015	15:50:50	
3030	295.5 F	T	11/12/2015	16:20:50	Test complete
					Removed pellets after test @ 16:30 11/12/2015
					16.2lbs Removed
					Total Consumption
					129.45 lbs

Stove Installation Configuration



Fuel Source



Stove setting



Appendix G

Pictures



Ardi sam
Project # G-102366578
Model Serenity
12/7/15
ASTM E2779
Run 1

WOOD PELLETS
MARTHA
100% Renewable
Wood Resource
NET WT. 40 LB / 18.1 kg

WICK LANE **RoughDeck**