



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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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.



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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 ≤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.



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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 property, 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* M*	1.70	1.119	1.290	5.37	69.8
	12/7/15	L* OA*	0.75 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.	l lime l		Velocity	Volumetric Flow Rate	Ave. Temp.		Volume CF)		ite Catch ng)
ixuii ivo.		(ff/sec)	(dscf/min)	(°R)	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)		% g/kg	
	Train 1	Train 2	Train 1	Train 2	Deviation	Deviation
1	629.93	624.20	7.43	5.99	10.73%	0.219



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TABLE 5. - GENERAL SUMMARY OF RESULTS

Run No.	Burn Rate (kg/hr)(Dry) (Overall)	Initial Draft (in/H₂O)	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	CO Emissions	Heating Efficiency	Heat Output
(kg/hr)(Dry)	(g/hr)	(% HHV)	(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	CO Emissions	Heating Efficiency	Heat Output
(kg/hr)(Dry)	(g/hr)	(% HHV)	(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 singe 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.



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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 \pm 6 inches above the scale platform. (See Figure 2.)



IV.A.(1) DILUTION TUNNEL

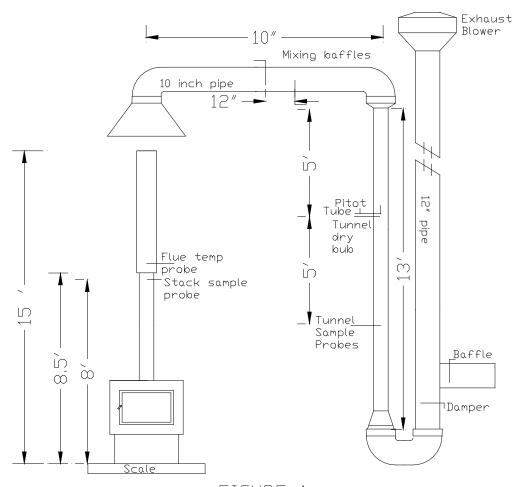
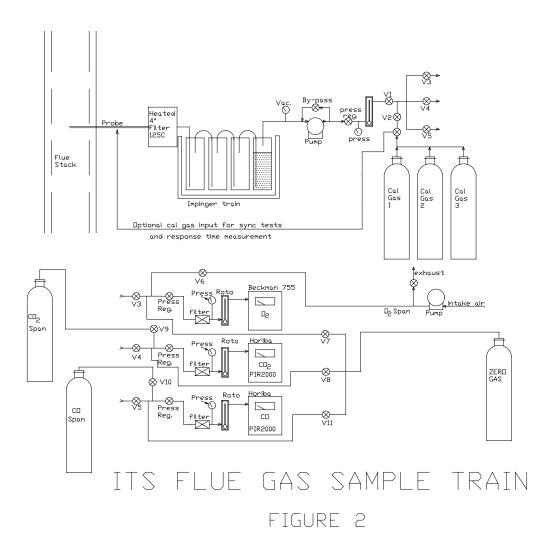


FIGURE 1



IV.B. OPERATIONAL DRAWINGS

IV.B.(1) STACK GAS SAMPLE TRAIN





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

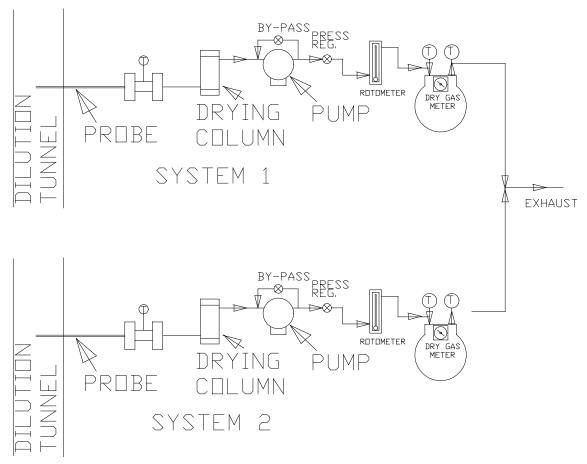


Figure 3



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 ft 3 , the resolution is .1%, giving an accuracy higher than the $\pm 2\%$ 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. Pretest 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 Sin

Ken Slater

Associate Engineer - Hearth

Reviewed by:

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

The certificate and schedule are held in force by regular annual surveillance visits by Intertek Testing Services NA, Inc. and the reader or user should contact Intertek to validate its status. This certificate remains the property of Intertek Testing Services NA, Inc. and must be returned to them on demand. This Certificate is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this certificate. Only the Client is authorized to permit copying or distribution of this certificate and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

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



Certificate of Conformity WHI15-223943001 Appendix A

Certificate of	Conformity #:	Certificate of Conformity Issue Date:		
WHI15-2239	43001	January 25, 2016		
REVISION # REVISION DATE REPO		REPORT PAGES	REVISION	
	January 25,			
0	2016	N/A	Original Report Issue	
1	March 5, 2021	N/A	5-year renewal	
	February 2,			
2	2022	N/A	Update per EPA deficiency letter issued 1/26/22	

Revised Repo	ort #:	Report Issue Date:		
102366578M	102366578MID-002		015	
REVISION #	REVISION DATE	REPORT PAGES	REVISION	
	December 22,			
0	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.	
	February 2,	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.	
2	2022	Appendix B	Added efficiency data with Marth fuel analysis.	

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

From: Seth Bailey

To: <u>sanchez.rafael@epa.gov</u>

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

Seth Bailey
Regulatory Compliance Manager
Ardisam, Inc.
(m) 608.332.3943
(w) 715.822.2415 ext. 130
seth.bailey@ardisam.com

Appendix A

Laboratory Operating Procedure



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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



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I. APPLIANCE INSPECTION AND SET-UP

A. Incoming Inspection

- Check for completeness of unit including parts, accessories, installation and operating instructions, drawings and specifications, etc. Note any discrepancies or missing parts.
- 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.



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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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- 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.



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d. Calculate leakage rate as follows.

System 1: DGM3-DGM₁ = CFM₁ System 2: DGM4-DGM₂ = CFM₂

If CFM₁ or CFM₂ is greater than 0.02 cfm, or $_1$ S greater than 0.04 x 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 x 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.
- 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).
- 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.
 - I. 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.



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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.
- 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:

 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	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	•	
Control #:	G102366578		

Test Duration: 360
Output Category: Overall

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

|--|

VERSION: 2.2 12/14/2009

VERSION:	2.2	12/14/2009						
Manufacturer:	Ardisam		Appliance Type:	Pellet	(Cat, Non-	Cat, Pellet)		
Model:	Serenity							
Date:	12/7/2015		Temp. Units	F	(F or C)	Default	Fuel Value	es:
Run:	1		Weight Units	lb	(kg or lb)		D. Fir	Oak
Control #:	G102366578					HHV (kJ/kg)	19,810	19,887
Test Duration:	360					%C	48.73	50
Output Category:	Overall		Fuel I	Data		%Н	6.87	6.6
				D. Fir		%O	43.9	42.9
Wood	Moisture (% wet):	4.49	HHV	19,887	kJ/kg	%Ash	0.5	0.5
Loa	d Weight (lb wet):	14.54	%С	50				
_								

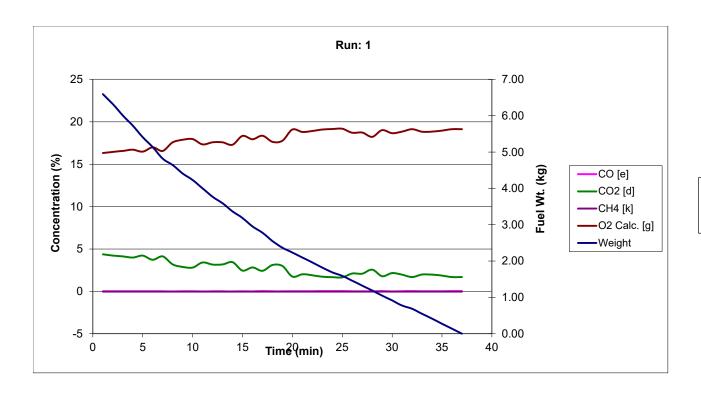
Burn Rate (dry kg/h):	1.05	%Н	6.6
Total Particulate Emissions:	6.71 g	%O	42.9
		%Ash	0.5

	Averages 0.01 2.67 17.85						
Elapsed	Fuel Weight		as Composit		Flue	Room	
Time (min)	Remaining (lb)	CO	CO ₂	O_2	Gas	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 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 occurence and the next reading showing a decrease in weight.

Manufacturer: Model: Date: Ren: Control #: Test Duration:	12/07/15 1 G 102366578 360	MHV 69.83%	DHV 75.21%	Note: In the Trout data", "Calc. % Q.*, "Faul Properties", and "Mass Balance" columns, [4], [6], [6], [8], [9], [6], [9], [6], [6], [6], and [6] refer to their respective variables in Clauses 13.7.3 to 13.7.5.	Combustion Heat Transfe Heat Output		99.50% Dry 70.18%	Air Fuel Ratio (A y Molecular Weight (M, Moles Eshaust Gas (N Air Fuel Ratio (AIF) 500 kJih 881 kJih	(₄) 29.15	54HC 0.8			ation Efficiency: Total input (kJ): otal Outout (kJ): Efficiency: Total CO (c):	125,287 116 87,482 82 69,83%			Initial Dry V	llood (wet basis): Weight Wt _h , (kg): ure Content Dry	6.30	Mo		Gai: 4.49 lig: 6.30 CA: 50 HY: 6.6 CX: 42.9																			
	Comb Eff HT Eff Output Burn Rate Grams CO Input MC wet	99.50% 70.18% 14,580 1.05 32 20,881 4.49	99.50% 75.58% kJih kah a kJih	Ultimate CO ₂ CO _{2 at} 12.80 F ₀ 1.943	Burn Duration Burn Rate Stack Temp			550 ksh 8.0 Deg.C							Fuel Hea		6.60 HHV LHV 19.887 18.464	6 Blufb	HHV LH 8555.6 794	V 3.4												SUMS			AVERAGE			**************************************			
	Averages	0.01	2.67	7.16 20.79 18.11 108.98	20.81 101.8%	70.8% 7	2.1% 50.	47 2.76 58.11	8 2.63	50.10	26617 4.17	6.60 2.60	19887.00	4.49 7	9.21 21.01	0.64	2.16 -0.03	0.06	42.13 321	.09 0.22	-0.46 138	1.29 34.12	2.61 382	.13 347	75.69 263	31.81 25	563.20 2533.96	3310.61 3068.	293.96	5418.43 288-	6.64 2321	79 120924.	8 -15824.61	59380.30 4545		35028.23	-2150.51	37178.7	91588.3	-2150.5	32.2 -44.5
	INPUT DAT	TA		Oxygen Calculation Input Dat Excess Total Calc. % Flue	Room Eff		Net A				Total Carbon H	Fuel Propertie		Ster	-	Mass Balance 100 mole dry		kg Wood per 100 mole did					Sta loisture Ten		Heat Conte		- Ambient to Stack	Temperature	Room		Ener	gy Losses (kJ/l			Total	Total	Chemical				
Element	Weight Remaining (kg	COTH	CO, [4]	Excess Total Calc.% Flue Av FA O: O: fel Gas (*C) Te	mp (°C) %	Transfer	S De		mee Now			rdroger Oxyo		Moisture	(moles/1	100 mole dry 1	100 gas) 01 04	100 mole dia	CO. O.	Moles per kg	g of Dry Wood HC N		loisture Ter		20. (CO N ₂	CH, H-O	remo	co. c	h cc	Flue Gas Con	Stituent CH,	H-O Comb H-O Fu		Loss	Chemical Loss 1	Sensible and			Grams Produced
0	6.60	0.01	4.37	352.3% 20.69 16.31 144.5	21.6 101.0%	73.9% 7	4.6% 27	8 6.60 0.00	6.30	0.00	0 4.17	6.60 2.68	19887.00	4.49 70	9.31 21.04		3.50 -0.02	0.10	42.04 156	91 0.08	-0.24 762	80 33.64	2.61 417	70 490	01.04 358		84.05 3544.43	4722.73 4288.1	294.78	206.03 578	41 21.9	2703.70	-213.40	1623.52 126	4 5045.20	0.00	0	0.00	0	0 0	0.00 0.00
10	6.32	0.01	4.23		22.1 100.9%		5.1% 28					6.60 2.68			9.30 21.03		3.39 -0.02		41.98 163	47 0.14	-0.24 787	41 33.65	2.61 410		6.99 346		67.46 3330.00	4419.39 4029.5		192.97 565				1614.95 125		2034.55	-72	2106.22	6145		1.60 -1.58
20	5.01	0.01	4.13		22.3 101.0%		3.3% 29 2.8% 30					6.60 2.68 6.60 2.68			9.29 21.03 9.28 21.03		3.31 -0.02		42.02 168 42.03 176	57 0.11	-0.25 805 -0.26 836	80 33.67	2.61 420 2.61 419				45.04 3604.90 28.91 3488.86	4813.70 4361.4		209.63 632 208.63 658		2 2908.42		1627.28 126: 1627.77 126.	3 5309.91 8 5417.80	1503.72	-55	1558.36	4128 4140		0.88 -1.14
40	5.41	0.01	4.21		21.7 101.0%		3.4% 28					5.60 2.68			9.30 21.03		3 37 -0.03		42.05 164	55 0.05	-0.25 791	69 33.67	2.61 421		11.95 381	11 31 37	04.82 3554.05	4104.00 4417.0	294.86	213.26 627			-223.95	1629.51 126		1498.37	-57	1555.03	4128		0.63 -1.13
50	5.14	0.01	3.72	430.5% 20.73 17.00 138.1	21.1 101.1%	72.0% 7	2.8% 32				5506 4.17	6.60 2.68	19887.00		9.27 21.03		2.99 -0.03	0.09	42.04 192	02 0.12	-0.29 895	44 33.74	2.61 411		12.69 350		08.88 3370.93	4471.83 4079.5	294.21	195.60 672		3018.45		1621.20 125.	9 5411.93	1525.47	-62	1587.73	4060	-62 0	0.98 -1.30
60	4.82	0.00	4.13 3.18		20.9 101.2%		3.5% 29				4691 4.17 3856 4.17	6.60 2.68 6.60 2.68	19887.00		9.30 21.03		3.30 -0.03	0.10	42.12 169.	10 0.02	-0.27 809		2.61 420		11.86 379		85.09 3544.45	4861.91 4409.5	294.04	212.38 640 165.83 694			-238.17 -339.92	1630.26 126: 1606.91 123:		1256.41	-55	1311.01	3435		0.13 -1.00 -0.30 -1.18
70	4.64	0.00	3.18	524.1% 20.76 17.58 119.9 583.7% 20.77 17.88 118.3	21.0 101.5%		1.9% 42			29.60	3856 4.17	6.60 2.68 6.60 2.68	19887.00	4.49 75	9.24 21.02		2.55 -0.03		42.31 234	16 -0.06 96 0.15	-0.38 ####	MAN 23.05	2.61 393		19.16 296		85.89 2853.15 28.95 2796.82	3740.86 3454.5		165.83 694 161.72 758			-339.92	1608.91 123.		1017.60	-60	1086.27	2839		0.88 -1.18
90	4.23	0.00	2.81	603.5% 20.78 17.97 122.3	20.7 101.8%	69.3% 7	0.6% 43		4 4.04		3903 4.17	6.60 2.68			9.22 21.01		2.26 -0.03	0.07	42.22 269	94 0.07	-0.42 ####	MAW 34.00	2.61 395				55.80 2922.35	3837.62 3538.1	293.85	169.59 819	59 21.2	3478.39		1615.38 124.	6 5854.10	1149.04	-60	1218.04	2754	-69 0	0.41 -1.31
100	4.00	0.00	3.41		20.8 101.6%		3.8% 35					6.60 2.68 6.60 2.68	19887.00		9.26 21.02		2.73 -0.03		42.28 215	32 -0.05	-0.35 984		2.61 387			06.08 27	32.83 2701.67	3531.15 3271.5		156.70 604			-312.74	1599.84 123: 1609.37 123:		1057.02	-72	1128.67	3309		-0.32 -1.23
120	3.59	0.00	3.16		21.0 101.7%		3.3% 38				3000 4.17	5.60 2.68			9.24 21.02		2.54 -0.03		42.25 234	SS 0.00	0.37 ####		2.61 388				98 16 2795 62	3779.73 3400.5		167.21 702 158.63 664			-333.94	1609.37 123.1		983.50	-60	104.42	2848 2852		0.00 -1.11
130	3.37	0.00	3.44	475.8% 20.74 17.30 115.1	20.5 101.6%	74.6% 7	5.8% 35	5 3.37 48.93	3 3.22	48.93	3856 4.17	6.60 2.68	19887.00	4.49 75	9.25 21.02	0.82	2.76 -0.03	0.08	42.27 212	39 -0.05	-0.35 973		2.61 388	28 373	11.71 282	25.26 27	51.50 2720.14	3555.38 3293.9	293.64	157.76 600	05 -15.1	4 2546.70	-308.62	1600.16 123.	4 4804.34	931.57	-63	994.08	2925	-63 4	-0.29 -1.07
140	3.19	0.01	2.45		20.5 102.0%		8.4% 49					6.60 2.68			9.20 21.01		1.98 -0.03		42.23 316	57 0.13	-0.48 mmm	MAW 34.13	2.61 391			28.98 28	51.97 2819.57	3693.52 3414.0	293.67	163.48 927 162.98 783				1617.36 123		1243.00	-76	1320.61	2587		0.74 -1.53
150	2.95 2.78	0.00	2.82		20.5 102.0%		1.7% 43		1 2.82			6.60 2.68 6.60 2.68			9.22 21.01 9.19 21.00		2.27 -0.03 1.97 -0.03		42.32 268	99 -0.02	-0.43 ####	MAN 34.03	2.61 391 2.61 386	23 385			36.97 2804.73 90.94 2650.34	3672.91 3396.1	293.67	162.98 783 151.97 874			-384.59 -387.22	1611.66 123. 1605.60 123.		1087.04	-75	1162.08 1224.60	2759 2536		-0.10 -1.3 2.68 -1.3
170	2.55	000	3.11		20.4 101.7%		3.7% 39		0 2.44		3919 4.17	6.60 2.68	19887.00		9.24 21.02		2.50 -0.03		42.26 239	74 0.00	-0.38 ANN	MAN 23.93	2.61 390		8.50 288	89.72 28	13.98 2781.96	3540.81 3368.6	293.57	161.36 692			-340.70	1606.08 123		1032.14	-67	1099.01	2887		0.00 -12
180	2.37	0.00	2.99		20.6 101.8%		2.9% 40				3000 4.17	6.60 2.68			9.23 21.02		2.40 -0.03		42.28 251.	35 0.00	-0.40 ####		2.61 390		10.59 289		22.43 2790.34	3653.15 3378.1	293.72	161.94 728			-357.21	1608.17 123.0		813.16	-54	865.82	2187		0.00 -0.9
190	2.24	0.01	1.74		20.5 102.6%		7.3% 70 10.9% 60					6.60 2.68 6.60 2.68		4.49 75	9.15 21.00		1.42 -0.03		42.22 463	64 0.34	-0.52 ####	MAW 34.54	2.61 368 2.61 368			28.59 21	72.74 2147.49	2771.64 2601.8	293.69	123.76 103				1608.67 121. 1603.07 121.		839.30 759.79	-67	906.03	1730 1851		1.23 -1.42 0.15 -1.31
210	1.96	0.00	1.90		20.6 102.2%		9.7% 64				2011 4.17	6.60 2.68			9.16 21.00		1.55 -0.03		42.46 390	03 0.37	-0.62 ####	MAN 34.32	2.61 367				34.74 2100.44	2720.20 2013.1	293.36	121.24 915				1603.07 121.		796.79	-51	854.45	1831		1.38 -1.3
220	1.82	0.03	1.73		20.3 101.7%		0.1% 69					6.60 2.68	19887.00		9.15 20.99		1.43 -0.03		41.73 459	98 0.77	-0.52 ANN		2.61 358		1.71 194		96.70 1874.44	2403.73 2271.5		106.47 894				1590.98 120.		775.27	-44	818.80	1815		2.81 -1.20
230 240	1.69	0.02	1.68		20.9 102.4%		9.5% 72 8.9% 73				2175 4.17 2170 4.17	6.60 2.68 6.60 2.68	19887.00		9.15 20.99 9.14 20.99		1.38 -0.03 1.36 -0.03		42.06 479. 41.90 487	73 0.50	-0.52 8899		2.61 360 2.61 359			71.30 193 67.89 19	02.72 1900.20 19.46 1896.96	2440.10 2302.6		108.87 945 108.24 955			-616.01 -607.09	1598.51 120. 1597.45 120.		663.70 674.36	-52	715.28 720.09	1511		1.54 -1.21 2.01 -1.15
250	1.60	0.00	2.11		20.4 102.6%		3.4% 58		5 1.40			6.60 2.68	19887.00		9.14 20.99		1.71 -0.03	0.04	42.43 376	55 0.04	-0.50 8889		2.61 353	42 273			77 02 2003 33	2576 68 2427 5	293.78	115.86 782	73 10.8		-507.09	1993.83 121	8 5287.50	676.06	-46	742.00	1490	-40 2	0.14 -1.21
260	1.32	0.00	2.06		20.4 102.5%	71.3% 7	3.0% 58	8 1.32 79.91		79.91		6.60 2.68	19887.00		9.18 21.00		1.69 -0.03	0.05	42.37 381.	53 0.10	-0.50 ANNO	MAW 34.35	2.61 363	59 273	5.44 206		30.61 2006.89	2581.59 2431.1	293.57	115.89 794	44 28.6	3235.60	-528.63	1593.87 121.		693.95	-65	758.50	1880	-65 0	0.36 -1.23
270	1.19	0.00	2.56		20.5 102.1%		6.2% 47					6.60 2.68			9.21 21.01		2.05 -0.03		42.36 301.	55 0.00	-0.48 ####		2.61 365	21 279			75.67 2051.46	2541.87 2485.6	293.66	118.49 641				1585.26 121.		624.30	-56	680.67 850.76	2002	-56 0	0.00 -1.01
280 290	1.05	0.03	1.79		20.6 101.9%		9.1% 67.				2595 4.17 2595 4.17	6.60 2.68 6.60 2.68			9.15 21.00		1.47 -0.03		41.87 444.	50 0.62	-0.62 ####		2.61 364				51.87 2027.92 10.24 1887.86	2010.34 2457.2	293.71	115.77 935 109.42 715				1597.09 121. 1589.29 120.		801.98	-49	850.76 715.29	1793 1952		2.27 -1.29 -0.30 -1.24
300	0.78	0.01	1.96	900.6% 20.83 18.85 85.3	20.8 102.3%	71.5% 7	3.1% 62	0 0.78 88.25	5 0.74	88.25	2180 4.17	6.60 2.68	19887.00	4.49 75	9.17 21.00	0.47	1.60 -0.03	0.05	42.17 404	67 0.30		WWW 34.37	2.61 359	41 255	3.71 194	45.51 180	97.68 1875.43	2406.53 2272.1	293.95	107.70 787	30 85.8	3186.68	-535.54	1589.14 120.	7 5341.93	585.64	-49	634.84	1595	-49 0	0.93 -1.05
310	0.69	0.03	1.60		20.8 101.8%		9.8% 71					6.60 2.68			9.14 20.99		1.40 -0.03		41.75 471	45 0.77	-0.64 ####		2.61 359				86.61 1864.47	2391.87 2259.4		105.98 911				1592.32 120.		653.03	-38	691.31	1506		2.33 -1.11
320 330	0.55	0.00	1.99		20.8 102.6%		3.9% 61					6.60 2.68 6.60 2.68			9.17 21.00 9.17 21.00		1.61 -0.03		42.39 401. 42.10 402.	74 0.11 21 0.35	-0.62 ANNO		2.61 358 2.61 365				77.11 1855.08 82.63 2058.35	2379.24 2248.1		107.07 773 118.20 856				1590.47 120. 1595.57 121.		670.03 753.51	-68	737.73	1894		0.38 -1.25 1.33 -1.23
340	0.42	0.02	1.00		20.1 102.1%		2.2% 65					5.60 2.68			9.17 21.00		1.52 -0.03		42 10 402		-0.55 8886		2.61 356				02.63 2000.30 02.18 1879.85	2410 38 2278 1		108.10 841				1593.96 120.		732.94	-00	800.29	1899		0.92 -1.33
350	0.14	0.03	1.60	1052.4% 20.84 19.14 21.4	20.6 101.7%	66.4% 6	7.5% 71	4 0.14 97.88	8 0.13	97.88	3924 4.17	6.60 2.68	19887.00	4.49 75	9.14 20.99	0.41	1.39 -0.03	0.04	41.73 473	53 0.78		MAW 34.45	2.61 364	51 276	7.03 210	05.78 205	53.46 2029.49	2512.48 2459.1	293.71	115.47 997	.15 223.4	8 3974.01	-571.34	1599.25 121.	6 6459.34	1274.65	-60	1343.29	2550	-69	4.33 -2.02
360	0.00	0.04	1.60	1045.1% 20.84 19.13 87.7	20.6 101.6%	67.8% 6	8.8% 71	0.001 100.0	0.00	100.00	1329 4.17	6.60 2.68	19887.00	4.49 75	9.14 20.99	0.41	1.40 -0.03	0.04	41.64 470.	56 0.85	-0.62 ANN	MAW 34.41	2.61 360	86 262	10.28 199	95.69 19-	H6.50 1923.70	2470.44 2331.1	293.73	109.10 935	10 245.7	5 3744.85	-556.94	1593.35 120.	2 6195.15	414.12	-21	434.93	915	-21 1	1.61 -0.63



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	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	_	
Control #:	G102366578		

Test Duration: 360
Output Category: Overall

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

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VERSION: 2.2 12/14/2009

VERSION:	2.2	12/14/2009								
Manufacturer:	Ardisam		Appliance Type:	Pellet	(Cat, Non-	Cat, Pellet)				
Model:	Serenity									
Date:	12/7/2015		Temp. Units	F	(F or C)	Default	Fuel Value	es		
Run:	1		Weight Units	lb	(kg or lb)		D. Fir	Oak		
Control #:	G102366578					HHV (kJ/kg)	19,810	19,887		
Test Duration:	360					%C	48.73	50		
Output Category:	Overall		Fuel I	Data		%Н	6.87	6.6		
				Marth		%O	43.9	42.9		
Wood	Moisture (% wet):	4.49	HHV	18,967	kJ/kg	%Ash	0.5	0.5		
Loa	d Weight (lb wet):	14.54	14.54 %C 46.87							

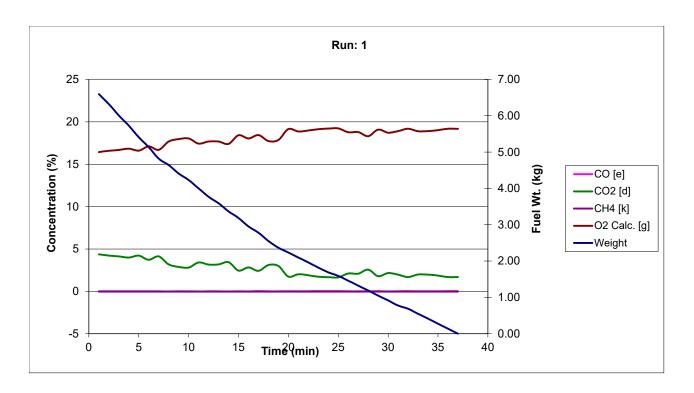
Wood Moisture (% wet):	4.49	HHV	18,967	kJ/kg
Load Weight (lb wet):	14.54	%C	46.87	
Burn Rate (dry kg/h):	1.05	%Н	6.41	
Total Particulate Emissions:	6.71 g	%O	46.62	
		%Ash	0.1	

	Averages	0.01	2.67	17.85	228.17 Temp	69.45 . (°F)
Elapsed	Fuel Weight	Flue Ga	as Composit	ion (%)	Flue	Room
Time (min)	Remaining (lb)	CO	CO ₂	O ₂	Gas	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 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 occurence and the next reading showing a decrease in weight.

Model: Date: Run: Control #: I Duration: 3		min		[a] [b], [c], [b], [u], [u], [w], [ii]	lance" columns, [e], [d], [g], and [k] refer to their	Combust	ing Efficiency: ion Efficiency: fer Efficiency:	99.50%	Air Fuel I Dry Molecular We Dry Moles Eshaust Air Fuel Ratio	ight (M _e) 2 I Gas (N _e): 15	19.16 183.71 %H 15.66 0.1): 119,491	113,332 (Blu 79,490 (Blu		Initial	Dry Weight Wt	basis): 4.49 i(kg): 6.30 nt Dry 4.70		Moisture Co	Dry kg :	6.30																				
	EH	HHV 70.14%	LHV 75.65% 99.50%	respective variables in C	Ultimate CO ₂	Heat Outs Heat Inc	ut: 13.251 E ut: 18.892 E	Blub Blub	13.968 kJh 19.915 kJh							v: 70.14%	73.430 1012			monate cons	4.10			cox	45.62																				
	HT EM Output		76.03% kJ/h		CO _{2ml} 20.36 F ₀	Burn Durati	on: 6.00	h									Loss	d Weight (kg):	6.60																										
	Burn Rate Grams CO	30	kah		1.013	Burn Ra		Ibh	1.050 ksh								Fuel	Heating se in kJ/kg - CV	HHV : 18.967 1	LHV 7.585	Blufb 8159.8	LHV 7565.2																							
	Input MC wet	19,915	kJ/h			Stack Ten	rp: 226.4 I	Deg. F	108.0 Deg. C																										SUMS			A	VERAGE			SUI	rs		
	Averages INPUT DATA		2.67	7.39 20.86 Oxygen Calculatio		20.81 101.75 Combu		72.3% Net	47.06 2.76 Air Wet W1		2.63 58.1 v Wt. % D		3.91	6.41 2.9 Fuel Properti		0 4.49 Mw	79.13 20	99 0.68 Mass Bal		0.03 0	07 39.32 od per	300.80	0.21 -0.43	1289.79	32.95 2.61	382.13 Stack			2563.20 2 rge - Ambient t		61 3068.54	293.96 5057 Boom	.07 27033.0	8 2166.66	112747.22 Losses (kJ/kg	-14259.38	57330.11		5260.02 Total	33155.27	-1928.27	35083.5	87603.8	-1928.3	30.1
psed	Weight	%	*	Excess Total	Calc. % Flue	Room Eff	Transfer	Eff	Fuel Now C		Now Coma	med Total		droger Oxyo	en Calorifi	c Moisture		les/100 mole	dry flue gas)	100 m	ole dfa		s per kg of Dry		Moisture		- Treat		ue Gas Constit	went		Temo			lue Gas Const	tuent			Loss		Chemical	Sensible and		Chem	Grams
10 R	emaining (kg)	CO [e]	CO ₂ [d]	Air EA 0 ₂	O, (g) Gas (°C) To	mp (°C) %	74.1%	74.8%	Ratio Wt	x 1	Wt ₄ y	Input	/12= [a] /1	1= [b] /16=	[c] Value			u] [w]	00	[k] P	6k CO ₂	0, 147.60 0	CO HC	N ₂	H ₂ O Present	K	4001.04	O ₂	200	N ₂ CH	H ₂ O	K CC	1 ₃ O ₃	20.45	N ₂	CH	H ₂ O Comb		Rate ATTA GS	Loss	Loss 1	Latent Loss	Output	Loss 2	0.00
	6.32	0.01	4.23	380.1% 20.82	16.59 137.7	22.1 100.89	74.7%	75.3%	25.8 6.32	4.14 6	1.04 4.1	4 7801		5.41 2.91	18967.0	0 4.49	79.17 21				11 39.18	153.74 0	0.13 -0.22		12.51 2.61 12.52 2.61	417.70	4506.99	3462.26	3367.46 33	30.00 4419	39 4029.91	295.26 180.		37.12	2443.82	-194.21	1560.75	125.36	4685.25	1927.11	-64	1991.51		-64	1.49
	5.01	0.01	4.13	391.8% 20.82 409.6% 20.83		22.3 100.99		73.5%	27.4 6.01 28.4 5.73		5.74 8.9 5.47 13.1			5.41 2.91 5.41 2.91		0 4.49	79.17 21. 79.17 21.	00 1.05			11 39.22	158.50 0 165.77 0	0.10 -0.23 0.11 -0.24		12.54 2.61 12.56 2.61	420.47 419.23	4989.10 4984.44		3645.04 30 3628.91 35	104.90 4813 188.86 4786	70 4361.49	295.50 195. 294.79 194		29.71 30.68	2710.80	-204.04 -213.48	1572.58 1572.98		5025.29 5126.27	1423.12	-49	1472.29	3948 3960	-49 -52	0.82
	5.41	0.01	4.21	382.6% 20.82	16.61 148.7	21.7 101.09	72.9%	73.6%	25.9 5.41	18.00	5.17 18.0	0 5366	3.91 6	5.41 2.91	18967.0	0 4.49	79.18 21.	.00 1.07	3.49	0.02 0.	11 39.25	154.75 0	0.07 -0.23	737.85	32.53 2.61	421.87	5071.95	3811.31	3704.82 36	64.05 4894	99 4432.97	294.86 199	07 589.81	21.24	2703.63	-202.59	1574.75	126.41 5	5012.32	1418.12	-51	1469.20	3948	-51	0.50
	5.14	0.01	3.72	445.6% 20.83 393.0% 20.82		21.1 101.09		73.0%	30.5 5.14 27.5 4.82		1.91 22.1 1.60 26.5			5.41 2.91	18967.0		79.16 21. 79.18 21	00 0.95	3.09		09 39.24 10 39.32	180.39 0	0.12 -0.26		12.60 2.61 12.56 2.61	411.21 420.40	4652.69	3504.72 3790.55	3408.88 33	70.93 4471	83 4079.52	294.21 182. 294.04 198.	58 632.20 25 602.65	33.06 5.13	2813.68	-232.43 -215.36	1565.46		5121.05	1443.48	-56	1499.45	3903 3285	-55	0.91
	4.64	0.00	3.16	541.8% 20.85	17.68 119.9	20.6 101.79	72.6%	73.8%	35.9 4.64	29.60	1.43 29.6	0 3578	3.91 6	5.41 2.91	18967.0	0 4.49	79.15 21.	.00 0.81	2.64	0.03 0.	08 39.49	219.71 -4	0.05 -0.34		12.77 2.61	393.02	3919.16	2964.04	2885.89 28	153.15 3740	86 3454.57	293.79 154.	78 651.22	-14.73	2807.14	-306.66	1553.98	123.86	4909.59	963.61	-62	1025.65	2714	-62	-0.2
	441	0.01	2.89	603.1% 20.86 623.4% 20.86		21.0 101.45		72.2%	39.3 4.41		1.21 33.1			5.41 2.91	18967.0		79.14 20. 79.14 20.	99 0.73	2.41		07 39.30	244.72 0	0.15 -0.35	ARVANAV	12.79 2.61	391.40	3840.50 4016.80	2905.35		96.82 3664	00 3386.47 62 3538.12	294.12 150:		42.57 19.80	3014.60	-315.99	1552.74		5279.54	1037.66	-54	1091.23	2690 2636	-54	0.82
	4.00	0.00	3.41	498.8% 20.84	17.44 114.8	20.8 101.69	74.8%	75.9%	33.5 4.00	39.33	182 39.3	3 4164	3.91 6	5.41 2.91	18967.0	0 4.49	79.16 21.	00 0.86	2.82	0.03 0.	09 39.46		0.05 -0.32	917.38	12.71 2.61	387.94	3706.34	2806.08	2732.83 27	01.67 3531		293.94 146.	26 567.18	-14.05	2478.47	-282.27	1545.42	123.38	4564.39	1002.00	-65	1066.78	3162	-65	-0.3
	3.77	0.00	3.16	543.6% 20.85 540.7% 20.85		20.4 101.69		73.5%	35.0 3.77		160 42.8			5.41 2.91	18967.0		79.15 20.	99 0.80	2.63		08 39.43	220.44 0	0.00 -0.34	985.50	12.76 2.61 12.75 2.61	394.24	3957.61		2913.00 28	80.00 3779	73 3485.94	294.10 156		0.00	2841.12	-301.29 -399.58	1554.47		5033.89	984.06	-50	1042.71	2724 2726	-59	0.0
	3.37	0.00	3.44	492.1% 20.84	17.40 115.1	20.5 101.59	74.8%	76.0%	33.1 3.37	48.93	122 48.5	3 3578	3.91 6	5.41 2.91	18967.0	0 4.49	79.16 21.		2.85	0.03 0.	09 39.46		0.05 -0.31	907.04	2.71 2.61	388.28	3731.71	2825.26	2751.50 27	20.14 3555		293.64 147.	25 563.33	-14.13	2467.28	-278.58	1545.76	123.44	4554.35	883.10	-57	939.61	2795	-57	-0.2
	3.19	0.01	2.45	729.5% 20.87 621.2% 20.86		20.5 101.99		72.0%	46.5 3.19 40.4 2.95		1.04 51.6 1.82 55.2			5.41 2.91	18967.0		79.13 20. 79.14 20.				05 39.41 07 39.50	296.60 0	0.13 -0.44	ANYMAN	12.95 2.61 12.86 2.61	391.73	3871.62		2851.97 28	119.57 3693 104.73 3672	52 3414.04	293.67 152 293.67 152		35.86	3592.49	-389.81 -346.73	1551.47		5945.07	1174.75	-70	1244.44	2573 2539	-70 -68	-0.0
	2.78	0.03	2.42	732.5% 20.87	18.44 113.2	21.0 101.15	68.6%	69.4%	45.6 2.78	57.83	2.66 57.8	3538	3.91 6	5.41 2.91	18967.0	0 4.49	79.11 20.	99 0.62	2.04	0.02 0.	05 39.02		0.47 -0.39		2.86 2.61	386.37	3634.61	2752.59		50.34 3461	02 3209.52	294.14 141.	83 819.35	132.92	3384.91	-349.10	1550.45	123.22	5803.58	1113.05	-41	1154.50	2525	-41	2.5
	2.55	0.00	3.11	554.6% 20.85 581.0% 20.86		20.4 101.69		73.9%	35.6 2.55		2.44 61.3			5.41 2.91	18967.0		79.15 20. 79.14 20.	99 0.79	2.58		08 39.44	224.92 0	0.00 -0.34	ANYMAN	52.77 2.61 52.80 2.61	390.35 390.78	3818.50	2889.72	2813.98 27	181.96 3840 190.34 3853	81 3368.63	293.57 150		0.00	2791.48	-307.36 -327.17	1551.25		4959.55 5103.28	977.39 769.79	-60	1037.71	2760 2091	-60	0.0
	2.24	0.01	1.74	1051.8% 20.89	19.14 25.4	20.5 102.45	66.0%	67.6%	65.4 2.24	66.09	2.14 66.0	9 2450	3.91 6	5.41 2.91	18967.0	0 4.49	79.10 20.			0.03 0.	04 39.40	433.78 0	0.32 -0.62	*****	33.32 2.61	358.57	2931.02	2228.59	2172.74 21	47.49 2771	64 2601.81	293.69 115	48 956.71	90.36	3848.95	-553.01	1551.77	121.63 6	5141.89	793.41	-60	853.04	1657	-60	1.15
	2.10	0.00	1.90	908.2% 20.88 963.8% 20.89		20.2 102.69		71.1%	56.7 2.10 59.8 1.95		2.00 68.1			5.41 2.91			79.12 20. 79.11 20	99 0.51	1.69		05 39.62	370.38 0	0.04 -0.56	******	33.20 2.61	358.62	2945.74 2878.75	2239.93	2183.83 21	158.44 2785 109.89 2720	26 2615.10 87 2555.35	293.36 116.	71 829.63	10.85	3352.90	-500.96 -493.56	1546.78		5477.59 5702.20	719.17 753.18	-64	783.32 805.15	1771	-64 -52	1.25
	1.82	0.03	1.73	1054.6% 20.89	19.14 85.8	20.3 101.59	69.2%	70.3%	64.9 1.82	72.38	1.74 72.3	8 2470		5.41 2.91	18967.0	0 4.49	79.09 20	98 0.45			04 38.94	430.39 0	0.72 -0.56	******	33.20 2.61	358.91	2551.71		1896.70 18	74.44 2403	73 2271.58	293.48 99.3		204.76	3333.36	-498.47	1535.14	120.77	5631.77	733.46	-38	771.72	1737	-35	2.62
	1.59	0.02	1.68	1098.3% 20.89 1115.9% 20.89		20.9 102.29			67.5 1.69 68.4 1.59		1.61 74.2 1.52 75.8			5.41 2.91 5.41 2.91			79.10 20. 79.09 20.		1.43		04 39.25 04 39.10	448.79 0 455.96 0	0.47 -0.62	ANYMAN	33.32 2.61	350.40 359.99	2588.21 2583.31	1971.30	1922.72 19	00.20 2440 196.96 2434	10 2302.68 80 2298.80	294.09 101. 293.78 100:		134.04 175.02	3512.79	-554.31 -546.31	1541.96		5741.62	627.94	-46	673.84 678.32	1446	-46	1.44
	1.46	0.00	2.11	865.1% 20.88	18.77 90.3	20.4 102.59	71.8%	73.6%	54.2 1.46	77.85	1.40 77.8	5 2425	3.91 6	5.41 2.91	18967.0	0 4.49	79.12 20.	99 0.53	1.76	0.03 0.	05 39.60	352.57 0	0.04 -0.53		33.15 2.61	353.42	2730.46	2078.52	2027.02 20	03.33 2576	68 2427.50	293.53 108.	12 732.83	10.12	2977.05	-476.85	1538.06	121.18 5	5010.50	640.64	-60	700.15	1784	-60	0.13
	1.32	0.00	2.56	876.4% 20.88 695.2% 20.87		20.4 102.45		73.2%	54.9 1.32 44.6 1.19		1.27 79.5			5.41 2.91	18967.0		79.12 20.				05 39.54		0.09 -0.53	ANYMAN	33.15 2.61	363.59	2735.44			06.89 2581	59 2431.79 87 2485.69	293.57 108. 293.66 110.		26.74	3017.08	-475.95 -385.74	1538.11		5079.09 4454.07	657.46	-58	715.45	1798 1913	-58	0.34
	1.05	0.03	1.79	1019.6% 20.89		20.6 101.79	68.2%				1.00 84.1	1 2475		5.41 2.91		0 4.49	79.10 20	98 0.46	1.52	0.03 0.	05 39.07		0.58 -0.56	*****	33.19 2.61	354.45	2764.83			27.92 2510	34 2457.21	293.71 108.	03 875.37	165.24	3496.94	-496.17	1541.05		5811.72	758.43	-43	801.59	1717	-43	2.12
	0.92	0.00	2.16	844.1% 20.88 929.0% 20.88		21.0 102.69			53.1 0.92 57.8 0.78		0.88 86.1 0.74 88.2			5.41 2.91 5.41 2.91	18967.0		79.12 20. 79.11 20	98 0.54			05 39.71 05 39.36		0.08 -0.54	ANYMAN	33.16 2.61 33.16 2.61	350.04 359.41	2571.21		1910.24 18	187.86 2423 175.43 2406	53 2272.73	294.16 102. 293.95 100.			2744.80	-479.00 -482.14	1533.66		4674.05 5061.27	509.97 554.87	-65	675.16 598.86	1865	-65	-0.28
	0.69	0.03	1.60	1080.4% 20.89	19.18 85.9	20.8 101.69	68.9%	70.0%	65.4 0.69	89.58	0.66 89.5	8 2059	3.91 6	5.41 2.91	18967.0	0 4.49	79.09 20.	98 0.44	1.45	0.03 0.	04 38.96		0.71 -0.58		33.23 2.61	359.03	2538.54	1934.12	1886.61 18	64.47 2391	87 2259.48	293.95 98.9	0 853.12	203.43	3391.11	-513.64	1536.31	120.74	5689.97	617.79	-34	651.46	1442	-34	2.17
	0.55	0.00	1.99	922.0% 20.88 923.6% 20.88		20.8 102.59			57.5 0.55 57.5 0.42		0.52 91.3 0.40 93.6			5.41 2.91	18967.0		79.11 20. 79.11 20.				05 39.56 05 39.29	376.04 0	0.10 -0.56	ANNAMAN	33.20 2.61	358.68 365.66	2525.50 2807.35	1924.34		55.08 2379 56.35 2651		293.93 99.5 293.87 110.			2921.02 3243.20	-500.97 -472.22	1534.62 1539.78		4925.98 5442.70	635.17	-61	695.98 762.33	1810	-61 -49	0.35
	0.27	0.01	1.86	988.9% 20.89	19.02 85.8	20.1 102.49	70.6%	72.3%	61.2 0.27	95.86 0	26 95.8	6 2510	3.91 6	5.41 2.91	18967.0	0 4.49	79.11 20.	98 0.47	1.57	0.03 0.	05 39.45	403.63 0	0.23 -0.59	ANYMAN	33.25 2.61	358.91	2558.96	1950.00	1902.18 18	79.85 2410	38 2278.15	293.30 100:	96 787.07	65.67	3155.41	-522.32	1537.83	120.79	5245.41	694.23	-60	754.54	1816	-60	0.85
	0.14	0.03	1.60	1085.1% 20.89 1078.6% 20.89		20.6 101.69			65.6 0.14 65.2 0.00		0.13 97.8			5.41 2.91 5.41 2.91			79.09 20. 79.09 20.			0.02 0.	04 38.94 04 38.85		0.73 -0.58	******	33.23 2.61	364.51 360.86				129.49 2612	48 2459.12 44 2331.15				3706.02	-514.25 -501.34	1543.00		6105.23 5859.07	1204.78	-60	1205.11		-60	4.04
				1010.0.0 20.00																																									



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.

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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 Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

Manufacturer:	Ardisam	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	-	
Control #:	C102366578		

Test Duration: 60
Output Category: High Burn Rate

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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Run: 1	VERSION.	2.2	12/14/2003					
Date: 12/7/2015 Temp. Units F (F or C) (kg or lb)	Manufacturer:	Ardisam		Applia	ince Type:	Pellet	(Cat, Non-	-Cat, Pellet)
Run: 1	Model:	Serenity						
Control #: G102366578 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 %0 42.9 %Ash 0.5 Averages 0.01 4.11 16.38 291.63 70.93 Temp. (°F) Elapsed Fuel Weight Flue Gas Composition (%) Flue Room Time (min) Remaining (lb) CO CO2 O2 Gas 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	Date:	12/7/2015		Te	emp. Units	F	(F or C)	Defa
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 %O 42.9 **Ash 0.5 **Averages	Run:	1		We	eight Units	lb	(kg or lb)	
Output Category: High Burn Rate Fuel Data D. Fir % Wood Moisture (% wet): Load Weight (lb wet): 3.92 4.49 %C 50 HHV 19,887 %C 50 kJ/kg %As Burn Rate (dry kg/h): 1.70 %H 6.6 6.6 6.71 g %O 42.9 %Ash 0.5 Total Particulate Emissions: 6.71 g 0.01 4.11 16.38 291.63 70.93 Temp. (°F) 70.93 Temp. (°F) Elapsed Time (min) Remaining (lb) Flue Gas Composition (%) Flue Room Temp Flue Room Temp 0 3.92 0.01 4.37 16.10 292.2 70.9 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	Control #:	G102366578						HHV (kJ/kg
Wood Moisture (% wet): 4.49	Test Duration:	60						%
Wood Moisture (% wet): 4.49 HHV 19,887 to 50 kJ/kg %As Load Weight (lb wet): 3.92 %C 50 50 50 6.6 6.6 9 6.6 9 42.9 6.6 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 6.7 9 42.9 8 70.93 7	Output Category:	High Burn Rate			Fuel	Data		%
Load Weight (Ib wet): 3.92 %C 50 Burn Rate (dry kg/h): 1.70 %H 6.6 Total Particulate Emissions: 6.71 g %O 42.9						D. Fir		%
Burn Rate (dry kg/h): 1.70	Wood	Moisture (% wet):	4.49		HHV	19,887	kJ/kg	%As
Total Particulate Emissions: 6.71 g	Loa	d Weight (lb wet):	3.92		%C	50		
Averages 0.01 4.11 16.38 291.63 70.93 Temp. (°F)	Bui	rn Rate (dry kg/h):	1.70		%Н	6.6		
Averages 0.01 4.11 16.38 291.63 70.93 Temp. (°F)	Total Particulate Emissions:		6.71	g	%O	42.9		
Elapsed Fuel Weight Flue Gas Composition (%) Flue Room Gas Temp					%Ash	0.5		
Elapsed Fuel Weight Flue Gas Composition (%) Flue Room Gas Temp								
Elapsed Time (min) Fuel Weight Remaining (lb) Flue Gas Composition (%) CO Flue Gas		Averages	0.01	4.11	16.38	291.63	70.93	
Time (min) Remaining (lb) CO CO2 O2 Gas 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						Tem	o. (°F)	
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	Elapsed	Fuel Weight	Flue Ga	s Composit	ion (%)	Flue	Room	
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	Time (min)	Remaining (lb)	CO	CO ₂	O_2	Gas	Temp	
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	0	3.92	0.01	4.37	16.10	292.2	70.9	
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	10	3.32	0.01	4.23	16.25	279.8	71.8	
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	20	2.62	0.01	4.13	16.36	297.2	72.2	
50 0.70 0.01 3.72 16.79 280.5 69.9	30	2.01	0.01	3.99	16.51	295.0	71.0	
					16.27	299.7		
60 0.00 0.00 4.13 16.36 297.1 69.6	50	0.70	0.01	3.72	16.79	280.5		
	60	0.00	0.00	4.13	16.36	297.1	69.6	

12/14/2009

VERSION: 2.2

Note 1: For other fuels, use the heating value and
fuel composition determined by analysis of fuel
sample in accordance with Clause 0.2

Oak

19,887

50

6.6 42.9

0.5

Default Fuel Values D. Fir

19,810

48.73

6.87

43.9

0.5

HHV (kJ/kg)

%C

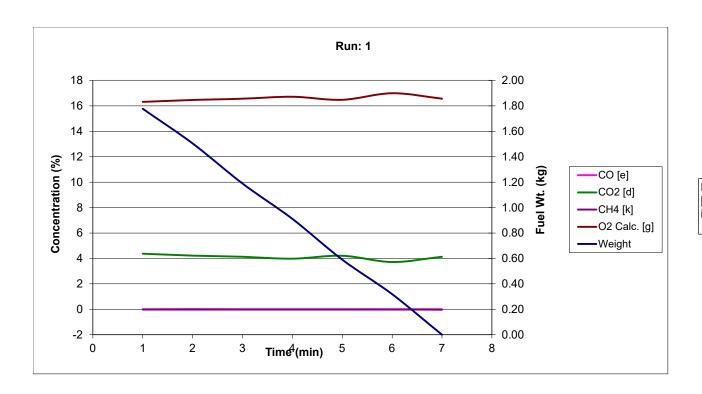
%Н

%O

%Ash

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 occurence and the next reading showing a decrease in weight.





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Tony Joseph A.L.P. (Tony) Joseph Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

Manufacturer:	Ardisam	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	-	
Control #:	C102366578		

Test Duration: 60
Output Category: High Burn Rate

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					
Manufacturer:	Ardisam		Applia	nce Type:	Pellet	(Cat, Non-	Cat, Pellet)
Model:	Serenity						
Date:	12/7/2015		Te	mp. Units	F	(F or C)	Default
Run:	1		We	ight Units	lb	(kg or lb)	
Control #:	G102366578						HHV (kJ/kg)
Test Duration:	60						%C
Output Category:	High Burn Rate			Fuel I	Data		%Н
					Marth		%O
Wood	Moisture (% wet):	4.49		HHV	18,967	kJ/kg	%Ash
Loa	d Weight (lb wet):	3.92		%С	46.87		
Bui	n Rate (dry kg/h):	1.70		%Н	6.41		г
Total Partic	culate Emissions:	6.71 g		%O	46.62		
				%Ash	0.1		
	Averages	0.01	4.11	16.38	291.63	70.93	
					Temp	o. (°F)	Г
Elapsed	Fuel Weight	Flue Gas	Composit	ion (%)	Flue	Room	
Time (min)	Remaining (lb)	co	CO ₂	O ₂	Gas	Temp	
0	3.92	0.01	4.37	16.10	292.2	70.9	
4.0							
10	3.32	0.01	4.23	16.25	279.8	71.8	
10 20			4.23 4.13	16.25 16.36	279.8 297.2	71.8 72.2	
	3.32					72.2 71.0	
20 30 40	3.32 2.62 2.01 1.30	0.01 0.01 0.01	4.13 3.99 4.21	16.36 16.51 16.27	297.2	72.2 71.0 71.1	
20 30	3.32 2.62 2.01 1.30	0.01 0.01 0.01	4.13 3.99	16.36 16.51 16.27 16.79	297.2 295.0	72.2 71.0 71.1 69.9	
20 30 40	3.32 2.62 2.01 1.30	0.01 0.01 0.01	4.13 3.99 4.21	16.36 16.51 16.27	297.2 295.0 299.7	72.2 71.0 71.1	

12/14/2009

VERSION: 2.2

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

Oak

19,887

50

6.6

42.9

0.5

Default Fuel Values D. Fir

19,810

48.73

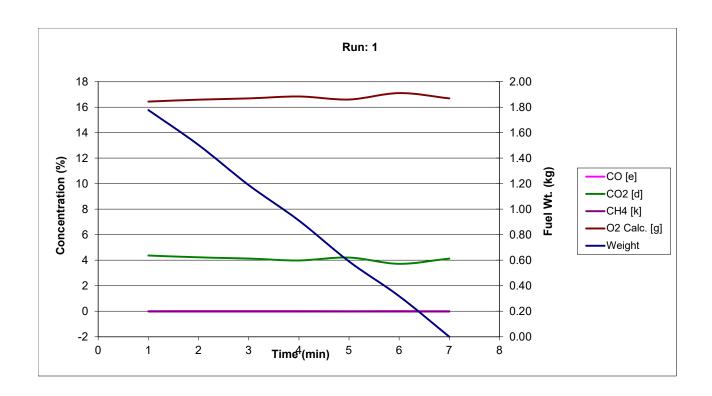
6.87

43.9

0.5

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 occurence and the next reading showing a decrease in weight.





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 Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

Manufacturer:	Ardisam	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	-	
Control #	C102266579		

Test Duration: 120
Output Category: ledium Burn Rate

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					
Manufacturer:	Ardisam		Applian	ce Type:	Pellet	(Cat, Non-	Cat, Pellet)
Model:	Serenity						
Date:	12/7/2015		Ten	np. Units	F	(F or C)	Defa
Run:	1		Weig	ght Units	lb	(kg or lb)	
Control #:	G102366578					, ,	HHV (kJ/kg
Test Duration:	120						· %
Output Category:	Medium Burn Rate			Fuel [Data		%
					D. Fir		%
Wood	Moisture (% wet):	4.49		HHV	19,887	kJ/kg	%As
	d Weight (lb wet):	5.40		%C	50	J	
	n Rate (dry kg/h):	1.17		%Н	6.6		
	culate Emissions:	6.71 g		%O	42.9		
		J		%Ash	0.5		
	Averages	0.00	3.08	17.43	247.86	69.23	
	Averages	0.00	3.08	17.43			
Elapsed	•		3.08 Composition		247.86 Temp Flue		
•	Averages Fuel Weight Remaining (lb)				Temp	o. (°F)	
Time (min)	Fuel Weight Remaining (lb)	Flue Gas CO	Composition	on (%) O ₂	Temp Flue Gas	o. (°F) Room Temp	
Time (min)	Fuel Weight Remaining (lb)	Flue Gas	CO ₂	on (%) O ₂	Temp Flue Gas	o. (°F) Room Temp 69.6	
Time (min)	Fuel Weight Remaining (lb)	Flue Gas CO 0.00	Composition	on (%) O ₂ 16.36 17.34	Temp Flue Gas	0. (°F) Room Temp 69.6 69.2	
Time (min) 0 10	Fuel Weight Remaining (lb) 5.40 5.01	Flue Gas CO 0.00 0.00 0.01	CO ₂ 4.13 3.18	on (%) O ₂	Temp Flue Gas 297.1 247.8	0. (°F) Room Temp 69.6 69.2	
Time (min) 0 10 20	Fuel Weight Remaining (lb) 5.40 5.01 4.50	Flue Gas CO 0.00 0.00 0.01 0.00	CO ₂ 4.13 3.18 2.89	on (%) O ₂ 16.36 17.34 17.65	Temp Flue Gas 297.1 247.8 244.9	0. (°F) Room Temp 69.6 69.2 69.8	
Time (min) 0 10 20 30	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11	Flue Gas CO 0.00 0.00 0.01 0.00 0.00	4.13 3.18 2.89 2.81	on (%) O ₂ 16.36 17.34 17.65 17.71	Temp Flue Gas 297.1 247.8 244.9 252.1	69.6 69.8 69.3 69.4	
Time (min) 0 10 20 30 40	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00	4.13 3.18 2.89 2.81 3.41	on (%) O ₂ 16.36 17.34 17.65 17.71 17.07	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6	69.6 69.8 69.3 69.4	
Time (min) 0 10 20 30 40 50	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00	4.13 3.18 2.89 2.81 3.41 3.16	on (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0	69.6 69.8 69.8 69.3 69.4 69.7	
Time (min) 0 10 20 30 40 50 60	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00	4.13 3.18 2.89 2.81 3.41 3.16 3.18	on (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1	69.6 69.8 69.8 69.3 69.4 69.7 68.7 68.9	
Time (min) 0 10 20 30 40 50 60 70	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.0	4.13 3.18 2.89 2.81 3.41 3.16 3.18	on (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2	69.6 69.2 69.8 69.3 69.4 69.7 68.7 68.9 68.9	
Time (min) 0 10 20 30 40 50 60 70 80	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20 1.80 1.29 0.91	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.01 0.00 0.00	4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.44 2.45	on (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05 18.10	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2 245.5	69.6 69.8 69.8 69.3 69.4 69.7 68.7 68.9 68.9 69.8	

0.00

0.00

2.99

17.49

243.7

120

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

Oak

19,887

50 6.6

42.9

0.5

Default Fuel Values D. Fir

19,810

48.73

6.87

43.9

0.5

HHV (kJ/kg)

69.0

%C

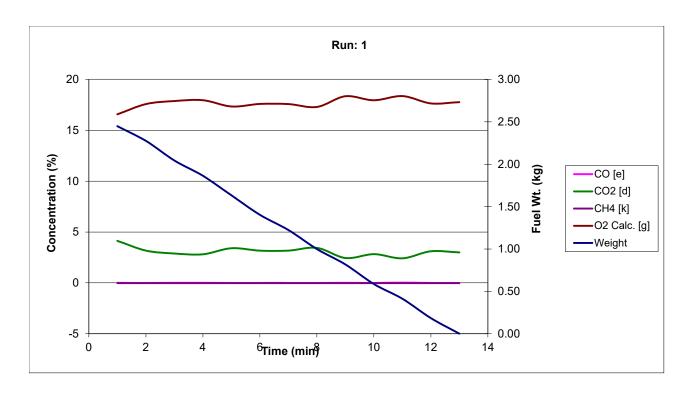
%Н

%O

%Ash

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 occurence and the next reading showing a decrease in weight.

Manufacture Mod Dat Re Control Test Duratio	t: Seren t: 12/07/ t: 1 t: G10239	7715 90578 min HH f 60.48	40% 74.	LHV 4.75%	Note: In the "I Properties", a [a]. [b]. [c]. [h] respective var	input data", "Co nd "Mass Bala j. [u], [w], (ii), ar riables in Clau	nce" column d [k] refer to ses 13.7.3 to	Fuel s, [e], [d], [f] their s 13.7.5.	\neg	Combs Heat Tra Heat Or	ating Effici ation Effici nafer Effici dout: 1 nout: 2	iency: iency: 5.319 B		2% De	y Molece Moles E Air Fue 148 kJi 268 kJi	dar Weig ahaust I Ratio (a	an (N.):	29: 1380 39:	44	14HC 0.8						Total	tal Input	(kJ): (kJ): (Ro):	46,536 32,297	6 44,1 7 30.6						of Wood Dry Weig Moisture	ek Wt	kg): :	34		Moist	ine Conte	t M _{Cath} ley kg : CA: HY: CX:																																				
	Outp Burn R Grams Inpu	put 16,1 Rate 1.17 a CO 4	148 k. 17 ks	kJ/h			CO _{Dull}	19.80 F ₀ 1.044		Burn Dun Burn I Stack T		2.00 2.58 N3.8 D		h ah 1.	7.6 De																Fu	'uel Heat	iaht (ka): tina LJIka - CV	: 2.4 HH V: 19.8	v L	LHV 8.464	8	tulb 8	HV L 55.5 79	V 1.4																																							
	MCw	vet 4.40	42																																																												SUM						AVER	AGE				SUI	WS				
	Averag	O.D SECOND	.00 2	3.08	5.55	20.76	17.69	119.92	20.68	101.	% 71	1.5%	72.6%	40	41 1	22	50.11 % Wet	1.1	_	50.11 % Dev	483	286	4.17	6.60	to tred Per	2.68	1268	7.00	4.49	79.2	24 2		0.73 Mass Bal		7 -0	0.03	0.07 to Wood		21 24	.06 0	.05	-0.39	107.60	33.94	2.61		93.07 čack	39	21.14	2965 Conten	.03	2886.7		54.01	3743.84	3455			51.53	2420.5	4 2	12.07	40838.	to of Dry	92.21	20923.	80 1	1610.18	5440 Tot		13189.12	 -817.54	140	05.7	3509	06.5	817.5	3.6	6
Element					Uxygen	Calculation		input		Long	USC P	seat.	Net		r we	E WII	% wat	Dry	Vt.	% Dry						Devoso		-	new .					unce dry flue			eg weddo 100 mole					f Dry Wi					emp		near	Comen			Constitu		empera	nure	Ro	om					Gas Co		rueij				Los		Total	 hemical		ble and	Tot		Chem	-	rama Pro
																																																					- w-2011	M	CH	H			-0	_		riu	week CO		н.	H-O Co											Loss 2		
	Welc	oht %			Excess	Total C	alc. %	Plue en (CC)	Tamp (°C				-	1 4																																																																	
Time	Remainin	ng (kg) CO	(e) CO	O, [d]	Air EA	Total C	alc. % D ₂ (g)	Plus es (°C)	Temp ("C	5 %		%	%	Ra	tio !	Nt	×	Wt	-	y	Inp	put /	12= [s]	/1= D	[6]	/16= [c]	Vah	ue F	uel Burr	nt [h)	N)	[u]	[w]	0		[k]	Nk		0, 1	2 1	0	HC	N ₂	H ₂ O	Preser	4	K		CO ₂	0,		co							201	0,		co	N ₂		M ₄						Loss	Loss 1	Later	t Loss	Outp	tput I	Loss 2	co	
	Remainin 2.45	ng (kg CO 5 0.0	(e) CO		Air EA 379.4%	O ₂ 20.70	atc. % D ₂ (q) 4 16.57	Plue les (°C) 147.3	Temp (°C	101.	2% 7	% 2.4%	% 73.2%	Ra 20	5 2	Mt 45	x 0.00	2.3		0.00	ling 0	put /	12= [a] 4.17	/1= D	0 [6]	/16≈ [c] 2.68	19881	7.00 F	4.49	79.3	h) 30 2	[u] 21.03	(w) 0.99	3.3	0 -0	[k] 0.03	0.10	4	102 160	10 0	02	HC 0.27	N ₂ 909.07	H ₂ O 33.70	Preser 2.61	42	K 10.40	50	00 ₃ 41.86	3790	55	3685.0	9 35	44.45	4861.91	4402	1 29	04 21	2.38	540.9		1.49	N ₂	3 -23	8.17	1630.2		O Fuel N 126.35	5325	92	0.00	Loss 1	Later	nt Loss 00	Outs	tput I	0	0.00	00
	Remainin 2.45 2.21	ng (kg) CO) 5 00 7 00	(e) CO		Air EA 379.4% 524.1%	70tal C O ₂ 20.70 20.76	alc. % D ₂ (g) 0 16.57 17.58	Place les (°C) 147.3 119.9	20.9 20.6	101.	7% 73 9% 73	% 2.4% 2.3%	% 73.2% 73.6%	Rs 29 38	5 2 5 2	Mt 45 27	0.00 7.16	2.3 2.1		9 0.00 7.16	0 553	put // 0 22	12- [a] 4.17 4.17	6.60 6.60	(b)	716= [c] 2.68 2.68	19881 19881	7.00 7.00	4.49 4.49	79.3 79.2	N) 30 2 24 2	[u] 21.03 21.02	(w) 0.99 0.75	33 25	1 I 0 -0 5 -0	(R) 0.03 0.03	0.10 0.05	4	10 ₂ (10 0 16 -0	02 02 05	HC -0.27 -0.38	N ₂ 909.07	H ₂ O 33.70 33.93	2.61 2.61	42	K 10.40 13.02	50	CO ₂ 41.86 19.16	3790 2964	55	3685.0 2885.8	9 35	44.45 53.15	4861.91 3740.86	4409 3454	51 29 57 29	D4 21	2.38	540.9 694.0		5.78	N ₂ 2948.6 3011.0	3 -23 7 -33	8.17 9.92				5325 5248	92	0.00	0 -98	150	00	406	54	0 -95	0.00	10
	Remainin 2.45 2.27 2.04	ng (kg CO 5 0.0 7 0.0 4 0.0	% CO (e) CO 00 4 00 3 01 2		Excess Air EA 379.4% 524.1% 583.7%	70tal C O ₂ 20.70 20.76 20.77	alc. % D ₂ (g) 16.57 17.58 17.88	Place les (°C) 147.3 119.9 118.3	20.9 20.6 21.0	101. 101. 101.	2% 73 2% 73 2% 73	% 2.4% 2.3% 0.9%	% 73.2% 73.6% 71.9%	Ra 29 38 42	5 2 5 2 2 2	Mt 45 27 04	X 0.00 7.16 16.57	2.3 2.1 1.9		7.16 16.57	555 330	22 00	4.17 4.17 4.17 4.17	/1= p 6.60 6.60	(b) 0	2.68 2.68 2.68 2.68	19881 19881 19881	7.00 7.00 7.00	4.49 4.49 4.49	79.3 79.2 79.2	N) 30 2 24 2 22 2	[u] 21.03 21.02 21.01	(w) 0.99 0.75 0.69	33 25 23	1 1 0 -0 5 -0 3 -0	(N) 0.03 0.03 0.03	0.10 0.05 0.07	1	10 ₂ 1 112 160 131 23- 111 260	10 0 16 -0 96 0	02 05 16	0.27 -0.38 -0.39	N ₂ 909.07 800000 800000	H ₂ O 33.70 33.93 33.95	2.61 2.61 2.61 2.61	42 39 39	K 10.40 13.02 11.40	50 39 38	H1.86 19.16 H0.50	3790 2964 2905	55 .04 .35	3885.0 2885.8 2828.9	9 35 9 28 5 27	44.45 53.15 96.82	4861.91 3740.86 3864.00	4409 3454 3385	51 29- 57 295 67 29-	D4 21 79 16 12 16	2.38 5.83 11.72	540.9 694.0 758.1	-	5.78 5.62	N ₂ 2948.6 3011.0 3233.2	3 -23 7 -33 1 -35	8.17 9.92 0.32	1630.2 1608.9	1 0	126.35 123.86 123.68	5325 5248 5579	92 02 88	0.00 1457.08 1095.69	0 -98 -60	0 150	00 5.40 6.38	0 406 281	54 12	0 -95 -60	0.00 -0.43 0.88	10 43 18
	Remainir 2.45 2.27 2.04 1.86	ng (kg) CO) 5 0.0 7 0.0 4 0.0 6 0.0	N CO 4 00 4 00 3 01 2 00 2		Air EA 379.4% 524.1% 583.7% 603.5%	70tal C O ₂ 20.70 20.76 20.77 20.78	alc. % D ₂ (g) 6 16.57 17.58 17.88 17.97	Plue ies (°C) 147.3 119.9 118.3 122.3	20.9 20.6 21.0 20.7	101. 101. 101. 101.	7% 77 5% 77 5% 76 5% 66	% 2.4% 2.3% 0.9% 9.3%	% 73.2% 73.6% 71.9% 70.6%	Ra 29 38 42 43	5 2 5 2 2 2 4 1	Nt 45 27 04 86	x 0.00 7.16 16.57 23.96	23 2.1 1.9 1.7		7 0.00 7.16 16.57 23.96	553 390 390	put /* 22 09 03	4.17 4.17 4.17 4.17 4.17	6.60 6.60 6.60	(b) 0 0	716= [c] 2.68 2.68 2.68 2.68 2.68	Vali 19881 19881 19881	7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2	N) 30 2 24 2 22 2 22 2	[u] 21.03 21.02 21.01 21.01	(w) 0.99 0.75 0.69 0.67	33 25 23 22	1 1 0 -0 5 -0 3 -0 6 -0	0.03 0.03 0.03 0.03	0.10 0.05 0.07 0.07	1	10 ₂ (10 1.12 161 1.31 23 1.11 261 1.22 261	10 0 16 -0 96 0 94 0	02 05 06 16 07	HC -0.27 -0.38 -0.39 -0.42	N ₂ 909.07 ************************************	H ₂ O 33.70 33.93 33.95 34.00	2.61 2.61 2.61 2.61 2.61	42 30 30 30	K 10.40 13.02 11.40 15.45	50- 39- 38- 40-	H1.85 19.16 40.50 16.80	3750 2964 2965 3036	55 .04 .35 .25	3685.0 2885.8 2828.9 2955.8	9 36 9 28 5 27 0 29	44.45 53.15 96.82 22.35	4861.91 3740.86 3864.00 3837.62	4409 3454 3386 3538	51 29- 57 290 87 29- 12 290	D4 21 79 16 12 16 85 16	238 5.83 11.72 9.59	640.9 694.0 758.1 819.5	-1 -1 -2	5.78 5.78 5.62 1.21	2948.6 3011.0 3233.2 3478.2	1 -23 7 -33 1 -35 3 -37	8.17 9.92 0.32 4.14		1 0		5325 5248	92 02 88	0.00	0 -98 -60 -69	150 110 121	00 5.40 6.38 8.04	406	54 12	0 -95 -60 -69	0.00 -0.43 0.88 0.41	10 43 18
	Remainin 2.46 2.21 2.04 1.86	ng (kg) CO) 5 0.0 7 0.0 4 0.0 5 0.0	N CO CO 4 00 3 01 2 00 2 00 3		Excess Air EA 379.4% 524.1% 583.7% 603.5% 462.3%	Total C O ₂ 20.70 20.76 20.77 20.78 20.74	alc. % D ₂ [g] 6 16.57 17.58 17.88 17.97	147.3 119.9 118.3 122.3	20.9 20.6 21.0 20.7 20.8	101. 101. 101. 101. 101.	2% 75 5% 75 5% 76 5% 60	% 2.4% 2.3% 0.9% 9.3% 4.6%	% 73.2% 73.6% 71.9% 70.6% 75.8%	Rs 29 38 42 43	5 2 5 2 2 2 4 1 9 1	Nt 45 27 04 86 63	X 0.00 7.16 16.57 23.96 33.35	2.3 2.1 1.9 1.7		7 0.00 7.16 16.57 23.96 33.35	955 396 396 436	put /* 22 09 03 66	12= [a] 4.17 4.17 4.17 4.17 4.17	/1- p 6.60 6.60 6.60 6.60	[6] 0 0 0 0	716= [c] 2.68 2.68 2.68 2.68 2.68	Vali 19881 19881 19881 19881	7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2	N) 30 2 24 2 22 2 22 2 25 2	[u] 21.03 21.02 21.01 21.01 21.02	0.99 0.75 0.69 0.67 0.61	33 25 23 22 27	0 -0 5 -0 3 -0 6 -0 3 -0	DK3 0.03 0.03 0.03 0.03	Nk 0.10 0.05 0.07 0.07 0.08	4	10 ₂ (10 112 16 131 23 111 26 122 26 128 21	10 0 16 -0 96 0 94 0	02 .05 15 07	HC -0.27 -0.38 -0.39 -0.42 -0.35	N ₂ 909.07 ******** ******** 254.05	H ₂ O 33.70 33.93 33.95 34.00 33.87	2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 38	K 10.40 13.02 11.40 15.45 17.94	50- 39/ 38- 40/ 371	H1.85 19.16 H0.50 16.80	3790. 2964. 2905. 3036. 2806.	55 04 35 25 08	2885.8 2828.9 2955.8 2732.8	9 35 9 28 5 27 0 29 3 27	44.45 53.15 56.82 22.35 01.67	4861.91 3740.86 3664.00 3837.62 3531.15	4409 3454 3386 3538 3271	51 29- 57 290 67 29- 12 290 57 290	04 21 79 16 12 16 85 16 94 15	2.38 5.83 11.72 12.59 6.70	640.9 694.0 758.1 819.5 604.2	-1 -1 -1 -2	5.78 5.62 1.21 5.05	N ₂ 2948.6 3011.0 3233.2 3478.2 2658.6	3 -23 7 -33 1 -35 3 -37 7 -31	8.17 9.92 0.32 4.14 2.74	1630.2 1608.9 1607.7 1615.3 1599.8	5 1 0 8	126.35 123.86 123.68 124.08 123.38	5325 5248 5579	92 02 88	0.00 1457.08 1095.69 1149.04 1057.02	0 -98 -80 -69 -72	155 115 121	00 IS 40 IS 38 IS 04 IS 67	0 406 281 275 330	54 12 54	0 -95 -60 -69 -72	0.00 -0.43 0.88 0.41 -0.32	10 43 18 11
	Remainin 2.40 2.21 2.04 1.80 1.60	oht 50 mg (kg) CO) 5 00 00 00 00 00 00 00 00 00 00 00 00 0	(e) CO 00 4 00 3 01 2 00 2 00 2		Excess Air EA 379.4% 524.1% 583.7% 603.5% 462.3% 533.9%	Total C O ₂ 20.70 20.76 20.77 20.78 20.74 20.76	alc. % O ₂ (g) 0 16.57 17.58 17.88 17.97 17.34 17.59	Place less (°C) 147.3 119.9 118.3 122.3 114.8 121.1	20.9 20.6 21.0 20.7 20.8 21.0	101. 101. 101. 101. 101. 101.	7% 77 2% 77 2% 77 2% 77 2% 77	% 2.4% 2.3% 0.9% 9.3% 4.6% 2.1%	73.2% 73.6% 71.9% 70.6% 73.3%	Rs 29 38 42 43 35 38	5 2 5 2 2 2 4 1 9 1 6 1	Nt 45 27 04 86 63 40	x 0.00 7.16 16.57 23.96 33.35 42.72	23 2.1 1.9 1.7 1.5		y 0.00 7.16 16.57 23.96 33.35 42.72	553 390 390 431 381	put // 0 22 09 03 66 88	12= [s] 4.17 4.17 4.17 4.17 4.17 4.17	/1- p	[b] 0 0 0 0 0	716= [c] 2.68 2.68 2.68 2.68 2.68 2.68	Vali 19881 19881 19881 19881 19881	7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49	79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 22 2 26 2 24 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02	(w) 0.99 0.75 0.89 0.67 0.81 0.75	25 23 22 27 27	1 1 0 -0 5 -0 3 -0 6 -0 3 -0 4 -0	BQ 0.03 0.03 0.03 0.03 0.03	0.10 0.05 0.07 0.07 0.07	4	10 ₃ 6 112 16 131 23 111 26 122 26 128 21 128 23	10 0 16 -4 96 0 94 0 32 -4 95 0	02 02 05 15 07 05	HC -0.27 -0.38 -0.39 -0.42 -0.35 -0.37	N ₂ 909.07	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91	2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 38 38	K 10.40 13.02 11.40 15.45 17.94 14.24	50- 39- 38- 40- 371- 392-	41.85 19.16 40.50 16.80 06.34 67.61	3790. 2964. 2905. 3036. 2806. 2902.	55 .04 .35 .25 .08 .13	2885.8 2828.9 2905.8 2732.8 2913.0	9 35 9 28 5 27 0 29 3 27 0 28	44.45 53.15 96.82 22.35 01.67 80.00	4861.91 3740.86 3664.00 3837.62 3531.15 3779.73	3454 3386 3538 3271 3486	51 29- 57 29- 67 29- 12 29- 57 29- 54 29-	D4 21 79 16 12 16 85 16 94 15 10 16	2.38 5.83 11.72 12.59 16.70 17.21	640.9 694.0 758.1 819.5 604.2 702.9	-1 -1 -1 -1	5.78 5.62 1.21 5.05	N ₂ 2948.6 3011.0 3233.3 3478.3 2658.6 3047.4	3 -23 7 -23 1 -25 9 -27 7 -31 9 -23	8.17 9.92 0.32 4.14 2.74 3.94	1630.2 1608.9 1607.7 1615.3 1599.8 1609.3	5 1 0 8	126.35 123.86 123.68	5325 5245 5579 5854 4815 5317	92 02 88 .10 .00	0.00 1457.08 1095.69 1149.04 1057.02 1039.41	-98 -60 -69 -72 -65	155 115 121 121	00 IS.40 IS.38 IS.04 IS.67 IA.42	0 406 281 275 330 284	54 12 54 59 48	0 -98 -60 -69 -72 -65	0.00 -0.43 0.88 0.41 -0.32 0.00	10 63 18 11 12 10
	Remainin 2.45 2.27 2.04 1.86 1.63 1.40	oht 5, ng (kg) CO 5 00 07 00 00 00 00 00 00 00 00 00 00 00	(e) CO 00 4 00 3 01 2 00 2 00 3 00 3 00 3		Excess Air EA 379.4% 524.1% 583.7% 603.5% 482.3% 525.9% 523.0%	Total O ₂ 20.70 20.76 20.77 20.78 20.77 20.78 20.74 20.76 20.76	alc. % 0, tel 0 16.57 17.58 17.88 17.97 17.34 17.59 17.58	Plue las (°C) 147.3 119.9 118.3 122.3 114.8 121.1 115.6	20.9 20.6 21.0 20.7 20.8 21.0 20.7 20.8 21.0 20.4	101. 101. 101. 101. 101. 101. 101.	2% 75 2% 75 2% 75 2% 75 2% 75 2% 75 75 75 75 75	% 2.4% 2.3% 0.9% 9.3% 4.6% 2.1% 3.1%	73.2% 73.6% 71.9% 70.6% 73.8% 74.4%	Rs 29 38 42 43 35 38 38	5 2 5 2 2 2 4 1 9 1 6 1 4 1	Nt 45 27 04 86 63 40 22	x 0.00 7.16 16.57 23.96 33.35 42.72 50.06	23 21 19 17 15 13		y 0.00 7.16 16.57 23.96 33.35 42.72 50.06	955 396 396 431 381 383	put // 0 22 09 03 66 88 35	12= [s] 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/1- p 6.60 6.60 6.60 6.60 6.60	[b] 0 0 0 0 0 0	2.68 2.68 2.68 2.68 2.68 2.68 2.68 2.68	Vali 19881 19881 19881 19881 19881 19881	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 22 2 25 2 24 2 24 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02	(w) 0.99 0.75 0.89 0.67 0.61 0.75	25 23 22 27 27 25	1 1 0 -0 5 -0 3 -0 6 -0 3 -0 4 -0 5 -0	PQ 0.03 0.03 0.03 0.03 0.03 0.03	0.10 0.05 0.07 0.07 0.08 0.07	4	10 ₃ (1) 1.12 160 1.31 23- 1.11 260 1.22 260 1.28 211 1.25 23- 1.25 23-	10 0 16 -4 96 0 94 0 32 -4 95 0	02 02 05 15 07 05 05	HC -0.27 -0.38 -0.39 -0.42 -0.35 -0.37 -0.37	N ₂ 909.07	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91 33.91	2.51 2.51 2.51 2.51 2.51 2.51 2.51 2.51	42 39 39 39 38 38 38	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77	50- 39- 38- 40- 37- 39- 37- 37-	60 ₃ 41.85 119.16 40.50 16.80 16.34 57.61 54.71	3790. 2964. 2905. 3036. 2806. 2902. 2842.	55 .04 .35 .25 .08 .13 .43	2885.8 2828.9 2955.8 2732.8 2913.0 2768.1	9 35 9 28 5 27 0 29 3 27 0 28 6 27	44.45 53.15 96.82 22.35 01.67 80.00 36.62	4861.91 3740.86 3664.00 3837.62 3531.15 3779.73 3577.84	4409 3454 3386 3538 3271 3486 3313	51 29- 57 29- 67 29- 12 29- 57 29- 57 29- 55 29- 55 29-	D4 21 79 16 12 16 85 16 94 15 10 16	2.38 5.83 11.72 9.59 6.70 7.21 8.63	640.9 694.0 758.1 819.5 604.2 702.9 664.1	1 4 4 2 -1	5.78 5.62 1.21 5.05 1.00	N ₂ 2948.6 3011.0 3233.3 3478.3 2658.6 3047.4 2862.4	3 -23 7 -23 1 -35 9 -37 7 -31 9 -33	8.17 9.92 0.32 4.14 2.74 3.94 2.03	1630.2 1608.9 1607.7 1615.3 1599.8	5 1 0 8	126.35 123.86 123.68 124.08 123.38	5325 5248 5579 5854 4815 5317 5099	92 .02 .88 .10 .00 .06	0.00 1457.08 1096.69 1149.04 1057.02 1039.41 983.50	Less 1 0 -98 -60 -69 -72 -65 -64	155 115 121 121 112 110	00 5.40 6.38 8.04 8.67 9.42 7.28	0 406 281 275 330 284 285	54 12 54 09 48	0 -95 -60 -69 -72 -65 -64	0.00 -0.43 0.88 0.41 -0.32 0.00 0.00	00 43 88 81 11 32 00
	Weld Remainin 2.45 2.27 2.00 1.85 1.40 1.22 1.00 1.20 1.20 1.20 1.20 1.20 1.2	oht 5: ng (kg) CO 5 00 7 00 8 00 8 00 0 00 2 00 0 00	N (e) CO 00 4 00 3 01 2 00 2 00 2 00 3 00 3 00 3		Excess Ar EA 379.4% 524.1% 523.1% 603.5% 462.3% 525.9% 523.0% 475.8%	Total O ₂ 20.70 20.76 20.77 20.78 20.74 20.76 20.76 20.76	alc. % D ₂ fel 6 16.57 17.58 17.88 17.97 17.34 17.59 17.59	Page (es (°C) 147.3 119.9 118.3 122.3 114.8 121.1 115.6 115.1	20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.4	101. 101. 101. 101. 101. 101. 101.	2% 75 2% 75 2% 75 2% 75 2% 75 7% 75 7% 75	% 2.4% 2.3% 0.9% 9.3% 4.6% 2.1% 3.1% 4.6%	73.2% 73.6% 71.9% 70.6% 75.6% 73.3% 74.4%	Rs 29 38 42 43 35 38 38 38	5 2 5 2 2 2 4 1 9 1 6 1 4 1 5 1 5 1 5 1	Nt 45 27 04 86 63 40 22 00	x 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20	23 2.1 1.9 1.7 1.5 1.3		y 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20	555 390 390 431 381 381	put /* 22 09 03 66 88 88 35	12- [s] 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/1= p 6.60 6.60 6.60 6.60 6.60 6.60	[b] 0 0 0 0 0 0 0	2.65 2.65 2.65 2.65 2.65 2.65 2.65 2.65	Vali 19881 19881 19881 19881 19881 19881	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 22 2 26 2 24 2 24 2 26 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02 21.02	(w) 0.99 0.75 0.89 0.87 0.81 0.75 0.76	25 23 22 27 25 27 25 25	1 1 0 -0 5 -0 3 -0 6 -0 3 -0 4 -0 5 -0	P4 0.03 0.03 0.03 0.03 0.03 0.03 0.03	0.10 0.08 0.07 0.07 0.08 0.07 0.08	1	10 ₂ (112 160 1.12 160 1.31 23- 1.11 260 1.22 260 1.28 211 1.25 23- 1.25 23- 1.27 211	10 0 16 -6 96 0 94 0 32 -4 95 0 65 0	00 02 06 16 07 05 00 00 00	HC -0.27 -0.38 -0.39 -0.42 -0.35 -0.37 -0.37 -0.37	N ₂ 909.07	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91 33.91 33.91	2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 38 39 38	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77 18.28	50 39 38 40 37 38 37 37 37	00; 41.85 49.16 40.50 16.80 06.34 67.61 54.71	2964 2965 3036 2806 2806 2802 2842 2825	55 04 35 25 08 13 43	2885.8 2885.8 2828.9 2955.8 2732.8 2913.0 2768.1	9 36 9 28 5 27 0 29 3 27 0 28 6 27 0 27	44.45 53.15 56.82 22.35 51.67 80.00 36.62 20.14	4861.91 3740.86 3864.00 3837.62 3531.15 3779.73 3577.84 3555.38	4409 3454 3386 3538 3271 3486 3313 3293	51 29- 57 290 67 29- 12 290 57 290 54 29- 95 290 53 290 53 290	04 21 79 16 12 16 85 16 94 15 10 16 55 15	2.38 5.83 11.72 9.59 6.70 17.21 8.63 17.76	640.9 694.0 758.1 819.5 604.2 702.9 654.1 600.0	1 2 2 1 -1	5.78 5.78 5.62 1.21 5.05 1.00 1.00 5.14	N ₂ 2948.6 3011.0 3233.2 3478.2 2658.6 3047.4 2882.4 2846.7	3 -23 7 -33 1 -35 9 -37 7 -31 9 -33 1 -33	8.17 9.92 0.32 4.14 2.74 3.94 2.03 8.62	1630.2 1608.9 1607.7 1615.3 1599.8 1609.3	5 1 0 8	126.35 123.86 123.68 124.08 123.38	5325 5248 5579 5854 4815 5317 5099 4804	92 02 88 10 00 00 05	0.00 1457.08 1095.69 1149.04 1057.02 1039.41	Loss 1 0 -96 -60 -69 -72 -65 -64 -63	155 115 121 112 110 104	00 6.40 6.38 8.04 8.67 94.42 17.28	0 406 281 275 330 284	54 12 54 09 48 52	0 -95 -60 -69 -72 -65 -64 -63	0.00 -0.43 0.85 0.41 -0.32 0.00 0.00	10 43 18 11 32 10 10 29
	Remainin 2.46 2.27 2.04 1.85 1.46 1.22 1.00 0.85	ng (kg) CO) 77 0.0 84 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0 85 0.0	N (e) CO 00 4 00 3 01 2 00 2 00 3 00 3 00 3 00 3		Excess Air EA 3.79.4% 524.1% 524.1% 583.7% 603.5% 482.3% 525.9% 523.0% 475.8% 700.6%	Total C ₂ 20.70 20.76 20.77 20.78 20.74 20.76 20.74 20.76 20.74 20.80	alc. % D ₂ fel 6 16.57 17.58 17.88 17.97 17.34 17.59 17.58 17.59 17.58	Page (PC) 147.3 119.9 118.3 122.3 114.8 121.1 115.6 115.1 118.6	20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.5 20.5	101. 101. 101. 101. 101. 101. 101. 101.	2% 75 2% 75 2% 75 2% 75 2% 75 76 75 76 75 76 75 76 75	% 2.4% 2.3% 0.9% 9.3% 4.6% 2.1% 3.1% 4.6% 7.0%	73.2% 73.6% 71.9% 70.6% 73.5% 74.4% 75.6% 68.4%	Rs 29 38 42 43 35 38 38 38 49	5 2 2 2 2 4 1 9 1 6 1 4 1 5 1 9 0	Nt 45 27 04 86 63 40 22 00	x 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20 66.63	23 21 19 17 15 13 11 09 07		y 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20 66.63	955 390 390 431 381 383 383 383	put /* 22 09 03 66 88 35 56 30	12- [s] 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/1- p	[b] 0 0 0 0 0 0 0	2.68 2.68 2.68 2.68 2.68 2.68 2.68 2.68	Vali 19881 19881 19881 19881 19881 19881 19881	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 22 2 25 2 24 2 24 2 26 2 26 2 27 2 28 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02 21.02 21.02	[w] 0.59 0.75 0.89 0.87 0.81 0.75 0.76 0.82	25 23 22 27 25 27 25 27	1 1 0 -0 5 -0 3 -0 6 -0 3 -0 4 -0 5 -0 8 -0	P4 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.0	0.10 0.05 0.07 0.07 0.05 0.07 0.08 0.05	4	100 4 1.12 168 1.31 23 1.11 268 1.12 268 1.22 268 1.28 215 1.25 23 1.25 23 1.27 215 1.23 316	10 0 16 -4 96 0 94 0 32 -4 95 0 55 0	00 02 06 16 07 05 00 00 00 00	HC -0.27 -0.38 -0.39 -0.42 -0.35 -0.37 -0.37 -0.37 -0.36	N ₂ 909.07 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91 33.91 33.86 34.13	2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 38 38 38 38	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77 18.28 11.73	50 39 38 40 37 39 37 37 37 37	00 ₃ 41.85 19.16 40.50 16.80 16.34 67.61 34.71 71.62	3790 2964 2905 3036 2806 2992 2842 2825 2928	55 04 35 25 08 13 43 26 98	2885.8 2885.8 2828.9 2955.8 2732.8 2913.0 2768.1 2751.5 2851.9	9 35 9 28 5 27 0 29 3 27 0 28 6 27 0 27 7 28	44.45 53.15 56.82 22.35 51.67 80.00 36.62 20.14 19.57	4861.91 3740.86 3864.00 3837.62 3531.15 3779.73 3577.84 3555.38 3693.52	4409 3454 3386 3538 3271 3486 3313 3293 3414	51 29- 57 290 67 290 12 290 57 290 34 29- 35 290 34 290 34 290	04 21 79 16 12 16 85 16 94 15 10 16 55 15 64 15	2.38 5.83 11.72 9.59 6.70 (7.21 8.63 (7.76 (3.48	640.9 694.0 758.1 819.5 604.2 702.9 664.1 600.0 927.2	1 2 2 1 -1 1 0 1 0 1	5.78 5.62 1.21 5.05 1.00 1.00 5.14 8.42	N ₂ 2948.6 3011.0 3233.2 3478.2 2658.6 3047.4 2862.4 2646.7 3852.6	3 -23 7 -33 1 -35 9 -37 7 -31 9 -33 1 -33 0 -30 2 -43	8.17 9.92 0.32 4.14 2.74 3.94 2.03 8.62 2.60	1630.2 1608.9 1607.7 1615.3 1599.8 1609.3	5 1 0 8	126.35 123.86 123.68 124.08 123.38	5325 5248 5579 5854 4815 5317 5099	92 02 88 10 00 00 05	0.00 1457.08 1096.69 1149.04 1057.02 1039.41 983.50 931.57 1243.00	-58 -60 -69 -72 -65 -64 -63 -78	0 150 111 121 112 110 104 29	00 6.40 6.38 8.04 9.67 9.42 17.28 4.08	0 406 281 275 330 284 285 292 258	54 12 54 59 48 52 25 87	0 -95 -60 -69 -72 -65 -64 -63 -78	0.00 -0.43 0.88 0.41 -0.32 0.00 0.00 -0.29 0.74	10 43 18 11 12 10 10 10 14
7 ime 0 10 20 30 40 50 60 70 80	Remainin 2.46 2.27 2.04 1.63 1.63 1.40 1.22 1.00 0.63	ng (kg) CO) 5 0.0 77 0.0 84 0.0 85 0.0 85 0.0 95 0.0 90 0.0 90 0.0	S (16) CO CO CO 4 CO 3 01 2 CO CO 3 01 2 CO 3 00 3 00 3 00 3 00 3 00 3 00 3	O ₂ [d]	Air EA 3379.4% 524.1% 583.7% 603.5% 482.3% 525.9% 523.0% 475.8% 601.3%	Total C 20.70 20.76 20.77 20.78 20.74 20.76 20.76 20.76 20.76 20.76 20.76 20.76	alc. % 0-168 16.57 17.58 17.88 17.87 17.54 17.59 17.58 17.30 18.35 17.95	Page (PC) 147.3 119.9 118.3 122.3 114.8 121.1 115.6 115.1 118.6 118.1	20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.5 20.5 20.5	101. 101. 101. 101. 101. 101. 101. 101.	2% 75 2% 75 2% 75 2% 75 2% 75 2% 75 2% 75 2% 75 2% 75 2% 75	% 2.4% 2.3% 0.9% 9.3% 4.6% 2.1% 3.1% 4.6% 7.0%	% 73.2% 73.6% 71.9% 70.6% 73.5% 74.4% 75.6% 68.4%	Ra 29 38 42 43 35 38 38 38 49	tio 5 2 5 2 5 2 2 2 4 1 9 1 1 8 1 1 4 1 1 5 1 1 9 0 0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Nt 45 27 04 86 63 40 22 20 00 82	x 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20 56.63 76.09	23 21 19 17 15 13 11 09 07		y 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20 66.63 76.09	553 300 300 430 330 330 330 330 330 330	put /* 22 09 03 66 88 35 56 36 46	12= [a] 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/1= p 6.60 6.60 6.60 6.60 6.60 6.60 6.60	[b] 0 0 0 0 0 0 0 0 0	2.68 2.68 2.68 2.68 2.68 2.68 2.68 2.68	Vali 19831 19831 19831 19831 19831 19831 19831 19831 19831	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2 79.2 79.2 79.2 79.2	hj 30 2 24 2 22 2 22 2 25 2 24 2 24 2 26 2 26 2 27 2 28 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02 21.02 21.02 21.02	[w] 0.99 0.75 0.89 0.87 0.81 0.75 0.76 0.82 0.58	25 23 22 27 25 27 25 25 27 19	1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P4 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.0	Nk 0.10 0.05 0.07 0.07 0.05 0.07 0.08 0.05 0.05	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	100 4 1.12 168 1.31 23 1.11 268 1.12 268 1.22 268 1.25 23 1.25 23 1.27 21 1.23 316 1.32 268	10 0 16 -0 96 0 94 0 32 -0 95 0 55 0 55 0	00 02 06 16 07 05 00 00 00 00 05	HC -0.27 -0.38 -0.39 -0.42 -0.35 -0.37 -0.37 -0.35 -0.48	N ₂ 909.07 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91 33.91 33.91 33.86 34.13	2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 39 39 39 30 30 30 30 30 30 30 30 30 30 30 30 30	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77 18.28 11.73 11.23	50 39 38 40 37 37 37 37 38	00 ₃ 81.85 80.90 80.90 80.90 80.34 87.61 94.71 94.71 71.62	3790 2964 2906 3036 2806 2802 2842 2825 2923 2913	55 04 35 25 08 13 43 26 98 49	2685.0 2685.6 2626.9 2955.6 2732.8 2913.0 2768.1 2751.5 2851.9 2850.9	9 36 9 28 5 27 0 29 3 27 0 28 6 27 0 27 7 28	44.45 53.15 96.82 22.36 91.67 80.00 36.62 20.14 19.57 94.73	4861.91 3740.86 3864.00 3837.62 3531.15 3779.73 3577.84 3555.38 3693.52 3672.91	4409 3454 3386 3538 3271 3486 3313 3293 3414	51 29 57 29 17 29 12 29 57 29 57 29 54 29 55 29 53 29 53 29 54 29 54 29	D4 21 79 16 12 16 85 16 94 15 10 16 55 15 64 15 67 16	2.38 5.83 11.72 9.59 6.70 17.21 8.63 17.76 3.48	640.9 694.0 758.1 819.5 604.2 702.9 664.1 600.0 927.2	1 5 4 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5.78 5.62 1.21 5.05 1.00 1.00 5.14 8.42 5.12	N ₀ 2948.6 3011.0 3233.3 3478.3 2658.6 3047.4 2882.4 2846.7 3852.8 3329.1	3 -23 7 -33 1 -35 9 -37 7 -31 9 -33 1 -33 0 -30 2 -43	8.17 9.92 0.32 4.14 2.74 3.94 2.03 8.62 2.60	1630.2 1608.9 1607.7 1615.3 1599.8 1609.3 1600.1 1617.3	5 1 0 8 4 7 1 1 5 6 6	126.35 123.86 123.68 124.08 123.38 123.94 123.49 123.44 123.75	5325 5248 5579 5854 4815 5317 5029 4804 6290 5621	92 02 88 10 00 00 06 95 34 46	0.00 1457.08 1095.09 1149.04 1057.02 1039.41 983.50 931.57 1243.00 1087.04	-58 -60 -69 -72 -65 -64 -63 -78 -75	155 115 121 112 110 104 29 130	00 5.40 6.38 8.04 9.67 9.42 17.28 4.08 9.61	0 406 281 275 330 284 285 292 268 275	54 12 54 59 48 52 25 87	0 -95 -60 -69 -72 -65 -64 -63 -75	0.00 -0.43 0.88 0.41 -0.32 0.00 0.00 -0.29 0.74 -0.10	10 43 85 11 32 10 10 29 14
Time 0 10 20 30 40 50 60 70 80 80	Remainin 2.40 2.20 2.04 1.60 1.60 1.40 1.20 0.60 0.55 0.41	ng (kg) CO 5	00 4 00 3 01 2 00 2 00 3 00 3 00 3 00 3 00 3 00 3	O _j [d]	Air EA 379.4% 524.1% 583.7% 603.5% 482.3% 523.0% 475.8% 700.6% 700.5%	Total C O ₂ 20.70 20.76 20.77 20.78 20.74 20.76 20.76 20.74 20.80 20.78 20.80 20.78	alc. % 0, tell 0 16.57 17.58 17.88 17.87 17.97 17.34 17.59 17.58 17.50 18.35 17.95 18.35	Page (PC) 147.3 119.9 118.3 119.9 118.3 114.8 121.1 115.6 115.1 115.6 115.1 115.6	70 p p p p p p p p p p p p p p p p p p p	101. 101. 101. 101. 101. 101. 101. 101.		% 2.4% 2.3% 0.9% 0.9% 4.6% 2.1% 3.1% 4.6% 7.0% 0.4% 8.3% 0.4% 0.4% 8.3% 0.4% 0.4% 0.4% 0.4% 0.4% 0.4% 0.4% 0.4	% 73.2% 73.6% 71.9% 70.6% 73.5% 74.4% 73.5% 63.4% 63.1%	Ra 23 36 42 43 35 36 49 43 50 50	tio 5 2 5 2 5 2 2 2 4 1 9 1 1 8 1 1 4 1 1 5 1 1 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Nt 45 27 04 86 63 40 22 20 00 82 59 41	x 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20 66.63 76.09 83.16	23 2.1 1.2 1.7 1.5 1.3 1.1 0.9 0.7		y 0.00 7.16 16.57 23.36 42.72 50.06 59.20 66.63 76.08	555 300 300 430 330 335 335 335 335 335 335	put P 222 09 03 56 56 58 55 55 56 14	12= [a] 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/4= p 6.60 6.60 6.60 6.60 6.60 6.60 6.60 6.	[b] 0 0 0 0 0 0 0 0 0	2.68 2.68 2.68 2.68 2.68 2.68 2.68 2.68	Vali 1983 1983 1983 1983 1983 1983 1983 1983	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 22 2 24 2 24 2 24 2 24 2 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02 21.02 21.02 21.02	[w] 0.59 0.75 0.69 0.67 0.81 0.75 0.76 0.82 0.58 0.67	25 22 27 25 25 27 25 27 29 27	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BQ 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.0	Nk 0.10 0.05 0.07 0.07 0.05 0.07 0.08 0.05 0.05	4	10 10 10 10 10 10 10 10 10 10 10 10 10 1	110 0 116 4 96 0 94 0 95 0 95 0 95 0 95 0 95 0 95 0 95 0 95	00 02 06 06 07 07 05 00 00 00 00 05 13	MC -0.27 -0.38 -0.39 -0.42 -0.35 -0.37 -0.37 -0.48 -0.43 -0.43	N ₂ 1000.07 1000.00 1	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91 33.91 33.86 34.13 34.03 34.03	261 261 261 261 261 261 261 261 261 261	42 33 33 33 33 33 33 33 33 33 33 33	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77 18.28 11.73 11.23 16.37	50 39 38 40 37 37 37 38 38 38	CO ₂ 41.86 119.16 40.50 116.80 106.34 67.61 54.71 71.62 50.74	0; 3790. 2964. 2905. 3036. 2806. 2802. 2842. 2825. 2913. 2752.	55 04 35 25 08 13 43 26 98 49	2685.0 2685.6 2626.9 2955.6 2732.8 2913.0 2768.1 2751.5 2851.9 2850.9	9 35 9 28 5 27 0 29 3 27 0 28 6 27 0 27 7 28 7 28	64.45 53.15 96.82 22.35 91.67 80.00 36.62 20.14 19.57 94.73	4861.91 3740.86 3664.00 3837.62 3531.15 3779.73 3577.84 3555.38 3693.52 3672.91 3461.02	4409 3454 3385 3538 3271 3485 3313 3293 3414 3395	51 29 57 29 17 29 12 29 57 29 57 29 64 29 95 29 93 29 94 29 95 20 95 20 95 95 95 95 95 95 95 95 95 95 95 95 95	D4 21 79 16 12 16 85 16 94 15 10 16 55 15 64 15 67 16 67 16	2.38 5.83 11.72 9.59 6.70 7.21 8.63 7.76 3.48 2.98	640.9 694.0 758.1 819.5 604.2 702.9 664.1 600.0 927.2 783.7 874.5	1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5.78 5.78 5.62 1.21 5.05 1.00 5.14 8.42 5.12 12.41	N ₂ 2948.6 3011.6 3233.3 3478.3 2658.6 3047.4 2862.4 2862.6 3329.1 3630.6	3 -23 7 -33 1 -35 3 -37 7 -31 9 -33 1 -33 0 -30 2 -43 0 -38 2 -38	8.17 9.92 0.32 4.14 2.74 3.94 2.03 8.62 2.60 4.59	1630.2 1608.9 1607.7 1615.3 1599.8 1609.3 1600.1 1617.3 1611.6	5 1 0 8 4 7 1 1 5 6 6 6	126.35 123.86 123.68 124.08 123.38 123.94 123.49 123.44 123.75 123.70 123.22	5325 5248 5579 5854 4815 5317 5099 4804 6290 5621 6140	92 02 88 10 00 00 00 95 34 46 46	0.00 1457.08 1095.09 1149.04 1057.02 1039.41 983.50 931.57 1243.00 1087.04 1177.68	0 -96 -60 -69 -72 -65 -64 -63 -75 -75 -47	0 150 112 121 113 110 104 29 133	00 5.40 6.35 8.04 9.67 9.42 17.25 4.08 9.61 12.08	0 406 281 275 330 284 285 292 268 275 263	54 12 54 59 48 52 25 87 59	0 -95 -60 -69 -72 -65 -64 -63 -75 -75 -47	0.00 -0.43 -0.88 -0.41 -0.32 -0.00 -0.29 -0.74 -0.10 -0.68	10 43 18 11 132 10 10 10 29 14 10 10
Time 0 10 20 30 40 50 60 70 80	Remainin 2.46 2.27 2.04 1.80 1.40 1.22 1.00 0.80 0.55 0.44	mg (kg) CO) 5 00 7 00 8 00 8 00 8 00 0 00 0 00 0 00 0	00 4 00 3 01 2 00 2 00 3 00 3 00 3 00 3 00 3 00 3	O ₂ [d] A 4.13 3 3.18 5 2.89 5 3.41 4 3.16 5 3.41 4 2.45 7 2.82 6 2.42 7 3.11 5	Air EA 379,4% 528,1% 528,1% 528,7% 603,5% 603,5% 603,5% 603,5% 601,3% 706,6% 601,3% 706,6% 536,5%	20.76	alc. % D ₂ (ed) 16.57 17.58 17.58 17.97 17.34 17.59 17.50 17.50 18.35 17.95 18.37 17.65	Fibe (PC) 147.3 119.9 118.3 122.3 114.8 121.1 115.6 118.1 118.6 118.1 113.2 117.2	20.9 20.9 20.7 20.7 20.7 20.8 21.0 20.4 20.5 20.5 21.0 20.5 21.0 20.5	101. 101. 101. 101. 101. 101. 101. 101.		% 2.4% 2.3% 0.59% 9.3% 4.6% 2.1% 3.1% 4.6% 7.0% 0.4% 8.3% 2.4%	% 73.2% 73.6% 71.9% 73.6% 73.5% 74.4% 73.6% 63.4% 71.7% 63.1% 73.7%	Ra 229 33 34 42 43 35 36 46 43 35 36 46 43 36 36 46 43 36 36 36 36 46 43 36 46 43 36 46 43 46 40 40 40 40 40 40 40 40 40 40 40 40 40	tio 1 5 2 5 2 2 2 2 2 4 1 1 8 1 1 5 1	Nt 45 45 27 04 86 63 40 22 20 00 82 41 18	x 0.00 7.16 16.57 23.96 42.72 50.06 59.20 66.63 76.09 83.16 92.48	23 21 12 1.7 1.5 1.3 1.1 0.9 0.7 0.5 0.3		y 0.00 7.16 16.57 23.36 33.35 42.72 50.06 59.20 66.63 76.02 83.16 92.48	100 00 00 00 00 00 00 00 00 00 00 00 00	put P 222 09 03 56 56 58 55 56 56 56 56 56	12= [a] 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/4= p 6.60 6.60 6.60 6.60 6.60 6.60 6.60 6.	[b] 0 0 0 0 0 0 0 0 0 0	766 (c) 2.68 2.6	Validation 19881 1	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.3 79.2 79.2 79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 25 2 26 2 24 2 26 2 26 2 26 2 27 2 28 2 20 2 20 2 21 2 21 2 22 2 23 2 24 2 25 2 26 2 27 2 28 2 29 2 20 2	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02 21.02 21.02 21.02 21.02 21.02 21.02 21.02 21.02	[w] 0.59 0.75 0.69 0.67 0.61 0.75 0.76 0.82 0.58 0.67 0.58	23 22 27 25 25 27 25 27 29 22 27 29 22 27 29 20 20 20 20 20 20 20 20 20 20 20 20 20	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BQ 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03	Nk 0.10 0.05 0.07 0.05 0.07 0.05 0.05 0.05 0.0	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	10 ₂ (1) 1.12 160 1.12 160 1.31 230 1.11 260 1.22 260 1.28 215 1.25 233 1.25 233 1.27 215 1.23 310 1.32 260 1.81 311 1.26 233	2 10 0 16 4 96 0 94 0 32 4 95 0 65 0 57 0 77 0 74 0	00 02 06 16 07 05 00 00 00 00 00 13 02 50	HC 0.27 0.38 0.39 0.42 0.35 0.37 0.37 0.35 0.48 0.43 0.43	N ₂ 909.07 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08	H ₂ O 33.70 33.93 33.95 34.00 33.87 33.91 33.91 33.86 34.13 34.03 34.03 34.03	2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 39 39 39 39 39	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77 18.28 11.73 11.23 16.37 10.35	50 39 38 40 37 37 37 38 38 38 38	CO ₂ 41.86 119.16 40.50 116.80 106.34 67.61 34.71 31.71 71.62 50.74 34.61 118.50	0; 3790. 2964. 2905. 3036. 2806. 2802. 2842. 2825. 2913. 2752. 2889.	55 04 35 25 08 13 43 26 98 49 72	2685.0 2685.8 2628.9 2905.8 2732.8 2913.0 2768.1 2751.5 2851.9 2680.9 2680.9 2813.9	9 36 9 28 5 27 0 29 0 28 6 27 7 28 7 28 4 26 8 27	44.45 53.15 56.82 22.35 51.67 80.00 36.62 20.14 19.57 04.73 90.34 81.96	4861.91 3740.86 3664.00 3837.62 3531.15 3779.73 3577.84 3555.36 3693.52 3640.81	4409 3454 3385 3538 3271 3486 3313 3293 3414 3395 3209 3368	51 29 57 29 67 29 12 29 57 29 57 29 64 29 65 29 63 29 64 20 64 20	D4 21 79 16 12 16 85 16 94 15 10 16 55 15 64 15 67 16 67 16 14 15	2.38 5.83 11.72 9.59 6.70 7.21 8.63 7.76 3.48 2.98 11.97 11.36	640.9 694.0 758.1 819.5 604.2 702.9 664.1 600.0 927.2 783.7 874.5 692.7	1 2 3	500 1.49 5.78 5.62 1.21 5.05 1.00 1.00 5.14 8.42 5.12 12.41 1.00	N ₂ 2948.6 3011.6 3233.3 3478.3 2658.6 3047.4 2852.4 2846.7 3852.6 3329.1 3630.0 2994.2	3 -23 7 -33 1 -35 9 -37 7 -31 9 -33 1 -33 1 -33 2 -43 2 -43 2 -38 1 -34	8.17 9.92 0.32 4.14 2.74 3.94 2.03 8.62 2.60 4.59 7.22 0.70	1630.2 1608.9 1607.7 1615.3 1509.8 1609.3 1600.1 1617.3 1611.6 1606.0	6 11 00 88 44 77 11 65 65 65 65 65 65 65 65 65 65 65 65 65	126.35 123.86 123.68 124.08 123.38 123.94 123.49 123.49 123.47 123.75 123.70 123.22 123.63	5325 5248 5579 5854 4815 5317 5099 4804 6290 5620 5140 5237	92 02 88 10 00 00 95 34 46 46 44	0.00 1457.08 1095.69 1149.04 1057.02 1039.41 983.50 931.57 1243.00 1087.04 1177.68 1492.87	0 -96 -69 -72 -65 -64 -63 -75 -75 -47 -97	150 115 115 121 116 116 104 29 136 116 125	00 6 40 6 38 8 50 8 67 8 67 8 42 77 28 4 06 9 61 9 60 9 50	0 406 281 275 330 284 285 292 268 275 263 417	54 12 54 59 48 52 25 87 59 36 76	0 -95 -60 -69 -72 -65 -64 -63 -75	0.00 -0.43 0.88 0.41 -0.32 0.00 -0.29 0.74 -0.10 2.68 0.00	10 43 15 11 32 10 10 10 29 14 10 10 10
Time 0 10 20 30 40 50 60 70 80 80	Remainin 2.40 2.20 2.04 1.60 1.60 1.40 1.20 0.60 0.55 0.41	mg (kg) CO) 5 00 7 00 8 00 8 00 8 00 0 00 0 00 0 00 0	00 4 00 3 01 2 00 2 00 3 00 3 00 3 00 3 00 3 00 3	O ₂ [d] A 4.13 3 3.18 5 2.89 5 3.41 4 3.16 5 3.41 4 2.45 7 2.82 6 2.42 7 3.11 5	Air EA 379.4% 524.1% 583.7% 603.5% 482.3% 523.0% 475.8% 700.6% 700.5%		alc. % Dy [el] 0 16.57 17.58 17.88 17.97 17.34 17.58 17.58 17.50 17.58 17.70 18.35 17.95 18.37 17.65	Place (**C) 147.3 119.9 118.3 122.3 114.8 121.1 115.6 116.1 116.5 116.1 117.2 117.6 117.6 117.6	20 8 20 8 21 0 20 7 20 8 21 0 20 4 20 5 20 5 20 5 20 6 20 7 20 8 21 0 20 8 20 8 20 8 20 8 20 8 20 8 20 8 20	101. 101. 101. 101. 101. 101. 101. 101.			% 73.2% 73.6% 71.9% 73.6% 73.5% 74.4% 73.6% 63.4% 71.7% 62.1% 73.7% 72.9%	Ra 29 38 42 43 35 38 35 36 49 43 40 40 40 40 40 40 40 40 40 40 40 40 40	tio 1 5 2 5 2 2 2 2 2 4 1 1 8 1 1 4 1 1 5 1 1 9 0 0 3 0 0 0 0 3 0 0 9 0	Nt 45 27 04 86 63 40 22 20 00 82 41 18 00	x 0.00 7.16 16.57 23.96 33.35 42.72 50.06 59.20 66.63 76.09 63.16 92.48	23 21 19 17 15 13 13 10 9 9,7 9,5 0,3 0,1		9 0.00 7.16 16.57 23.96 33.35 42.72 50.06 53.76 09 83.16 92.48 100.00	300 300 300 300 430 330 330 330 330 330	Pput P 1 222 09 003 003 003 003 003 003 003 003 003	12= [a] 4.17 4.17 4.17 4.17 4.17 4.17 4.17 4.17	/1= p 6.60 6.60 6.60 6.60 6.60 6.60 6.60 6.6	[b] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	716= [c] 2.68 2.	Vali 19831 19831 19831 19831 19831 19831 19831 19831 19831 19831 19831	7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00	4.49 4.49 4.49 4.49 4.49 4.49 4.49 4.49	79.2 79.2 79.2 79.2 79.2 79.2 79.2 79.2	h) 30 2 24 2 22 2 25 2 26 2 24 2 26 2 26 2 26 2 27 2 28 2 29 2 20 2 20 2 21 2 21 2 22 2 23 2 24 2 25 2 26 2 27 2 28 2 29 2 20 2 20 2 20 2 20 2 20 2 20 2 20	[u] 21.03 21.02 21.01 21.01 21.02 21.02 21.02 21.02 21.02 21.02 21.02 21.00 21.00 21.00 21.00 21.00 21.00	[w] 0.99 0.75 0.89 0.57 0.81 0.76 0.82 0.58 0.57 0.58 0.57 0.58 0.57 0.58 0.74 0.71	25 25 27 25 25 25 25 25 25 25 25 25 25 25 25 25	I I I I I I I I I I I I I I I I I I I	BQ 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03	Nk 0.10 0.05 0.07 0.05 0.07 0.05 0.05 0.05 0.0	4 4 4 4 4 4 4 4 4	200, 101, 112, 110, 111, 111, 111, 111,	2 10 0 116 4 126 0	00 02 06 16 07 05 00 00 00 00 00 13 02 50 00	HC 0.27 0.38 0.39 0.42 0.35 0.37 0.37 0.35 0.48 0.43 0.43 0.43 0.43	N ₂ 909.07 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08 909.08	H ₂ O 23.70 23.93 23.95 34.00 23.87 23.91 23.86 34.13 34.03 24.03 23.93 23.97	2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	42 39 39 39 39 39 39 39 39 39 39 39 39 39	K 10.40 13.02 11.40 15.45 17.94 14.24 18.77 18.28 11.73 11.23 16.37 10.35 10.78	50 39 38 40 37 37 37 37 38 38 38 38 38	CO ₂ 41.86 19.16 40.50 16.80 56.34 57.61 54.71 71.62 50.74 54.61 118.50 50.59	0; 3790. 2964. 2905. 3036. 2806. 2802. 2842. 2825. 2913. 2752. 2889. 2896.	55 04 35 25 08 13 43 26 98 49 59 72	2685.0 2685.8 2628.9 2905.8 2732.8 2913.0 2768.1 2751.5 2851.9 2630.9 2680.9 2813.9 2822.4	9 35 9 28 5 27 0 29 3 27 0 28 6 27 7 28 7 28 4 26 8 27 3 27	44.45 53.15 56.62 22.35 51.67 80.00 36.62 20.14 19.57 04.73 50.34 81.96 90.34	4861.91 3740.86 3664.00 3837.62 3531.15 3779.73 3577.84 3555.38 3653.52 3672.91 3461.02 3640.81	4409 3454 3386 3538 3271 3486 3313 3293 3414 3396 3209 3368 3378	51 29 57 29 67 29 12 29 57 29 67 29 67 29 68 20 68 20	D4 21 779 16 779 16 779 16 855 16 855 16 954 15 955 15 854 15 857 16	2.38 5.83 11.72 9.59 6.70 7.21 8.63 7.76 3.48 2.98 11.97 11.36	640.9 694.0 758.1 819.5 604.2 702.9 654.1 600.0 927.2 783.7 874.5 692.7 728.5	1 5 1 4 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	50 5.78 5.62 1.21 5.05 1.00 1.00 5.14 8.42 5.12 12.41 1.00 1.00	N ₂ 2948.6 3011.6 3233.3 3478.3 2658.6 3347.4 2852.4 2646.7 3652.6 3329.1 3630.6 2994.2 3125.7	3 -23 7 -33 1 -35 9 -37 7 -31 9 -33 1 -33 0 -30 0 -38 2 -43 2 -38 1 -34	8.17 9.92 0.32 4.14 2.74 3.94 2.03 8.62 2.80 4.59 7.22 0.70 7.21	1630.2 1608.9 1607.7 1615.3 1599.8 1609.3 1600.1 1617.3 1611.6	6 11 00 88 44 77 11 65 65 65 65 65 65 65 65 65 65 65 65 65	126.35 123.86 123.68 124.08 123.38 123.94 123.49 123.44 123.75 123.70 123.22	5325 5248 5579 5854 4815 5317 5099 4804 6290 5621 6140	92 02 88 10 00 00 95 34 46 46 44	0.00 1457.08 1095.09 1149.04 1057.02 1039.41 983.50 931.57 1243.00 1087.04 1177.68	0 -96 -69 -72 -65 -64 -63 -75 -47 -97 -31	150 115 115 121 116 116 104 29 136 116 125	00 5.40 6.35 8.04 9.67 9.42 17.25 4.08 9.61 12.08	0 406 281 275 330 284 285 292 268 275 263	54 12 54 59 48 52 25 87 59 36 76	0 -95 -60 -69 -72 -65 -64 -63 -75 -75 -47	0.00 -0.43 -0.88 -0.41 -0.32 -0.00 -0.29 -0.74 -0.10 -0.68	10 43 15 11 32 10 10 10 29 14 10 10 10



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 Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

Manufacturer:	Ardisam	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	_	
Control #:	G102366578		

Test Duration: 120
Output Category: ledium Burn Rate

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)

2.34	5.16	dry lb
4.49		
4.70		
6.71		
3		
2.00		
	4.49 4.70 6.71 3	4.49 4.70 6.71 3

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					
Manufacturer:	Ardisam		Applia	nce Type:	Pellet	(Cat, Non-	Cat, Pellet)
Model:	Serenity						
Date:	12/7/2015		Te	mp. Units	F	(F or C)	Default
Run:	1		We	ight Units	lb	(kg or lb)	
Control #:	G102366578						HHV (kJ/kg)
Test Duration:	120						%C
Output Category:	Medium Burn Rate			Fuel [Data		%H
					Marth		%O
Wood	Moisture (% wet):	4.49		HHV	18,967	kJ/kg	%Ash
Loa	d Weight (lb wet):	5.40		%С	46.87	Ū	
	rn Rate (dry kg/h):	1.17		%Н	6.41		_
Total Parti	culate Emissions:	6.71 g		%O	46.62		1
		J		%Ash	0.1		f
							S
	Averages	0.00	3.08	17.43	247.86	69.23	_
			0.00			UUU	
	3.1		0.00		Temp		Г
Elapsed	Fuel Weight						1
Elapsed Time (min)			CO ₂		Temp	o. (°F)	F
•	Fuel Weight Remaining (lb)	Flue Gas	s Compositi	ion (%)	Temp Flue	o. (°F) Room	F i
Time (min)	Fuel Weight Remaining (lb)	Flue Gas	CO ₂	ion (%) O ₂	Temp Flue Gas	o. (°F) Room Temp	F i C
Time (min)	Fuel Weight Remaining (lb) 5.40 5.01	Flue Gas	CO ₂	ion (%) O ₂	Temp Flue Gas 297.1	o. (°F) Room Temp 69.6	F i
Time (min)	Fuel Weight Remaining (lb) 5.40 5.01 4.50	Flue Gas CO 0.00 0.00 0.01	CO ₂ 4.13 3.18	ion (%) O ₂ 16.36 17.34	Temp Flue Gas 297.1 247.8	0. (°F) Room Temp 69.6 69.2	F i C
Time (min) 0 10 20	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11	Flue Gas CO 0.00 0.00 0.01	5 Compositi CO ₂ 4.13 3.18 2.89	ion (%) O ₂ 16.36 17.34 17.65	Temp Flue Gas 297.1 247.8 244.9	0. (°F) Room Temp 69.6 69.2 69.8	F i C
Time (min) 0 10 20 30	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00	S Compositi CO ₂ 4.13 3.18 2.89 2.81 3.41 3.16	ion (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0	0. (°F) Room Temp 69.6 69.2 69.8 69.3	F i C
Time (min) 0 10 20 30 40 50	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00	CO ₂ 4.13 3.18 2.89 2.81 3.41 3.16 3.18	ion (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1	69.6 69.8 69.8 69.3 69.4 69.7 68.7	F i C
Time (min) 0 10 20 30 40 50 60	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00	CO ₂ 4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.44	16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2	69.6 69.8 69.8 69.3 69.4 69.7 68.7	F i C
Time (min) 0 10 20 30 40 50 60 70	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20 1.80	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.0	\$ Composition CO ₂ 4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.44 2.45	16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05 18.10	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2 245.5	69.6 69.2 69.8 69.3 69.4 69.7 68.7 68.9	F i C
Time (min) 0 10 20 30 40 50 60 70 80	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20 1.80 1.29	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.	4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.44 2.45 2.82	ion (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05 18.10 17.69	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2 245.5 244.5	69.6 69.2 69.8 69.3 69.4 69.7 68.7 68.9 68.9	F i C
Time (min) 0 10 20 30 40 50 60 70 80 90	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20 1.80 1.29 0.91	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.01	4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.44 2.45 2.82	ion (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05 18.10 17.69 18.12	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2 245.5 244.5 235.8	69.6 69.8 69.3 69.4 69.7 68.7 68.9 68.9 69.8	F i C
Time (min) 0 10 20 30 40 50 60 70 80	Fuel Weight Remaining (lb) 5.40 5.01 4.50 4.11 3.60 3.09 2.70 2.20 1.80 1.29 0.91 0.41	Flue Gas CO 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.	4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.44 2.45 2.82	ion (%) O ₂ 16.36 17.34 17.65 17.71 17.07 17.34 17.32 17.05 18.10 17.69	Temp Flue Gas 297.1 247.8 244.9 252.1 238.6 250.0 240.1 239.2 245.5 244.5	69.6 69.2 69.8 69.3 69.4 69.7 68.7 68.9 68.9	F ii C V

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

Oak

19,887

50

6.6 42.9

0.5

Default Fuel Values D. Fir

19,810

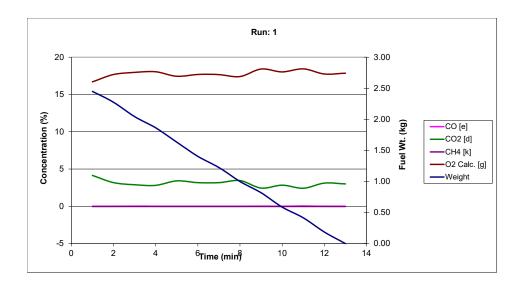
48.73

6.87

43.9 0.5

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 occurence and the next reading showing a decrease in weight.

Manufacturer																																																																																		
Model																el Ratio (Moi	ture Con	tent Mo		.49																																					
Date		7/15								rall Heating				Dry M				29.20																																																																
Run					Note: In th	e Trout data", ", and "Mass B	Date: % O ₂ *, *	Fuel		Combustion			99.50%	Dry Mo			N.):	1380.44	56	HC					Comb	uation E	ficiency:											ii): 4.					Dry kg		34																																					
	G10236	00578			Properties	r, and Mass B	lance" colum	ns, [e], [d], [c	al- H	ot Transfe	Efficienc	y:	70.06%	Air	Fuel Re	io (AIF)		39.80	0	8						Total In				2,095 (nitial Dry	Weight	Wt _{de} (k	g): 2.5	14				c	4	.87																																					
Test Duration	120	min	in		[8]. [D], [C],	(h), [u], [w], [j], variables in Cl	reser 13.7.31	o mer																		Total Out				9.345 ((Bbu)				Mol	sture Co	ontent D	ry 43	ro				H	9	.41																																					
				LHV						leat Output				15.471													ficiency:																0	4	1.62																																					
	Eff			75.19%						Heat Input	21.05	51 Blub		22.192	kJh											Total	CO (a):	2	1.33																																																					
	Comb	D Eff 99	99.50%	39.50%				ruste CO ₂																																																																										
	HTE	E# 70	70.06%	75.57%			CO _{2ut}	20.36	Br	m Duration	2.0	0	h																																																																					
	Outp	out 1	15.471	kath				F ₀																							Load W	Velaht (ka):	2.45																																																
	Burn R		1.17	kah				1.015		Burn Rate	2.5	8	lb/b	1.170	kah																Fuel He	eating		HHV	LH	,		HP	W L	w																																										
	Grams		3																												Value in	n kJiko	- CV:	18.957	17.5	15	Blu	/ib 815	9.8 75	5.2																																										
	Inpu			kJ/h						Rack Temp	243.1	8 Deg.	r	117.6	Deg. C																																																																			
	MCw		4.49																																																														JMS						AVERAG	GE					SUMS					
	Averag		0.00	3.08	5.73	20.85	17.78 1	19.92	20.68	101.5%	71.75	6 73	2.9%	37.68	1.22	50.1	1	1.17	50	.11	46052	3.9	1 0	5.41	2.9		1967.00	4.4	9	9.15	20.99			2.56	-0.0		0.05	39.	40 23	.68	0.05	-0.35	1032	3 32	78	2.61	393.	07	3921.1		2965.03	28		2854.0			3455.54		3 20	38.15	8902	77	188.50	380	74.12	-4052	27 :	0208.99	161	10.18	5149.2		12483.93	-73	36.27	1322	1.2	33568.0	-736	.6.3	3.3	
Elepsed		UT DATA			Oxygo			Input Da	rica .	Combust	Heat		Net	Air	Wet W	5. W	et .	Dry Wt.	% !	Dry				Fuel F	ropert	03		100	٧				Balane	ce r finn on			Wood										Sta		,	teat Cor					ck Tem	peratu	ne	Roo								f Dry Pu	el)				Total											
																																														loisture							las Con					Tem						lue Gas							Loss											ma Produ
	Welc	ioht	*	*	Excess	Total	Salc. %	Flue	Room	Eff	Transf	rer	EIT	- 301	HOW																					- 100	mole	dfa		Mole	per ag	of Dry V																																								
Time	Remainin	ing (kg) C	CO [e]	CO ¹ [4]	Air EA	Total O ₂	Calc. % O ₂ (g)	Flue as (°C) T	Room temp (°C)	%	Transf	er .	%	Ratio	Wt	×		Wt _{de}	1	,	Input	/12=	[4] /1	= [b]	/16=	[c]	Value	Fuel 5	lumt	[10]	[u]		[w]	01	Del		Nk	Ci) ₂ (Mole	CO	HC HC	N ₂	H		resent	К		CO2		0,	-	со	N ₂	С	H ₄	H ₂ O	K	-	102	0,		co		42	CH,	H		b H ₀ OF		Rate		Loss	Le	oss 1	Latent	Loss	Output		188 2	co	
	Remainir 2.45	ieht ing (kg) C	CO [e]	CO ₂ [d]	Air EA 393.0%	Total O ₂ 20.82	O ₂ (g) G	Flue es (°C) T 147.3	Room temp (°C) 20.9	% 101.1%	72.69	N 7.	%	Ratio 27.5	Wt 2.45	×		Wt _{dn} 2.34	0.0	F 00	Input 0	3.9	[a] /1 0	- [b]	/16= 2.9	[c]	Value 967.00	Fuel E	lumt 9 1	[h] 9.15	[u] 21.00		(w) .05	00 3.42	-0.0	3	Nk 0.10	dfa Ct	32 150	Micie 00	CO 1.02	HC -0.24	N ₂ 754.0	H ₂		resent 2.61	420.	40	CO ₂ 5041.8	6 3	O ₃ 3790.55	36	CO 85.09	N ₂ 3544.45	486	H ₄	H ₂ O 4409.51	294.0	4 19	8.25	O ₂	9	CO 5.13	274	4 ₃ 8.25	-215.3	is H	O Comb		Fuel MC 6.35	Rate 5040.60			Le		0.0		Outpu		0	0.00	
	Remainin 2.45 2.23	ing (kg) C	CO [e]	% CO ₂ [d] 4.13 3.18	Air EA 393.0% 541.8%	O ₂ 20.82 20.85	Calc. % O ₂ (g) G 16.69 17.68	Plac es (°C) T 147.3 119.9	Room lemp (°C) 20.9 20.6	% 101.1% 101.7%	72.65 72.65	N 7.	% 3.4% 3.8%	Ratio 27.5 35.9	Wt 2.45 2.27	0.0 7.1		Wt _{de} 2.34 2.17	0.0	F 00 16	0 5266	3.9	[a] /1 0	i- [b]	2.9 2.9	[c]	Value 1967.00 1967.00	Fuel E 4.4 4.4	lumt 9 1	[h] 9.18 9.15	[u] 21.00 21.00	1 1	(w) .05 .81	3.42 2.64	-0.0 -0.0	3	Nk 0.10 0.05	39 39	0 ₂ 6 32 156 49 211	00 .71	CO 0.02 0.05	HC -0.24 -0.34	N ₂ 754.0 983.8	H ₁		2.61 2.61	420. 393.	40	5041.8 3919.1	6 3	O ₂ 3790.55 2964.04	361	CO 85.09 85.89	N ₂ 3644.45 2853.15	486 3740	1.91 0.86	H ₂ O 4409.51 3454.57	294.0 293.1	4 19	0; 8.25 4.78	0 ₂ 602.6 651.2	9 2	5.13 -14.73	274	6 ₂ 8.25 7.14	-215.2 -306.6	6 6				S040.60 4909.50	15	0.00 1379.78	Le		1468	61	0 3886	t Los	0 89	0.00	
	Remainin 2.45 2.27 2.04	ing (kg) C	% CO[e] 0.00 0.00 0.01	% CO ₂ [d] 4.13 3.18 2.89	Excess Air EA 393.0% 541.8% 603.1%	O ₂ 20.82 20.85 20.85	Calc. % O ₂ (g) G 16.69 17.68 17.97	Place es (°C) T 147.3 119.9 118.3	20.9 20.6 21.0	% 101.1% 101.7% 101.4%	72.69 72.69 71.19	% 7. % 7.	% 3.4% 3.8% 2.2%	Ratio 27.5 35.9 39.3	Wt 2.45 2.27 2.04	7.19 16.5	7	Wt _{de} 2.34 2.17 1.95	0.0 7.1 16.	F 00 16 57	0 5266 3728	39 39 39	(a) /1 0	- [b] 1.41 1.41	2.9 2.9 2.9	[c]	Value 1967.00 1967.00	4.4 4.4 4.4	lumt 9 7	[h] 9.15 9.15 9.14	[u] 21.00 21.00 20.99	1 1	w] .05 .81 .73	01 3.42 2.64 2.41	00 00 00	3	Nk 0.10 0.05 0.07	30 30 30 30	0 ₂ 0 32 150 49 211 30 244	71 72	00 0.02 0.05 0.15	HC -0.24 -0.34 -0.35	N ₂ 754.0 983.8	32 32 # 32		2.61 2.61 2.61 2.61	420- 393/ 391-	40 02 40	5041.8 3919.1 3840.5	6 3 6 2 0 2	O ₃ 3790.55 2964.04 2905.35	361 281 281	CO 85.09 85.89 28.95	N ₂ 3544.45 2853.15 2796.83	486 3740 386-	0.86 4.00	H ₂ O 4409.51 3454.57 3385.47	294.0 293.0 294.0	4 19 9 15 2 15	8.25 4.78 0.94	602.6 651.2 710.5	9 2 9	5.13 -14.73 42.57	274 280 301	4 ₂ 8.25 7.14 4.60	-215.2 -306.6 -315.5	8 8		121 121 121	5.35 3.86 3.68	S040.00 4909.50 5279.54	15	0.00 1379.78 1037.66	Le		0.0 1468 1091	61	0 3886 2690	t Los	0 89 54	0.00 -0.40 0.82	
	Remainin 2.45 2.23	ing (kg) C	% CO [e] 0.00 0.00 0.01 0.00	% CO ₂ [d] 4.13 3.18 2.80 2.81	Air EA 393.0% 541.8% 603.1%	O ₂ 20.82 20.85	Calc. % O ₂ (gd G 16.69 17.68 17.97 18.05	Plue es (°C) T 147.3 119.9 118.3 122.3	20.9 20.6 21.0 20.7	% 101.1% 101.7% 101.4% 101.7%	72.69 72.69 71.19 60.69	% 7. % 7. % 7.	% 3.4% 3.8% 2.2% 0.8%	Ratio 27.5 35.9 39.3 40.5	2.45 2.27 2.04 1.85	7.10 16.5 23.5	7	Wt _{de} 2.34 2.17 1.95 1.78	0.0 7.1 16. 23.	50 16 57 96	0 5266 3728 3723	39 39 39 39	[a] /1 0 0	(41 (41 (41 (41	2.9 2.9 2.9 2.9	[c]	Value 1967.00 1967.00 1967.00	4.4 4.4 4.4 4.4	lumt 9 7 9 7 9 7	[N] 9.18 9.15 9.14 9.14	[u] 21.00 21.00 20.99 20.99	0 0	w 05 81 73 71	01 3.42 2.64 2.41 2.34	-0.0 -0.0 -0.0	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.08 0.07 0.07	39 39 39 39 39	0 ₂ 6 32 156 49 211 30 244 41 253	71 - 72 - 09	CO 1.02 1.05 1.15	HC -0.24 -0.34 -0.35 -0.38	N ₂ 754.0 983.8 assess	H 32 32 8 32 8 32		2.61 2.61 2.61 2.61 2.61	420- 393/ 391- 395-	40 02 40 45	5041.8 3919.1 3840.5 4016.8	6 3 6 2 0 2 0 3	O ₂ 3790.55 2964.04 2905.35 3036.25	361 281 281 281	CO 85.09 85.89 28.95 55.80	N ₂ 3644.45 2853.15 2796.83 2922.35	486 3740 385 383	1.91 0.86 4.00 7.62	H ₂ O 4409.51 3454.57 3386.47 3538.12	294.0 293.1 294.1 293.1	4 19 9 15 2 15 5 15	8.25 4.78 0.94 8.28	602.6 651.2 710.5 768.4	9 2 9 5	5.13 -14.73 42.57 19.80	274 280 301 324	4 ₂ 8.25 7.14 4.60 3.12	-215.2 -306.6 -315.5 -337.2	6 6 9		121 121 121		Rate 5040.66 4989.56 5279.54 5536.35	16 19 14	0.00 1379.78 1037.66 1086.67	Le		0.0 1468 1091 1148	61 23 76	0 3886 2690 2636	t Los	0 89 54 62	0.00 -0.40 0.82 0.38	
	Remainin 2.45 2.23	ing (kg) C	% CO [e] 0.00 0.00 0.01 0.00 0.00	% CO ₂ [d] 4.13 3.18 2.89 2.81 3.41 3.16	Air EA 393.0% 541.8% 603.1% 623.4% 498.8%	O ₂ 20.82 20.85 20.85	Calc. % O ₂ (gd) G 16.69 17.68 17.97 18.05 17.44	Flor es (°C) T 147.3 119.9 118.3 122.3 114.8	20.9 20.5 21.0 20.7 20.8	101.1% 101.7% 101.4% 101.7% 101.6%	72.69 72.69 71.19 69.69 74.89	N. 7. N. 7. N. 7. N. 7. N. 7.	% 3.4% 3.8% 2.2% 0.8% 5.9%	27.5 35.9 39.3 40.5 33.5	2.45 2.27 2.04 1.85 1.63	7.10 16.5 23.5 33.2	1 1 7 8 5	Wt _{de} 2.34 2.17 1.95 1.78 1.56 1.34	7.1 16. 23. 33.	96 35	0 5268 3728 3723 4164 3708	72° 29' 29' 29' 29' 29'	0 0	- [b] (41 (41 (41 (41 (41	29 29 29 29 29 29	[c] 5	Value 1967.00 1967.00 1967.00 1967.00	4.4 4.4 4.4 4.4 4.4	lumt 9 1 9 1 9 1 9 1	[N] 9.15 9.15 9.14 9.14 9.16 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99	0 0	(w) 05 81 73 71 86	01 3.42 2.64 2.41 2.34 2.82 2.63	40 40 40 40 40	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.05 0.07 0.07 0.09	30 30 30 30 30 30 30 30 30	0 ₂ 6 32 150 49 211 30 24- 41 25: 46 20: 43 23	00 71 72 09	0.02 0.05 0.07 0.05	HC -0.24 -0.34 -0.35 -0.38 -0.32	N ₂ 754.0 983.8 server 917.3 995.5	32 32 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61	420- 393- 391- 395- 387- 394	40 02 40 45 04	5041.8 3919.1 3840.5 4016.8 3706.3	6 3 6 2 0 2 0 3 4 2	O ₂ 3790.55 2964.04 2905.35 3036.25 2806.08	361 281 281 292 273 293	CO 85.09 85.89 28.95 55.80 32.83	N ₂ 3644.45 2853.15 2796.80 2922.35 2701.67 2880.00	486 3740 385 383 353	11.91 0.86 4.00 7.62 11.15	H ₂ O 4409.51 3454.57 3386.47 3538.12 3271.57	294.1 293.1 294.1 293.1 293.1	4 19 9 15 2 15 5 15 4 14	825 4.78 0.94 8.28 6.26 6.07	002.6 651.2 710.5 768.4 567.1	9 2 9 5 8	5.13 -14.73 42.57 19.80 -14.05	274 280 301 324 247 284	6 8.25 7.14 4.60 3.12 8.47	-215.3 -306.6 -315.5 -337.3 -282.2	8 8 9 17	1575.36 1553.98 1552.74 1559.98 1545.42	121 123 123 124 124	5.35 3.86 3.68 4.08 3.38	Rate 5040.60 4989.50 5279.54 5036.30 4564.30	16 19 14 15	0.00 1379.78 1037.66	Le		0.0 1468 1091 1148 1066	61 23 76 78	0 3886 2690 2636 3162	t Los 0 -85 -54 -65	0 89 54 62 65	0.00 -0.40 0.82 0.38 -0.30	
	Remainin 2.45 2.23	ing (kg) C	% CO [e] 0.00 0.00 0.01 0.00 0.00 0.00	% CO ₂ [d] 4.13 3.18 2.89 2.81 3.41 3.16 3.18	Air EA 393.0% 541.8% 603.1%	O ₂ 20.82 20.85 20.86 20.86 20.86	Tale: % O ₂ (gd) G 16.69 17.68 17.97 18.05 17.44 17.69 17.67	Place es (°C) T 147.3 119.9 118.3 122.3 114.8 121.1	Room lemp (°C) 20.9 20.6 21.0 20.7 20.8 21.0 20.4	101.1% 101.7% 101.4% 101.6% 101.6% 101.6%	72.69 72.69 71.19 60.69 74.89 72.39	% 7. % 7. % 7. % 7. % 7.	% 3.4% 3.8% 2.2% 0.8% 5.9% 3.5%	Ratio 27.5 35.9 39.3 40.5 33.5 36.0 35.8	2.45 2.27 2.04 1.85 1.63 1.40	7.11 16.5 23.5 42.7 50.0	1 7 6 5 2	Wt _{de} 2.34 2.17 1.95 1.78 1.56 1.34 1.17	0.0 7.1 16. 23. 33. 42.	96 35 72 06	0 5266 3728 3723 4164 3708 3658	72° 29' 29' 29' 29' 29' 29'	0 0	(41) (41) (41) (41) (41) (41) (41)	75° 29 29 29 29 29 29 29	[c] 5	Value 1967.00 1967.00 1967.00 1967.00 1967.00	4.4 4.4 4.4 4.4 4.4 4.4 4.4	lumt 9 1 9 1 9 1 9 1 9 1	(N) 9.18 9.15 9.14 9.14 9.16 9.15 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99 20.99	0 0	(w) .05 .81 .73 .71 .86 .80	01 3.42 2.64 2.41 2.34 2.82 2.63 2.64	00 -00 -00 -00 -00 -00	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.05 0.07 0.07 0.07 0.09 0.08	30 30 30 30 30 30 30 30 30 30	0 ₂ 6 32 150 49 211 30 244 41 253 46 203 43 221 43 211	00 71 72 09 13 44	0.02 0.05 0.05 0.05 0.07 0.05 0.05	HC -0.24 -0.34 -0.35 -0.38 -0.32 -0.34 -0.34	N ₂ 754.0 983.8 88988 917.3 986.5 981.9	H 32 32 8 32 8 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61 2.61	420- 393- 391- 395- 387- 394- 388-	40 02 40 45 04 24	5041.8 3919.1 3840.5 4016.8 3706.3 3957.6 3754.7	6 3 6 2 0 2 0 3 4 2 1 2	O ₂ 3790.55 2964.04 2905.35 3036.25 2806.08 2992.13 2842.43	361 281 282 292 277 299 277	CO 85.09 85.89 28.95 55.80 52.83 13.00 68.16	N ₂ 3644.45 2853.15 2796.80 2922.35 2701.67 2880.00 2736.60	486 3746 366 383 353 3577 3577	0.86 4.00 7.62 11.15 9.73 7.84	H ₂ O 4409.51 3454.57 3386.47 3538.12 3271.57 3486.94 3313.85	294.1 293.1 294.2 293.1 293.1 294.2	4 19 9 15 2 15 5 15 4 14 0 15 5 14	825 478 094 828 626 607 8.06	002.6 651.2 710.5 768.4 567.1 659.5	9 2 9 5 5 8 9 7	5.13 -14.73 42.57 19.80 -14.05 0.00 0.00	274 280 301 324 247 284 268	6 8.25 7.14 4.60 3.12 8.47 1.12 7.21	CH ₄ -215.3 -306.6 -315.5 -337.3 -282.2 -301.2	8 8 9		121 121 121 124 125 121	5.35 3.86 3.68	Rate 5040.66 4989.56 5279.54 5536.35	16 19 14 15 19	0.00 1379.78 1037.86 1086.67 1002.00	Le		0.0 1468 1091 1148	61 23 76 78	0 3886 2690 2636	t Los 0 -85 -65 -65	0 89 54 62 65 59	0.00 -0.40 0.82 0.38	
	Remainin 2.45 2.23	ing (kg) C	% CO (e) 000 000 000 000 000 000 000 000 000 0	% CO ₂ [d] 4.13 3.18 2.89 2.81 3.41 3.16 3.16 3.16 3.16	Air EA 393.0% 541.8% 603.1% 623.4% 498.8%	O ₂ 20.82 20.85 20.86 20.86 20.86	Tale: % O ₂ (ed) G 16.69 17.68 17.97 18.05 17.44 17.69 17.67	Place as (°C) T 147.3 119.9 118.3 122.3 114.8 121.1 115.6 115.1	Room lemp (°C) 20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.4	101.1% 101.7% 101.7% 101.6% 101.6% 101.6% 101.6% 101.6%	72.69 72.69 71.19 60.69 74.89 72.39 73.49	N. 7. N. 7. N. 7. N. 7. N. 7. N. 7. N. 7.	58% 3.8% 2.2% 0.8% 5.9% 3.5% 4.5%	Ratio 27.5 35.9 39.3 40.5 33.5 36.0 35.8 33.1	2.45 2.27 2.04 1.85 1.63 1.40 1.22	7.11 16.5 23.5 33.3 42.7 50.0	1 1 7 8 5 5 2 6	Wt _{de} 2.34 2.17 1.95 1.78 1.56 1.34 1.17 0.95	0.0 7.1 16. 23. 33. 42. 50.	96 35 72 06 20	0 5266 3728 3723 4164 3708 3658 3678	72° 29' 29' 29' 29' 29' 29' 29'	0 0	= [b] 	716- 2.9 2.9 2.9 2.9 2.9 2.9 2.9	[c] 5	Value 1957.00 1957.00 1957.00 1957.00 1957.00 1957.00	4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4	Sumt 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9	(N) 9.18 9.15 9.14 9.14 9.16 9.15 9.15 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99 20.99 21.00	0 0	(w) .05 .81 .73 .71 .86 .80 .81	01 3.42 2.64 2.41 2.34 2.82 2.63 2.64 2.85	00 -00 -00 -00 -00 -00 -00	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.05 0.07 0.07 0.09 0.08 0.08	30 32 32 32 32 32 32 32 32	0 ₂ 6 32 150 49 211 30 24- 41 253 46 203 43 221 46 190	00 71 72 09 13 44 24	0.02 0.05 0.05 0.05 0.07 0.05 0.00 0.00	HC -0.24 -0.34 -0.35 -0.32 -0.34 -0.34 -0.31	N ₂ 754.0 983.8 88888 917.3 986.5 981.9 907.0	H 32 32 32 32 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	420- 393- 391- 395- 387- 394- 388- 388-	40 02 40 45 04 24 77	5041.8 3919.1 3840.5 4016.8 3706.3 3957.6 3754.7	6 3 6 2 0 2 0 3 4 2 1 2 1 2	O ₂ 3790.55 2964.04 2906.35 3036.25 2806.08 2962.13 2842.43 2825.26	361 281 281 291 271 29 271 271	CO 85.09 85.89 28.95 55.80 32.83 13.00 68.16	N ₂ 3644.45 2853.15 2796.80 2922.35 2701.67 2880.00 2736.60 2736.60	486 374 385 383 353 357 357 357	0.86 4.00 7.62 11.15 9.73 7.84 5.38	H ₂ O 4409.51 3454.57 3386.47 3538.12 3271.57 3486.94 3313.85 3293.93	294.1 293.1 294.2 293.1 294.2 293.1 294.2	4 19 9 15 2 15 5 15 4 14 0 15 5 14 4 14	10 ₂ 8.25 4.78 0.94 8.28 6.26 6.07 8.06 7.25	002.6 651.2 710.5 768.4 567.1 659.5 623.1	9 2 9 5 8 9 7	5.13 -14.73 42.57 19.80 -14.05 0.00 0.00	274 280 301 324 247 284 268 246	6, 8.25 7.14 4.60 3.12 8.47 1.12 7.21 7.28	CH ₄ -215.3 -306.6 -315.5 -337.3 -282.2 -301.2 -299.5 -278.5	8 8 9	1575.36 1553.98 1552.74 1559.98 1545.42 1554.47	121 121 121 124 125 121	6.35 3.86 3.68 4.08 3.38 3.94	Rate 5040.66 4909.56 5279.54 5536.35 4564.36 5033.86	16 19 14 15 19 19	0.00 1379.78 1037.66 1086.67 1002.00 984.06	Le		0.0 1468 1091 1148 1066	0 61 23 76 78 71	0 3886 2690 2636 3162 2724	t Los 0 -81 -54 -62 -63 -63	0 89 54 62 65 59 58	0.00 -0.40 0.82 0.38 -0.30 0.00	
	Remainin 2.45 2.23	ing (kg) C	% CO (e) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	% CO ₂ [d] 4.13 3.18 2.89 2.81 3.41 3.18 3.18 3.14 3.16 3.18	Air EA 393.0% 541.8% 603.1% 623.4% 498.8%	O ₂ 20.82 20.85 20.86 20.86 20.86	Calc. % O ₂ (a) G 16.69 17.68 17.97 18.05 17.44 17.69 17.67 17.67 17.40 18.42	Place as (°C) T 147.3 119.9 118.3 122.3 114.8 121.1 115.5 115.1 116.6	Reom (emp (°C) 20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.4 20.5 20.5	101.1% 101.7% 101.7% 101.6% 101.6% 101.6% 101.6% 101.6%	72.65 72.65 72.65 71.15 60.65 74.85 72.35 73.45 74.85 67.45	% 7. % 7. % 7. % 7. % 7. % 7. % 7. % 7.	58% 3.8% 2.2% 0.8% 5.9% 3.5% 4.5% 6.0%	Ratio 27.5 35.9 39.3 40.5 33.5 36.0 35.8 33.1 46.5	2.45 2.27 2.04 1.85 1.63 1.40 1.22 1.00 0.82	7.11 16.5 23.5 33.2 42.7 50.0 59.2	1 1 7 8 5 5 2 8 0	Wt _{de} 2.34 2.17 1.95 1.78 1.56 1.34 1.17 0.95 0.78	0.0 7.1 16. 23. 33. 42. 50. 59.	96 57 96 35 72 06 20	0 5266 3728 3723 4164 3708 3658 3678 3748	72° 29' 29' 29' 29' 29' 29' 29' 29'	0 0	= [b] 	716- 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9	[c] 5	Value 1957.00 1957.00 1957.00 1957.00 1957.00 1957.00	4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4	Sumt	(N) 9.18 9.15 9.14 9.14 9.16 9.15 9.15 9.15 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99 21.00 20.99 21.00 20.99	0 0 0	W 05 81 73 71 86 80 81 87 62	BI 3.42 2.64 2.41 2.34 2.82 2.63 2.64 2.85 2.05	00 -00 -00 -00 -00 -00 -00	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.08 0.07 0.07 0.09 0.08 0.08 0.08	30 32 32 32 32 32 32 32 32 32	0 ₂ 6 32 150 49 211 30 24- 41 250 46 200 43 221 43 211 46 190 41 291	00 71 72 09 13 44 24 39	0.02 0.02 0.05 0.05 0.07 0.05 0.00 0.00	HC -0.24 -0.34 -0.35 -0.32 -0.34 -0.34 -0.34 -0.34 -0.31 -0.44	N ₂ 754.0 983.8 88888 917.3 986.5 981.9 907.0	H 32 32 32 32 32 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	420- 393- 391- 395- 387- 394- 388- 388- 388- 391-	40 02 40 45 04 24 77 28	5041.8 3919.1 3840.5 4016.8 3706.3 3957.6 3754.7 3731.7	6 3 6 2 0 2 0 3 4 2 1 2 1 2 1 2	O ₂ 3790.55 2964.04 2905.35 3036.25 2806.08 2992.13 2842.43 2825.26 2928.98	364 285 285 297 277 29 277 277 287	CO 85.09 85.89 28.95 55.80 32.83 13.00 68.16 51.50	N ₂ 3644.45 2853.15 2796.80 2922.35 2701.67 2880.00 2736.60 2736.60 2720.14 2819.57	486 374 385 383 353 357 357 357 357 356 366	0.86 4.00 7.62 11.15 9.73 7.84 5.38 6.52	H ₂ O 4409.51 3454.57 3386.47 3538.12 3271.57 3486.94 3313.85 3293.93 3414.04	294.1 293.1 294.1 293.1 293.1 294.1 293.1 293.1	4 19 9 15 2 15 5 15 4 14 0 15 5 14 4 14 7 15	10 ₂ 8.25 4.78 0.94 8.28 6.26 6.07 8.06 7.25 2.57	002.6 651.2 710.5 768.4 567.1 659.5 623.1 563.3	9 2 9 5 8 9 7 3	5.13 -14.73 42.57 19.80 -14.05 0.00 0.00 -14.13 35.86	274 280 301 324 247 284 268 246 355	4, 8.25 7.14 4.60 3.12 8.47 1.12 7.21 7.21 7.28 2.49	CH, -215.3 -306.6 -315.5 -337.3 -282.2 -301.2 -299.5 -278.5 -389.6	8 8 9	1575.36 1553.98 1552.74 1559.98 1545.42 1554.47	121 121 121 124 125 121	6.35 3.86 3.68 4.08 3.38 3.94	Rate 5040.66 4989.56 5279.54 5636.36 4964.36 5033.86 4830.97	16 19 14 15 19 19 19	0.00 1379.78 1037.66 1086.67 1002.00 984.06 931.63	Le		0.0 1468 1091 1148 1095 1042 989	61 23 76 78 71	0 3886 2690 2636 3162 2724 2726	t Los 0 -65 -65 -65 -65 -65 -65 -65 -65 -65 -65	0 89 54 62 65 59 58 57	0.00 -0.40 0.82 0.38 -0.30 0.00	
	Remainin 2.45 2.23	ing (kg) C	% CO [e] 000 000 000 000 000 000 000 000 000 0	% CO ₂ [d] 4.13 3.18 2.89 2.81 3.41 3.16 3.18 3.42 2.45 2.45	Air EA 303.0% 541.8% 603.1% 623.4% 498.8% 543.0% 543.0% 540.7% 492.1% 729.5% 621.2%	O ₂ 20.82 20.85 20.86 20.86 20.86	Calc. % O ₃ (a) 16.69 17.68 17.97 18.05 17.44 17.69 17.67 17.40 18.42 18.42 18.04	Place as (°C) T 147.3 119.9 118.3 122.3 114.8 121.1 115.1 118.5 118.1	Room (emp (°C) 20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.4 20.5 20.5 20.5	101.1% 101.7% 101.7% 101.6% 101.6% 101.6% 101.6% 101.6% 101.6%	72.65 72.65 71.15 69.65 74.85 72.35 73.45 74.85 67.45	N. 7. N. 7. N. 7. N. 7. N. 7. N. 7. N. 7. N. 7.	55 3.4% 3.8% 2.2% 0.8% 5.9% 3.5% 4.5% 6.0% 8.7%	Ratio 27.5 35.9 39.3 40.5 33.5 36.0 35.8 33.1 46.5 40.4	Wt 2.45 2.27 2.04 1.85 1.63 1.40 1.22 1.00 0.82 0.59	23.5 23.5 23.5 42.7 50.0 59.2 66.6	7 6 5 2 8 0 3	Wt _{de} 2.34 2.17 1.95 1.78 1.56 1.34 1.17 0.95 0.78	0.0 7.1 16. 23. 33. 42. 50. 50. 50.	F 50 16 57 96 35 72 06 20 63 09	9266 3728 3723 4164 3708 3658 3658 3678 3748	72° 29° 29° 29° 29° 29° 29° 29° 29° 29°	0 0	= [b] 5.41 5.41 5.41 5.41 5.41 5.41 5.41 5.41	/16= 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9	[c]	Value 1967-00 1967-00 1967-00 1967-00 1967-00 1967-00 1967-00	Fuel E 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4	lumt	[N] 9.18 9.15 9.15 9.14 9.16 9.15 9.15 9.15 9.15 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99 21.00 20.99 21.00 20.99	0 0 0	w 05 81 73 71 86 80 81 87 82 72	BI 3.42 2.64 2.41 2.34 2.82 2.63 2.64 2.85 2.05 2.36	00 00 00 00 00 00 00 00	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.05 0.07 0.02 0.05 0.05 0.05 0.05 0.07	30 30 30 30 30 30 30 30 30 30 30 30 30 3	0 ₂ 4 32 158 49 211 30 24- 41 253 46 203 43 221 43 211 46 198 41 298 50 253	00 71 72 09 13 -44 24 39 60 20	CO 1.02 1.05 1.07 1.07 1.07 1.05 1.00 1.00 1.00 1.00 1.00	HC -0.24 -0.34 -0.35 -0.38 -0.32 -0.34 -0.34 -0.31 -0.44	N ₂ 754.0 983.8 987.0 917.3 986.5 981.9 907.0	H ₁ 32 32 32 32 32 32 32 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	420- 393- 391- 395- 387- 394- 388- 388- 388- 391-	40 02 40 45 04 24 77 28 73	CO ₂ 5041.8 3919.1 3840.5 4016.8 3706.3 3957.6 3754.7 3871.6	6 3 6 2 0 2 0 3 4 2 1 2 1 2 1 2 2 2	O ₂ 3790.55 2964.04 2905.35 3036.25 2806.08 2992.13 2842.43 2825.26 2928.98	363 283 285 295 277 29 277 277 285 285 285	CO 85.09 85.89 28.95 55.80 32.83 13.00 68.16 51.50 51.97	N ₂ 3644.45 2853.15 2796.80 2922.36 2701.67 2880.00 2736.60 2736.60 2720.14 2819.57 2804.72	486 3746 386 383 353 357 357 357 357 357	H ₄ 11.91 0.86 4.00 7.62 11.15 9.73 7.84 6.38 0.52 2.91	H ₂ O 4409.51 3454.57 3386.47 3538.12 3271.57 3486.94 3313.85 3293.93 3414.04 3396.11	294.1 293.1 294.1 293.1 293.1 293.1 293.1 293.1 293.1	4 19 9 15 2 15 5 15 4 14 0 15 5 14 4 14 7 15 7 15	50 ₂ 8.25 4.78 0.94 8.28 6.26 6.07 8.06 7.25 2.57 2.11	602.6 651.2 710.5 768.4 567.1 659.5 623.1 563.3 868.1	9 2 9 5 8 9 7 3 3	5.13 -14.73 42.57 19.80 -14.05 0.00 0.00 -14.13 35.86 -4.78	274 280 301 324 247 284 268 246 350	4 ₅ 8.25 7.14 4.60 3.12 8.47 1.12 7.21 7.25 2.49 3.86	215.3 -306.6 -315.5 -337.3 -282.2 -301.2 -299.5 -278.5 -389.6 -346.7	8 8 9	1575.36 1553.98 1552.74 1559.98 1545.42 1554.47	121 121 121 124 125 121	6.35 3.86 3.68 4.08 3.38 3.94	Rate 5040.00 4009.00 5279.54 5030.30 4064.30 5033.80 4030.91 4054.30 91	105 109 144 155 109 107 177	Loss 0.00 1379.78 1037.66 1085.67 1002.00 984.06 931.63 883.10	Le		0.0 1468 1091 1148 1066 1042 989 939 1244	0 61 23 76 78 71 17 17	0 3886 2690 2636 3162 2724 2726 2726 2573 2639	t Los	188 2 89 89 62 65 59 58 57 70 68	0.00 -0.40 0.82 0.38 -0.30 0.00 0.00 -0.27 0.69 -0.09	
0 10 20 30 40 50 70 80 90	2.40 2.27 2.04 1.85 1.63 1.40 1.22 1.00 0.85 0.41	ing (kg) C 45 1 27 04 1 86 1 63 4 40 1 22 1 00 1 10 1 10 1 10 1 10 1 10 1 1	% CO [e] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	% CO ₂ [d] 4.13 3.18 2.80 2.81 3.41 3.16 3.16 3.18 3.44 2.45 2.82 2.42	Air EA 303.0% 541.8% 603.1% 623.4% 498.8% 543.6% 543.6% 540.7% 492.1% 729.5% 621.2% 732.5%	O ₂ 20.82 20.85 20.85 20.86 20.86 20.85 20.85 20.85 20.85 20.85 20.85 20.85 20.85	Date: % Option 16.69 17.68 17.68 17.97 18.05 17.44 17.69 17.67 17.40 18.42 18.04 18.04	Place es (°C) T 147.3 119.9 118.3 122.3 114.8 121.1 115.6 116.5 118.1 118.2	Reem (*C) 20.9 20.6 21.0 20.7 20.8 21.0 20.4 20.5 20.5 20.5 20.5 20.5	101.1% 101.1% 101.7% 101.6% 101.6% 101.6% 101.6% 101.6% 101.5% 101.5% 101.5% 101.5%	72.69 72.69 71.19 60.69 74.89 72.39 73.49 67.49 67.49 67.49	N. 7. N. 7.	56 3.4% 3.8% 2.2% 0.8% 5.9% 3.5% 4.5% 6.0% 8.7% 2.0%	Ratio 27.5 35.9 39.3 40.5 33.5 36.0 35.8 33.1 46.5 40.4 46.6	Wt 2.45 2.27 2.04 1.86 1.63 1.40 1.22 1.00 0.82 0.59 0.41	23.5 23.5 23.5 42.7 50.0 59.2 68.6 78.0	7 6 5 5 2 6 0 3 9	Wt _{de} 2.34 2.17 1.95 1.78 1.56 1.34 1.17 0.95 0.78 0.56 0.39	10.0 7.1 16. 23. 33. 42. 50. 50. 66. 76.	F 00 16 57 96 35 72 06 20 63 09 16	9 1266 3728 3728 3723 4164 3708 3658 3678 3748 3668 3638	79 29 29 29 29 29 29 29 29	[a] /1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(**E)	76- 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9		Value 1967.00 1967.00 1967.00 1967.00 1967.00 1967.00 1967.00 1967.00	Fuel E 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4	lumt	[N] 9.18 9.15 9.15 9.14 9.16 9.15 9.15 9.15 9.15 9.15 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99 21.00 20.99 21.00 20.99 20.99 20.99	0 0 0	w 05 81 73 71 86 80 81 87 62 72 62	3.42 2.64 2.41 2.34 2.62 2.63 2.64 2.85 2.05 2.05 2.05	00 -00 -00 -00 -00 -00 -00 -00 -00 -00	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Nk 0.10 0.05 0.07 0.07 0.09 0.08 0.08 0.09 0.05 0.07 0.05	30. 32. 32. 32. 32. 32. 32. 32. 32. 32. 32	0 ₃ 4 32 158 49 211 30 244 41 253 46 203 43 221 46 198 41 298 50 253 62 290 63 203 64 198 64 198	00 71 72 09 13 44 24 39 60 20 67	CO 1.02 1.05 1.07 1.07 1.07 1.00 1.	0.24 -0.24 -0.35 -0.35 -0.38 -0.32 -0.34 -0.34 -0.31 -0.44 -0.39 -0.39	N ₂ 754.0 983.8 88988 917.3 985.5 981.9 907.0 88988 88988	H ₁ 32 32 32 32 32 32 32 32 32 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	420, 393, 391, 395, 394, 388, 388, 391, 391,	40 02 40 45 14 24 77 28 73 23	CO ₂ 5041.8 3919.1 3840.5 4016.8 3706.3 3957.6 3754.7 3871.6 3850.7 3634.6	6 3 6 2 0 2 0 3 4 2 1 2 1 2 2 2 4 2 1 2 2 2	O ₂ 3790.55 2964.04 2905.35 3036.25 2806.08 2902.13 2842.43 2825.26 2928.98 2913.49 2752.59	363 283 285 295 277 29 277 277 285 285 285 265	CO 85.09 85.89 28.95 55.80 32.83 13.00 68.16 51.50 51.97 36.97 80.94	N ₂ 3644.45 2853.15 2796.85 2922.35 2701.67 2880.00 2736.65 2720.14 2819.57 2804.77 2804.77	2 486 3744 386 383 353 357 357 357 357 357 357 357 357 35	H ₄ 11.91 0.86 4.00 7.62 11.15 9.73 7.84 5.38 0.52 2.91 11.02	N ₂ O 4409.51 3454.57 3386.47 3538.12 3271.57 3486.94 3313.85 3293.93 3414.04 3396.11 3209.52	294.1 290.1 290.1 290.1 290.1 290.1 290.1 290.1 290.1 290.1	4 19 9 15 2 15 5 15 4 14 0 15 5 14 4 14 7 15 7 15 4 14	8.25 4.78 0.94 8.28 6.26 6.07 8.06 7.25 2.57 2.11	02.6 602.6 651.2 710.5 768.4 567.1 659.5 623.1 563.2 868.1 734.8	9 2 9 5 5 8 9 7 3 3 0	5.13 -14.73 42.57 19.80 -14.05 0.00 0.00 -14.13 35.86 -4.78 132.92	274 280 301 324 267 284 268 359 310 338	45 8.25 7.14 4.60 3.12 8.47 1.12 7.21 7.25 2.49 3.88 4.91	215.3 -306.6 -315.5 -337.3 -282.2 -301.2 -299.5 -278.5 -389.6 -346.7 -349.1	8 8 7 7 7 8 8 8 8 8 8 1 1 1 3 8 8 1 1 1 3 0 0	1575.36 1553.98 1552.74 1559.98 1545.42 1554.47 1548.63 1545.76 1561.47 1556.32	121 122 123 124 124 125 127 127 127 127 127 127 127 127 127 127	5.35 3.86 3.68 4.06 3.38 3.94 3.49 3.44 3.75 3.70 3.22	Rate 5040.00 4909.00 5279.54 5036.30 4054.30 5033.80 4054.30 5033.80 5033.50 5	105 109 144 155 159 159 177 177 179 189	Loss 0.00 1379.78 1037.65 1086.67 1002.00 954.06 931.63 883.10 1174.75 1028.61 1113.06	Le		0.0 1468 1091 1148 1086 1042 989 939 1244 1096 1154	0 61 23 76 78 71 17 11 44 30	0 3886 2690 2636 3162 2724 2726 2726 2573 2639 2525	t Los	188 2 0 0 54 62 65 59 58 57 70 68	0.00 -0.40 0.82 0.38 -0.30 0.00 0.00 -0.27 0.69 -0.09 2.50	
	Remainin 2.45 2.23	ing (kg) C 45 1 27 1 04 86 1 83 1 40 1 22 2 00 82 1 83 1 14 1 15 1	% CO [e] 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	% CO ₂ [d] 4.13 3.18 2.89 2.81 3.41 3.18 3.18 3.44 2.45 2.82 2.42 3.11	Air EA 303.0% 541.8% 603.1% 623.4% 498.8% 543.0% 543.0% 540.7% 492.1% 729.5% 621.2%	O ₂ 20.82 20.85 20.86 20.86 20.84 20.85 20.85 20.85 20.85 20.85	Tale: % O ₂ led O ₃ led O ₄ led O ₇	Place es (°C) T 147.3 119.9 118.3 122.3 114.8 115.1 115.6 115.1 118.5 118.1 113.2 117.2	Reem (*C) 20.9 20.9 20.8 21.0 20.7 20.8 21.0 20.4 20.5 20.5 20.5 20.5 20.6	101.1% 101.1% 101.7% 101.6% 101.6% 101.6% 101.6% 101.6% 101.6% 101.6% 101.6% 101.6%	72.69 72.69 72.69 72.19 72.19 74.89 72.39 73.49 74.89 67.49 70.79 68.69 72.79 71.99		% 3.4% 3.8% 2.2% 0.8% 5.5% 4.5% 6.0% 8.7% 2.0% 9.4% 3.5%	Ratio 27.5 35.9 39.3 40.5 33.5 35.0 35.8 35.8 46.5 46.5 46.6 35.6	Wt 2.45 2.27 2.04 1.85 1.63 1.40 1.22 1.00 0.82 0.59 0.41 0.18	x 0.00 7.11 16.5 23.5 42.7 50.0 50.0 66.6 76.0 83.1	7 6 5 5 2 6 0 3 9 8	Wt _m 2.34 2.17 1.95 1.78 1.56 1.34 1.17 0.95 0.78 0.56 0.39 0.18	10.0 7.1 16. 23. 33. 42. 50. 59. 66. 76.	7 00 116 57 96 335 72 06 20 63 63 69 16 48	Input 0 5266 3728 3723 4164 3708 3658 3678 3746 3668 3658 5406 1669	192- 29 29 29 29 29 29 29 29 29 29 29 29		(* [b] (*	/16- 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9	- 1	Value 1967-00 1967-00 1967-00 1967-00 1967-00 1967-00 1967-00	Fuel E 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.4 4.		[h] 9.18 9.15 9.15 9.14 9.14 9.15 9.15 9.15 9.15 9.15 9.15 9.15	[u] 21.00 21.00 20.99 20.99 21.00 20.99 21.00 20.99 20.99 20.99 20.99 20.99 20.99 20.99	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	w 05 81 73 71 86 80 81 87 82 72 62 79	01 3.42 2.64 2.41 2.34 2.63 2.63 2.64 2.85 2.05 2.05 2.04 2.58	00 -00 -00 -00 -00 -00 -00 -00 -00 -00	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	0.10 0.05 0.07 0.07 0.09 0.08 0.08 0.09 0.05 0.09	302 302 302 302 302 302 302 302 302 302	D ₂ (1) 332 15832 15849 211 330 24441 253 343 211 446 253 443 221 446 198 441 2580 255 02 290 444 220	772 09 13 44 24 39 60 20 67 52	CO 1.02 1.05 1.15 1.07 1.00 1.00 1.00 1.00 1.13 1.13 1.13 1.02 1.14 1.13	HC -0.24 -0.34 -0.35 -0.34 -0.34 -0.34 -0.34 -0.39 -0.39 -0.39 -0.34	N ₂ 754.0 983.8 88888 917.3 985.5 981.9 907.0 88888 88888 88888 88888	H 32 32 32 32 32 32 32 32 32 32 32 32 32		resent 2.61 2.61 2.61 2.61 2.61 2.61 2.61 2.61	80 420 393 391 395 387 394 398 398 391 391 391 390	40 102 40 45 104 24 77 28 73 23 37	CO ₂ 5041.8 3919.1 3840.5 4016.8 3706.3 3557.6 3754.7 3871.6 3850.7 3634.6 3818.5	6 3 6 2 0 2 0 3 4 2 1 2 1 2 2 2 4 2 1 2 2 2 2 2	O ₂ 3790.55 2964.04 2965.35 3036.25 2866.08 2992.13 2842.43 2825.26 2903.98 2713.59 2713.59 2713.59	363 283 285 295 277 277 277 285 285 285 285 285 285 285	CO 85.09 85.89 28.95 55.80 32.83 13.00 68.16 51.50 51.97 36.97 80.94 13.98	N ₂ 3644.45 2853.15 2796.85 2791.67 2880.00 2736.65 2720.14 2819.57 2804.75 2804.75 2804.75	2 486 3746 385 385 357 357 357 357 357 357 357 357 357 35	11.91 0.86 4.00 7.62 11.15 9.73 7.84 8.38 3.52 2.91 11.02 0.81	NyO 4402.51 3454.57 3385.47 3538.12 3271.57 3485.94 3313.85 3293.93 3414.04 3395.11 3209.52 3368.63	294.1 293.1 294.1 293.1 293.1 294.1 293.1 293.1 293.1 293.1 293.1 293.1 293.1	4 199 155 2 155 155 145 144 144 144 144 144 144 144	8.25 4.78 0.94 8.28 6.26 6.07 8.06 7.25 2.57 2.11 1.83 0.61	O ₂ 602.6 651.2 7103.7 768.4 567.1 659.5 623.1 868.1 734.8 819.1 649.5	9 2 9 5 5 8 9 7 3 3 0 5 5	5.13 -14.73 42.57 19.80 -14.05 0.00 0.00 -14.13 35.86 -4.78 132.92 0.00	274 286 301 324 267 268 268 355 310 338 275	45 8.25 7.14 4.60 3.12 8.47 1.12 7.21 7.25 2.49 3.88 4.91 1.48	CH, -215.2 -306.8 -315.5 -337.2 -301.2 -299.5 -278.5 -346.2 -346.2 -346.2 -307.2	5 5 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	1575.36 1553.98 1552.74 1559.98 1545.42 1554.47 1548.63 1545.76 1561.47	128 127 129 129 120 121 121 121 121 121 121 121 121 121	6.35 3.86 3.68 4.08 3.38 3.94	Rate 5040.00 4909.50 5279.54 5033.80 4030.91 4054.30 5345.00 5319.30 5319.30	15 16 19 14 15 15 17 17 15 17 17 10 18 15	Loss 0.00 1379.78 1037.65 1036.67 1002.00 984.06 931.63 883.10 1174.75 1028.61	Le		0.0 1468 1091 1148 1066 1042 989 939 1244	61 223 76 78 71 17 11 44 30 50	0 3886 2690 2636 3162 2724 2726 2726 2573 2639	t Los 0	188 2 0 0 54 62 65 59 58 57 70 68 41 87	0.00 -0.40 0.82 0.38 -0.30 0.00 0.00 -0.27 0.69 -0.09	



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 Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

Manufacturer:	Ardisam	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	•	
Control #:	G102366578		
Test Duration:	180	•	

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 Category: Low Burn Rate

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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	2.2	12/14/2009					
Manufacturer:	Ardisam		Applia	nce Type:	Pellet	(Cat, Non-	-Cat, Pellet)
	Serenity						
	12/7/2015			mp. Units	F	(F or C)	Default
Run:	1		We	ight Units	lb	(kg or lb)	
Control #:	G102366578						HHV (kJ/kg)
Test Duration:	180						%C
Output Category:	Low Burn Rate			Fuel I	Data		%Н
					D. Fir		%O
Wood	Moisture (% wet):	4.49		HHV	19,887	kJ/kg	%Ash
Load	d Weight (lb wet):	5.22		%C	50		
Bur	n Rate (dry kg/h):	0.75		%Н	6.6		T.
Total Partic	culate Emissions:	6.71 g	1	%O	42.9		n f
				%Ash	0.5		
	Averages	0.01	1.96	18.58	195.75	69.05	
					Temp). (°F)	١
Elapsed	Fuel Weight	Flue Gas	s Composit	ion (%)	Flue	Room	 F
Time (min)	Remaining (lb)	CO	CO_2	O_2	Gas	Temp	i.
0	5.22	0.00	2.99	17.49	243.7	69.0	c
10	4.93	0.00	2.99 1.74	17.49 18.82	243.7 203.8		C
10 20	4.93 4.62	0.01		18.82 18.52		69.0 68.4	\ \ a
10 20 30	4.93 4.62 4.32	0.01 0.00 0.02	1.74 2.02 1.90	18.82 18.52 18.67	203.8 203.9 201.4	69.0 68.4 69.0	C
10 20 30 40	4.93 4.62 4.32 4.01	0.01 0.00 0.02 0.03	1.74 2.02 1.90 1.73	18.82 18.52 18.67 18.82	203.8 203.9 201.4 186.4	69.0 68.4 69.0 68.6	\ \ a
10 20 30 40 50	4.93 4.62 4.32 4.01 3.72	0.01 0.00 0.02 0.03 0.02	1.74 2.02 1.90 1.73 1.68	18.82 18.52 18.67 18.82 18.87	203.8 203.9 201.4 186.4 189.1	69.0 68.4 69.0 68.6 69.7	\ \ a
10 20 30 40 50	4.93 4.62 4.32 4.01 3.72 3.51	0.01 0.00 0.02 0.03 0.02 0.03	1.74 2.02 1.90 1.73 1.68 1.65	18.82 18.52 18.67 18.82 18.87 18.91	203.8 203.9 201.4 186.4 189.1 188.3	69.0 68.4 69.0 68.6 69.7 69.1	\ \ a
10 20 30 40 50 60	4.93 4.62 4.32 4.01 3.72 3.51 3.22	0.01 0.00 0.02 0.03 0.02 0.03 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11	18.82 18.52 18.67 18.82 18.87 18.91 18.40	203.8 203.9 201.4 186.4 189.1 188.3 194.5	69.0 68.4 69.0 68.6 69.7 69.1 68.7	\ \ a
10 20 30 40 50 60 70	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45	203.8 203.9 201.4 186.4 189.1 188.3 194.5	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8	c v e
10 20 30 40 50 60 70 80	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95	203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9	\ \ a
10 20 30 40 50 60 70 80 90	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76	203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9	\ \ a
10 20 30 40 50 60 70 80 90 100	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.03	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36	203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0	\ \ a
10 20 30 40 50 60 70 80 90 100 110	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.03 0.00 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57	203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4 187.3	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0	\ \ a
10 20 30 40 50 60 70 80 90 100 110 120	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.03 0.00 0.01 0.03	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.69	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88	203.8 203.9 201.4 186.4 189.1 188.3 194.5 197.7 196.3 188.4 187.3 186.6	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4	\ \ a
10 20 30 40 50 60 70 80 90 100 110 120 130	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.01 0.03 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.69	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88	203.8 203.9 201.4 186.4 189.1 188.3 194.5 197.7 196.3 188.4 187.3 186.6 186.0	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 69.0 69.8 69.4 69.4	\ \ a
10 20 30 40 50 60 70 80 90 100 110 120 130 140	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51 1.21	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.01 0.03 0.00 0.01 0.03	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99 1.99	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88 18.55 18.57	203.8 203.9 201.4 186.4 189.1 188.3 194.5 197.7 196.3 188.4 187.3 186.6 186.0	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 69.0 69.8 69.4 69.4 69.4	\ \ a
10 20 30 40 50 60 70 80 90 100 110 120 130 140	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51 1.21 0.92 0.60	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.01 0.03 0.00 0.01 0.03 0.00	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99 1.99	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88 18.55 18.57	203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4 187.3 186.6 186.0 198.5	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 69.9 69.0 69.8 69.4 69.4 69.4 69.3 68.3	c v e
10 20 30 40 50 60 70 80 90 100 110 120 130 140	4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51 1.21	0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.01 0.03 0.00 0.01 0.03	1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99 1.99	18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88 18.55 18.57	203.8 203.9 201.4 186.4 189.1 188.3 194.5 197.7 196.3 188.4 187.3 186.6 186.0	69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4 69.4 69.4 69.3 68.3	c v e

12/14/2009

VERSION: 2.2

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

Oak

19,887

50

6.6 42.9

0.5

Default Fuel Values D. Fir

19,810

48.73

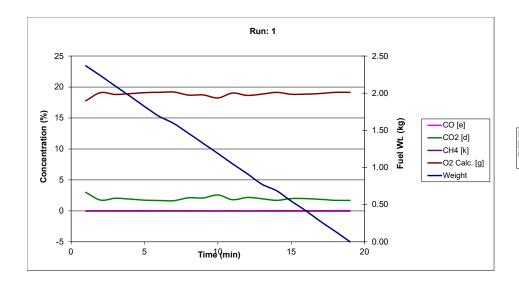
6.87

43.9

0.5

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 occurence and the next reading showing a decrease in weight.

Manufacturer:	Ardso	m																																																					
Model:	Seren	by												Air Fuel Rat	tio (AF)															Moisture Cr	ontent M _{Cet} :	4.49																							
Date:	12/07/	15							Ove	rall Heating I	Efficiency:	67.30%	Dry Moles	cular Weigh	t(M.) 2	9.07																																							
Run:				N	lote: In the 'In	put data", "Ca	k. % 0,1, 7	'uel		Combustion I	Efficiency:	99.50%	Dry Moles	Exhaust Go	m (N _i): 21:	50.45	NHC			Combusti	on Efficiency:	99.50%			Mo	isture of Woo	ood (wet basis)	4.49			Dry kg:	2.26																							
Control #:	G102366	1578		P	roperties", an	d 'Mass Balar [u], [w], [j], an	ce" columns	s, [e], [d], [g]	6 н	eat Transfer I	Efficiency:	67.64%	At Fu	sel Ratio (Al	n s	2.00	0.8			To	tal Input (kJ):	44.992	42.672 (Bt)	a)		nitial Dry We	eight Wt _{ex} (kg)	2.25			CA	50																							
Test Duration:	180	min			aj. (oj. (cj. (nj. estractiva vado	(U), (W), (I), am ables in Claus	es 13.7.3 to	13.7.5												Tota		30.282	28.721 (Bb)	ú		Moisture	re Content Dry	4.70			HY:	6.6																							
		HHN	V LHV	/	,				_ +	feat Output:	9.575	that	10.094 k	10h							Efficiency:	67.30%									COX:	42.9																							
	Eff								_	Heat Input:	14.226	thath	14.997 k	10h							Fotal CO (a):	24.01																																	
	Comb							rute CO ₂																																															
	HTD	E7.64	72.86	86			00 _{2m8}	19.80	Bu	m Duration:	3.00	h																																											
	Outpo	£ 10,00		1				Fo.																d Weight (kg)																															
	Burn R	ate 0.75		1				1.037		Burn Rate:	1.66	bh	0.754 ks	ah									Fue	(Heating	HHV	LHV		HHV	LHV																										
	Grams																						Vali	ae in kälko - C	OV: 19.887	18.464	Bluft	b 8555.6 T	943.4																										
	Inpu			1						Stack Temp:	193.1	Deg. F	89.5 D	Deg. C																																									
	MCw																																											SUMS				AVERAGE				SUMS			
	Averac	es 0.01	1 1.96			20.83 ·	8.86	90.97	20.58	102.2%	Meat	71.2%	63.42		49.89 1 6 Wet Dr		49.89 4 % Dry	321 4.	17 6.60	2.68 el Properties	19887.00	4.49 Nw	79.17 2	Mana B			0.05 ke Wood pe		15.00 0.3	36 -0.61	1738.04	34.38 2	2.61 364 Stu		751.58	2093.86	2041.80 20 e - Ambient t	017.98 2590	8.25 2445.1	4 293.73 Boom	2202.73	16349.59	1935.18	66058.36	-10318.81	30320.43		5728.98 Total	13440.33	-1044.85	14485.2	32880	1044.9	9 24.0	-23.1
Elegand	Weigi			-		Total C		Ehre.	Boom	Combust	mean	Net	Air W	wet wit 17	wet De	y wt.	s ury		, ru	er Osymen		Moisture			aunce a dev flue es		100 mole d			er ke of Dry		1.00	pisture Ter	BCK	neat Co		Gas Constit		perature	Temp				e Gas Corat				Loss	Total	Chemical	Sensible and	nd Tota	tal Chem		a Produced
Time	Welci		e1 CO, 1		ir FA	O C	BC. 76	PROFES T	Room (CC)	E	Frantater	EH.	Petio	NOW COS	naumeo A	NOW CO	maumed	otal Car	DON HVOTOG	er Uzvosn	Calerine	MOCREUM	(mc	ees/100 mos	e cry tue ga	(1)	100 mole di	- 00	Moies p	ser ag or ury			nannt b	mo .	00	0	GES CONSUI	N. C	H. H-O	Iemo	co	0		ie Gas Corat	CH	H-O Comb H	O Free I MC	Date	Loss	Loss 1	Latert Loss				HC HC
lime	Remainin	g (High CO)	ej coj j	- A	IP EA	01 0	-2 EMB			76	74	76	RESO	wt			y 1	iput nz	ial viele	1 1164 [C]	Value	Fuel Burns	[n]	ol (w)	- 111	[K]	PER.	1001	03 00	O NC	10000000	MO MA	esent P		001	0,	CO	H) U	ng ngo	R.				740	conq	ngo como n		5390.83	LOSS	LOSS 1	0.00	, outp	AUT LOSS /	0.00	0.00
	23/	0.00	0 250	36	02.2%	20.77	17.76	117.6	20.6	101.6%	71.0%	72.37%	40.9	2.37	0.00 2	220	0.00	0 4.	0.00	2.00	19667.00	4.49	79.23 21	.02 0.71	2.40	-0.03	0.07	42.20 2	51.35 0.0	0.40	*******	33.97 2	2.61 390	176 36.	30.59	2896.50	2022.43 27	90.34 3653	3.15 33/6./.	2 293.72	101.94	728.54	0.00	3125.73	-307.21	1000.17		6497.16	1247.80		1347.00	2572	77 .99	1.83	-2.11
20	2.10	0.00	0 200	10.	80.4%	20.89	8.81	95.5	20.2	102.0%	60.0%	70 9%	50.5	210 1	11.42 2	2.00	11.42	511 4	7 6.60	2.68	19887.00	4.49	79.15 21	00 0.48	1.64	-0.03	0.04	42.46 3	55.67 0.0	4 -0.62	******	34.41 2	2.61 366	62 29	M5 74	2220.59	21/2./4 21	158 44 2785	2001.0	293.89	125.07	886.26	11.63	3595.76	-514.50	1603.07		5785.95	750 70	-30	831.11	1851		0.15	-131
30	1.96	0.00	2 1.90	92	34.4%	20.83	8.92	94.1	20.6	102.2%	68.2%	69.7%	64.1	1.95 1	17.16 1	1.87	17.16	527 4.	7 6.60	2.68	19887.00	4.49	79.16 21	.00 0.45	1.55	-0.03	0.05	42.12 4	20.03 0.3	7 -0.61	ARVARAV	34.39 2	2.61 367	29 28	78.75	2189.46	2134.74 21	109.89 2720	0.87 2556.3	5 293.71	121.24	919.65	105.48	3707.18	-548.27	1600.19	121.51	6027.98	796.21	-58	854.45	1831		1.38	-1.30
40	1.82	0.00	3 1.73	10.	22.7%	20.84	2.09	85.8	20.3	101.7%	68.9%	70.1%	69.6	1.82 2	23.10 1	1.74	23.10 2	500 4.	7 6.60	2.68	19887.00	4.49	79.15 20	99 0.42	1.43	-0.03	0.04	41.73 4	59.96 0.7	7 -0.62	ATTOREY	34.41 2	2.61 358	91 255	51.71	1944.40	1896.70 18	74.44 2400	3.73 2271.5	5 293.48	106.47	894.39	219.43	3574.45	-553.75	1590.98	120.77	5952.75	775.27	-44	815.50	1811	15 -44	2.81	-1.29
50	1.69	0.00	2 1.68			20.84	12.15	87.3	20.9	102.4%	67.9%	69.5%	72.3	1.09 2	18.68	1.61	28.68 2	175 4.	7 6.60	2.68	19887.00	4.49	79.15 20	199 0.40	1.38	-0.03	0.04	42.06 4	79.73 0.5	0.69	ARVANAV	34.55 2	2.61 360	40 25	588.21	1971.30	1922.72 19	000.20 2440	0.10 2302.6	5 294.09	108.87	945.69	143.65	3767.01	-616.01	1598.51		6068.56	663.70	-52	715.28	1511		1.54	-1.21
60	1.59	0.03	3 1.65	10	182.4%	20.84	12.18	85.8	20.6	102.1%	67.5%	68.9%	73.4	1.59 2	2.77 1	1.52	32.77 2	170 4.	7 6.60	2.68	19887.00	4.49	79.14 20	199 0.40	1.36	-0.03	0.04	41.90 4	87.41 0.6	55 -0.68	ARVANAV	34.53 2	2.61 359	199 258	883.31	1967.89	1919.46 18	196.96 2434	8.80 2298.8	293.78	108.24	959.16	187.55	3814.82	-607.09	1597.45	120.84	6180.98	674.36	-46	720.09	1495	.6 -46	2.01	-1.19
70	1.46	0.00	0 2.11	83	38.5%	20.82	8.71	90.3	20.4	102.6%	71.6%	73.4%	58.2	1.46 2	8.32 1	1.40	38.32	543 4.	7 6.60	2.68	19887.00	4.49	79.18 21	.00 0.50	1.71	-0.03	0.05	42.43 3	76.58 0.0	4 -0.50	ARVANEE	34.35 2	2.61 363	42 27	30.46	2078.52	2027.02 20	103.33 2576	5.68 2427.5	293.53	115.86	782.73	10.84	3192.70	-529.64	1593.83	121.18	5287.50	676.06	-66	742.20	1867	67 -65	0.14	-1.21
80	1.32	0.00	0 2.08	84	49.5%	20.82	8.74	90.4	20.4	102.5%	71.3%	73.0%	58.8	1.32 4	14.07 1	27	44.07	574 4.	7 6.60	2.68	19887.00	4.49	79.18 21	.00 0.49	1.62	-0.03	0.05	42.37 3	81.53 0.9	0 -0.50	ANYONNY	34.35 2	2.61 363	59 27	735.44	2082.22	2030.61 20	06.89 2581	1.59 2431.7	9 293.57	115.89	794.44	28.66	3235.60	-528.63	1593.87		5361.01	693.95	-65	758.50 680.67	1880		0.36	-1.23
90	1.19	0.00	0 256	67	73.3%	20.79	8.23	92.1	20.5	102.1%	74.6%	76.2%	47.8	1.19 4	9.77	.14	49.77	527 4.	7 6.60	2.68	19887.00	4.49	79.21 21	.01 0.61	2.06	-0.03	0.05	42.36 3	01.55 0.0	0 -0.48	ARTONAN	34.12 2	2.61 365	21 27	97.46	2128.63	2075.67 20	151.46 2641	1.87 2485.0	293.66	118.49	641.90	0.00	2687.55	-428.07	1585.26		6145.40	824.30	-56	850.67	2000			-1.01
100	0.00	0.00	3 1.79	90		20.89	203	91.3	20.6	101.9%	D7.0%	76 76	67.5	0.03 6	10.74	1.00	00.74	100 4	7 6.60	2.66	19887.00	4.49	79.10 21	.00 0.43	1.47	-0.03	0.04	41.07 4	44.50 0.6	0.60	*******	34.40 2	2.01 304	045 276	D4.03	2104.13	2001.07 20	127.52 2010 187.86 2422	1.54 2407.2	1 293.71	110.77	335.46	177.00	3749.93	-001.10	1097.09		4927.08	647.99	-49	715.29	1790		-0.30	
170	0.70	0.00	1 100	0.0	no est	20.02	0.00	86.7	20.0	102.074	71.69	73.16	62.0	0.72 6	77.30 0	774	07.30	180 4	7 6.60	2.00	10007.00	4.40	70.17 21	00 0.57	1.00	0.03	0.05	42.33 3	01.57 0.3	0.60	********	34.37 2	2.01 300	41 25	W 7 71	1000.40	1910.24 10	TE 43 3400	. 63 2227.T	200.10	107.70	717.30	95.00	2150.69	536.64	1000.20		5341.93	585.64	40	634.84	1106		0.93	-1.05
130	0.50	0.00	1 160	10	M7 8%	20.84	19.13	85.9	20.8	101.8%	68 5%	89.8%	712	0.69 7	m 99 0	166	70 99 3	150 4	7 5.50	2.68	19887.00	4.49	79 14 20	99 0.41	1.60	-0.03	0.04	4175 4	71.45 0.7	7 -0.64	ARROSAN	34.44 2	2.61 359	03 25	338.54	1934 12	1886 61 18	164 AT 2301	87 2259.4	5 293.95	105.98	911.85	215.00	3536.30	-570.67	1502.32		6014 62	653.03	-38	691.31	1506		2.33	-1.11
140	0.55	0.00	0 1.99	85	93.8%	20.83	8.84	85.5	20.8	102.6%	72.0%	73.9%	61.6	0.55 7	16.88 0	1.52	76.88	564 4.	7 6.60	2.68	19887.00	4.49	79.17 21	.00 0.47	1.61	-0.03	0.05	42.39 4	01.74 0.1	1 -0.62	******	34.41 2	2.61 358	68 25	25.50	1924.34	1877.11 18	55.08 2379	2248.1	293.93	107.07	773.08	30.08	3132.57	-556.54	1599.47	120.71	5197.42	670.03	-68	737.73	1894	94 -65	0.38	-1.29
150	0.42	0.00	2 1.97				8.84	92.5	20.7	102.1%	69.6%	71.1%	61.7	0.42 8	2.39 0	2.40	82.39	506 4.	7 6.60	2.68	19887.00	4.49	79.17 21	.00 0.47	1.61	-0.03	0.05	42.10 4	02.21 0.3	6 -0.59	ANYONNY	34.34 2	2.61 365	.66 280	107.35	2135.84	2082.63 20	58.35 2651	1.90 2494.0	293.87	118.20	859.06	103.04	3477.96	-524.47	1595.57		5750.70	753.51	-55	808.62	1852		1.33	
160 170	0.27		1 1.86					85.8	20.1	102.6%	70.4%	72.2%	65.7	0.27 8	88.46 0			532 4.	7 6.60	2.68	19887.00	4.49	79.15 21	.00 0.44	1.52	-0.03	0.04	42.28 4	31.31 0.2	5 -0.65	ARVANAV	34.47 2	2.61 358		58.96	1950.00	1902.18 18	79.85 2410	0.38 2278.1	5 293.30	108.19	841.05	70.37	3383.86	-580.34	1593.95		5537.89	732.94	-67	800.29	1899	99 -67		-1.38
170	0.14							91.4	20.6	101.7%	66.4%	67.5%			94.09 0	0.13	94.09	124 4.	7 6.60	2.68	19887.00	4.49	79.14 20	199 0.41	1.39	-0.03	0.04	41.73 4	73.53 0.7	8 -0.64	ARVANAV	34.45 2	2.61 354		167.03	2105.78	2053.46 20	129.49 2512	2.48 2459.1	2 293.71	115.47	997.15	223.45	3974.07	-571.34	1599.25		6459.34	1274.65	-60	1343.29	2650			
180	0.00	0.04	4 1.60	10	45.1%	20.84	2.13	87.7	20.6	101.6%	67.8%	68.8%	71.0	0.00 1	00.00	0.00	100.00	329 4.	7 6.60	2.68	19887.00	4.49	79.14 20	99 0.41	1.40	-0.03	0.04	41.64 4	70.56 0.8	5 -0.62	ARVANAV	34.41 2	2.61 360	86 26	20.28	1995.69	1946.50 19	23.70 2470	2.44 2331.1	5 293.73	109.10	939.10	245.76	3744.85	-556.94	1593.36	120.92	6195.15	414.12	-21	434.93	915	3 -21	1.61	-0.67



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 Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

Manufacturer:	Ardisam	Technicians:	KS
Model:	Serenity		
Date:	12/07/15		
Run:	1	_	
Control #	G102366578		

Control #: G102366578
Test Duration: 180
Output Category: Low Burn Rate

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:		12/14/2009					
Manufacturer:			Applia	nce Type:	Pellet	(Cat, Non	-Cat, Pellet)
	Serenity						
Date:	12/7/2015			emp. Units	F	(F or C)	Default
Run:	•		We	ight Units	lb	(kg or lb)	
	G102366578						HHV (kJ/kg)
Test Duration:							%C
Output Category:	Low Burn Rate			Fuel	Data		%H
					Marth		%O
	Moisture (% wet):	4.49		HHV	,	kJ/kg	%Ash
Loa	d Weight (Ib wet):	5.22		%C	46.87		
Bui	rn Rate (dry kg/h):	0.75		%Н	6.41		
Total Parti	culate Emissions:	6.71)	%O	46.62		<u> </u>
				%Ash	0.1		f
							S
	Averages	0.01	1.96	18.58	195.75	69.05	
					-	o. (°F)	1
Elapsed	Fuel Weight		s Composit		Flue	Room	F
Time (min)	Remaining (lb)	CO	CO ₂	O_2	Gas	Temp	i i
	(,		2	• 2	Ous	Tomp	
0	5.22	0.00	2.99	17.49	243.7	69.0	c
0 10	5.22 4.93	0.00	2.99 1.74	17.49 18.82	243.7 203.8	69.0 69.0	C V
0 10 20	5.22 4.93 4.62	0.00 0.01 0.00	2.99 1.74 2.02	17.49 18.82 18.52	243.7 203.8 203.9	69.0 69.0 68.4	c
0 10 20 30	5.22 4.93 4.62 4.32	0.00 0.01 0.00 0.02	2.99 1.74 2.02 1.90	17.49 18.82 18.52 18.67	243.7 203.8 203.9 201.4	69.0 69.0 68.4 69.0	C V
0 10 20 30 40	5.22 4.93 4.62 4.32 4.01	0.00 0.01 0.00 0.02 0.03	2.99 1.74 2.02 1.90 1.73	17.49 18.82 18.52 18.67 18.82	243.7 203.8 203.9 201.4 186.4	69.0 69.0 68.4 69.0 68.6	C V
0 10 20 30 40	5.22 4.93 4.62 4.32 4.01 3.72	0.00 0.01 0.00 0.02 0.03 0.02	2.99 1.74 2.02 1.90 1.73 1.68	17.49 18.82 18.52 18.67 18.82 18.87	243.7 203.8 203.9 201.4 186.4 189.1	69.0 69.0 68.4 69.0 68.6 69.7	C V
0 10 20 30 40 50	5.22 4.93 4.62 4.32 4.01 3.72 3.51	0.00 0.01 0.00 0.02 0.03 0.02 0.03	2.99 1.74 2.02 1.90 1.73 1.68 1.65	17.49 18.82 18.52 18.67 18.82 18.87 18.91	243.7 203.8 203.9 201.4 186.4 189.1 188.3	69.0 69.0 68.4 69.0 68.6 69.7 69.1	C V
0 10 20 30 40 50 60	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7	C V
0 10 20 30 40 50 60 70	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8	C V
0 10 20 30 40 50 60 70 80	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9	C V
0 10 20 30 40 50 60 70 80 90	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9	C V
0 10 20 30 40 50 60 70 80 90	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.03	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8	C V
0 10 20 30 40 50 60 70 80 90 100 110	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.03	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4 187.3	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8	C V
0 10 20 30 40 50 60 70 80 90 100 110 120	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.00 0.01 0.03	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 197.7 196.3 188.4 187.3	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4	C V
0 10 20 30 40 50 60 70 80 90 100 110 120 130	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00 0.00 0.01 0.03 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 197.7 196.3 188.4 187.3 186.6	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4 69.4	C V
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51 1.21	0.00 0.01 0.00 0.02 0.03 0.02 0.03 0.00 0.00 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99 1.97	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88 18.55	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4 187.3 186.6 186.0	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4 69.4	C V
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51 1.21 0.92	0.00 0.01 0.00 0.02 0.03 0.00 0.00 0.00 0.00 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99 1.97 1.86	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88 18.55 18.57	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4 187.3 186.6 186.0 198.5	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4 69.4 69.4 69.3 68.3	C V
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140	5.22 4.93 4.62 4.32 4.01 3.72 3.51 3.22 2.92 2.62 2.31 2.02 1.71 1.51 1.21 0.92 0.60	0.00 0.01 0.00 0.02 0.03 0.00 0.00 0.00 0.00 0.00	2.99 1.74 2.02 1.90 1.73 1.68 1.65 2.11 2.08 2.56 1.79 2.16 1.96 1.99 1.97	17.49 18.82 18.52 18.67 18.82 18.87 18.91 18.40 18.45 17.95 18.76 18.36 18.57 18.88 18.55	243.7 203.8 203.9 201.4 186.4 189.1 188.3 194.5 194.8 197.7 196.3 188.4 187.3 186.6 186.0	69.0 69.0 68.4 69.0 68.6 69.7 69.1 68.7 68.8 68.9 69.0 69.8 69.4 69.4 69.4 69.3 68.3	C V

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

Oak

19,887

50 6.6

42.9

0.5

Default Fuel Values D. Fir

19,810

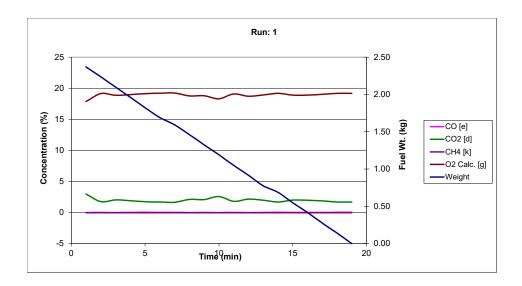
48.73

6.87

43.9 0.5

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 occurence and the next reading showing a decrease in weight.

Manufacturer:	Ardisam																																																		
Model:	Serenity											Air Fue	(Ratio (AF)														Moisture	Content M _{Cab} :	4.49																						
Date:	12/07/15								eating Efficie		.68% Dry			29.07																																					
Run:	1			Note: In th	e "Input data", "I	alc. % O ₂ *, *	Fuel	Comb	uation Efficie	ncy: 99	150% Dry	Moles Estrau	at Gas (N.):	2150.45	SHC			Combus	tion Efficiency.	99.50%			Moisture	of Wood (wet	thusis): 4.4	9		Dry kg:	2.26																						
Control #:	G102366578			Properties	, and 'Mass Ba	ance" column	n, [e], [d], [g],	Heat To	anafer Efficie	nov: 68	102%	Air Fuel Ratio	(A/F)	62.00	0.8				otal Input (kJ):	42.910	40,096 (5t)	0	Initial	Dry Weight W	L (kg): 2.26			CA:	45.87																						
Test Duration: 1	90	min		[a]. [b], [c],	(h), (u), (w), (i), a variables in Cla	and [k] refer to	their	1		,								To	tel Output (kJ):	29.042	27.545 (Bt)	i .		Moisture Contr	ent Dry 4.7			HY:	6.41																						
		HHV	LHV	respective	THE LABORATOR CO.	2002 137.30	2133.3	Heat C	Output: 9	183 Blub	2.5	681 kJh							Efficiency	67.68%								COX:	45.62																						
	Eff	67.68%	73,00%					Heat	hout: 13	568 Blub	14.2	303 kJh							Total CO (g):	22.40																															
	Comb Eff	99,50%	99,50%			Utte	rate CO-																																												
	HTER	68.02%	73.37%			CO _{2ut} :	20.36	Burn Du	ration 7	100	h																																								
	Output	2,531	kāh				E.															d Weight (kg):	2.37																												
	Burn Rate	0.75	knh				1.008	B.com	Rate: 1	66	bh or	as bed										Heating		LHV	NA.	/ LHV																									
	Grams CO	22					1,000	Dun	PLANE.		DII 0.7.	J- Ram									Ven	e in kilke - C	/: 18.967 1	7.585	Stuffb 8155	8 7565.2																									
	Input	14,303	kāh					Stack 1	Temp: 15	3.1 Deg.F	89	9.5 Dec. C									-																														
	MC wet	4.42																																						SUMS				AVERAGE			5	SUMS			
	Averages	0.01	1.96	9.52	20.88	18.92 1	0.97 2	0.58 102	1% 70.	0% 71.4	N 59.1	14 1.19	49.89	1.13	49.89	44178	3.91 6.	41 2.91	18967.00	4.49	79.11 21	28 0.50	1.65	0.03 0	1.05 39.3	1 388.41	0.33 -0.	55 1620.72	33.18 2.6	364.12	2751.58		6 2041.80	2017.98 2	598.25 2445	14 293.73	2055.53	15302.86	1805.80	61538.95	-9289.39	29257.72	2303.20	5422.88	12721.53	-932.54	13654.1	31456	156.4 -932.5	5 22.4	-20.8
	INPUT DATA			Охуд	on Calculation		Input Data	Com	bust Me	at Ne	t Air	r Wet Wt	% Wet	Dry Wt.	% Dry			Fuel Properties		Mw		Mass Ba	lance	kg W	ood per					Stack	H		Change - Ambi		mperature	Room			Energy Lo	sses (kJ/kg c	Dry Fuel)			Total							
Elegand	Weight	%	%	Excess	Total 6	atc. %	Flue R	loom E	of Tran	afer Ef	f Fue	el Now	Consumed	Now	Comsumed	Total C	Carbon Hydr	rozer Oxyge	1 Calorific	Moisture	(mo	les/100 mole	dry flue gas)	100 m	note dfa	Mok	s per kg of D	ry Wood	Mois	are Temp			Flue Gas Co	atituent		Temp			Flu	Gas Constit	ent			Loss	Total	Chemical	Sensible and	nd Tota	otal Chem		ms Produces
Time 5	emaining (kg)	CO [e]	CO ₂ [d]	Air EA	0,	O ₂ [q]	es (°C) Ten	mp (°C)	K 1	4 %	Rati	io Wt	×	Wt _{de}	y	Input P	12- [a] /1-	[b] /16= [c	Value	Fuel Burnt	[h] [u] [w]	01	[k] 1	Nk CO	0,	CO H	IC N ₂	H ₂ O Pres	int K	CO ₂	0,	co	N ₂	CH ₄ H ₂ C	K	co,	0,	co	N ₂	CH4	H ₂ O Comb	H ₀ O Fuel MC	Rate	Loss	Loss 1	Latent Loss	a Outpo	utput Loss:	2 CO	HC
0	2.37	0.00	2.99	581.0%	20.86	17.87	17.6	20.6 101	7% 71.	9% 73.1	1% 38.1	1 2.37	0.00	2.26	0.00	0	3.91 6.4	41 2.91	18967.00	4.49	79.14 20	99 0.76	2.49	0.03 0	05 39.4	6 235.75	0.00 -0.3	36 ARVANAV	32.80 2.6	390.78	3830.59	2898.50	2822.43	2790.34 3	653.15 3378.	2 293.72	151.15	683.32	0.00	2914.18	-322.17	1553.15	123.66	5103.28	0.00		0.00	0	3 0	0.00	
10	2.24	0.01	1.74	1051.8%	20.89	12.14	95.4	20.5 102	4% 66.	0% 67.6	2% 65.4	4 2.24	5.56	2.14	5.56	3643	3.91 6.4	41 2.91	18967.00	4.49	79.10 20	98 0.44	1.47	0.03 0	04 39.4	0 433.78	0.32 -0.6	52 ARVANAV	33.32 2.6	358.57	2931.02	2228.59	2172.74	2147.49 2	771.64 2601.	11 293.69	115.48	966.71	90.36	3848.95	-553.01	1551.77	121.63	6141.89	1179.57	-89	1268.22	246"	r63 -89	1.70	-1.90
20	2.10	0.00	2.02	908.2%	20.88	18.86	95.5	20.2 102	.6% 69.	3% 71.1	1% 56.7	7 2.10	11.42	2.00	11.42	2490	3.91 6.4	41 2.91	18967.00	4.49	79.12 20	99 0.51	1.69	0.03 0	05 39.6	2 370.38	0.04 -0.5	SS ARVANEY	33.20 2.6	358.62	2945.74	2239.93	2183.83	2158.44 2	785.26 2615.	0 293.36	116.71	829.63	10.85	3352.90	-500.96	1545.78	121.67	5477.59	719.17	-64	783.32	1771			
30	1.96	0.02	1.90	963.8%	20.89	18.98	94.1	20.6 102	.1% 68.	5% 69.5	2% 59.8	8 1.95	17.16	1.87	17.16	2505	3.91 6.4	41 2.91	18967.00	4.49	79.11 20	98 0.48	1.60	0.03 0	05 39.3	0 393.12	0.35 -0.5	55 ARVANAY	33.19 2.6	357.29	2878.75	2189.46	2134.74	2109.89 2	720.87 2556.	6 293.71	113.14	850.71	99.36	3456.97	-493.56	1544.07	121.51	5702.20	753.18	-52	805.15	1752		1.29	
40	1.82	0.03	1.73	1054.6%	20.89	19.14	85.8	20.3 101	5% 60.	2% 70.3	5% 64.5	9 1.82	23.10	1.74	23.10	2470	3.91 6.4	41 2.91	18967.00	4.49	79.09 20	98 0.45	1.48	0.02 0	04 38.9	4 430.39	0.72 -0.5	SS ARVANAV	33.20 2.6	358.91	2551.71	1944.40	1896.70	1874.44 2	403.73 2271.	8 293.48	99.35	836.85	204.76	3323.36	-498.47	1535.14	120.77	5631.77	733.46	-38	771.72	1737		2.62	-1.3
50	1.69	0.02	1.68	1098.3%	20.89	19.20	87.3	20.9 102	2% 68.	2% 69.7	1% 67.5	5 1.09	28.68	1.61	28.68	2074	3.91 6.4	41 2.91	18967.00	4.49	79.10 20	98 0.43	1.43	0.03 0	.04 39.2	5 448.79	0.47 -0.0	52 ARVANAV	33.32 2.6	350.40	2588.21	1971.30	1922.72	1900.20 2	440.10 2302	8 294.09	101.58	884.71	134.04	3512.79	-554.31	1541.95	120.85	5741.62	627.94	-46	673.84	1446			
80	1.50	0.03	1.65	1115.9%	20.89	19.23	85.8	20.6 102	1.0% 67	8% 69.2	2% 65.4	4 1.59	32.77	1.52	32.77	2069	3.91 6.4	41 2.91	18967.00	4.49	79.09 20	98 0.42	1.40	0.03 0	.04 39.1	0 455.96	0.61 -0.6	S1 ARVANAV	33.31 2.6	359.99	2583.31	1967.89	1919.46	1896.96 2	434.80 2298.	0 293.78	100.99	897.28	175.02	3557.43	-546.31	1541.00	120.84	5845.25	637.84	-40	678.32	1432		1.88	-1.0
70	1.46	0.00	2.11	865.1%	20.88	18.77	90.3	20.4 102	5% 71.	8% 73.6	5% 54.2	2 1.46	38.32	1.40	38.32	2425	3.91 6.4	41 2.91	18967.00	4.49	79.12 20	99 0.53	1.76	0.03 0	05 39.6	0 352.57	0.04 -0.5	53 ARVANAV	33.15 2.6	363.42	2730.46	2078.52	2 2027.02	2003.33 2	576.68 2427.	0 293.53	108.12	732.83	10.12	2977.05	-476.85	1538.06	121.18	5010.50	640.64 657.46	-60	700.15	1784		0.13	-1.0
80	1.32	0.00	2.08	876.4%	20.88	18.80	90.4	20.4 102	1.4% 71.	5% 73.2	2% 54.5	9 1.32	44.07	1.27	44.07	2455	3.91 6.4	41 2.91	18967.00	4.49	79.12 20	99 0.53	1.74	0.03 0	05 39.5	4 357.20	0.09 -0.5	53 ARVANAV	33.15 2.6	353.59	2735.44	2082.22	2030.61	2006.89 2	581.59 2431.	9 293.57	108.15	743.76	26.74	3017.08	-475.95	1538.11	121.19	5079.09		-58	715.45	1798	98 -58	0.34	-1.1
90	1.19	0.00	2.56	695.2%	20.87	18.31	92.1	20.5 102	1.0% 74.	8% 76.4	1% 44.6	6 1.19	49.77	1.14	49.77	2505	3.91 6.4	41 2.91	18967.00	4.49	79.13 20	99 0.65	2.13	0.03 0	05 39.5	3 282.59	0.00 -0.4	43 ARVANEY	32.95 2.6	365.21	2797.46	2128.63	2075.67	2051.46 2	541.87 2485	9 293.66	110.58	601.52	0.00	2505.87	-385.74	1530.51	121.33	4484.07 5811.72	592.28 758.43	-51	643.08	1917	.13 -51	0.00	-0.9
100	1.05	0.03	1.79	1019.6%	20.89	19.08	91.3	20.6 101	7% 68	2% 69.4	1% 62.5	9 1.05	55.74	1.00	55.74	2475	3.91 6.4	41 2.91	18967.00	4.49	79.10 20	98 0.46	1.52	0.03 0	05 39.0	7 416.02	0.58 -0.5	SS ARVANAV	33.19 2.6	354.45	2764.83	2104.13	2051.87	2027.92 2	610.34 2467.	1 293.71	108.03	875.37	165.24	3496.94	-496.17	1541.05	121.25	5811.72 4674.05	758.43	-43	801.59 675.16	1717	717 -43	2.12 -0.28	
110	0.92	0.00	2.10	044.1%	20.00	10.72	80.9	21.0 102	1.0% /3.	4% /54	176 53.1	1 0.92	61.30	0.86	61.30	24/5	2.91 6.4	41 2.91	10967.00	4.49	79.12 25	99 0.54	1.80	0.03 0	105 39.7	1 343.99	-0.06 -0.5	54 88890089	33.16 2.6	300.04	25/1.21	1900.40	1910.24	1007.00 2	423.80 2207.	4 234.10	102.11	673.70	-22.02	2744.80	-479.00	1533.00	120.61	46/4.05	554.87	-60	598.86	1525	40 -60		
120	0.78	0.01	1.96	1080.4%	20.88	18.91	86.3	20.8 102	.1% 71	8% 73.2	57.8	8 0.78	67.28	0.74	67.28	2079	3.91 6.4	41 2.91	18967.00	4.49	79.11 20	98 0.50	1.66	0.03 0	05 39.3	6 378.79	0.28 -0.5	54 ARVANAU	33.16 2.6	359.41	2583.71	1945.51	1897.68	1875.43 2	406.53 2272	3 293.95	100.50	736.94	80.14	2971.56	-482.14	1533.49	120.77	5001.27	554.87	-44	598.86	1525		0.85	-0.9
130	0.69	0.00	1.00	1000.4%	20.89	19.10	85.9	20.8 101	576 ED.	376 701	7% 55.4	4 0.69	70.99	0.00	70.52	2000	3.91 6.4	41 2.91	18967.00	4.49	79.09 25	20 0.44	1.40	0.03 0	05 30.5	6 441.00	0.71 -0.5	SC ARROSSE	33.23 2.6	359.03	2538.54	1934.12	1877.11	1866.47 2	391.67 2259.	1 200.00	98.90	733.63	203.43	3391.11	-513.64	1030.31	120.74	4925.98	635.17	-34	695.98	1810		0.35	
140	0.43	0.00	1.07	022.0%	20.00	18.00	00.0	20.7	10% ED	AN 74.5	7/4 S7/5	0.00	FO.00	0.32	97.70	2440	201 64	41 2.91	18067.00	4.49	70.11 2	0.50	1.07	0.03	05 30.5	0 378.09	0.74 0.1	53 ANNOONE	22.14 2.6	350.00	2505.50	2126.54	2092.02	2255 25 2	SEL DO 2504	220.93	110.70	904.13	20.07	2742.00	473.33	1630.78	121.25	FA47.70	713.15	-01	762.33	1772		1.34	-1.1
160	0.42	0.02	1.00	968.9%	20.80	19.02	85.8	102	450 70	en 71.2	M 87.5	3 0.37	50.39	0.40	99.00	2510	201 64	41 2.91	18067.00	4.49	70.11 2	0.50	1.00	0.03	05 30.2	5 ACC 42	0.33 0.1	TO ARROSSE	22.75 2.6	355.00	2507.30	2130.04	2,002,03	1970 86 2	410.39 2778	# 200.07	100.00	787.07	65.67	3155.41	#22.22 #22.22	1637.93	120.70	5245.41	694.23	-40	754.54	1816			
170	0.14	0.03	1.00	1085.1%				20.6 101	5% 55	7% 87.8	1% 65.5	6 014	94.09	0.13	94.09	3743	391 54	41 2.91	18967.00	4.49	79.09 20	98 0.43	1.64	0.02 0	04 38.9	4 443.03	0.73 -05	53 assesses	33.23 2.6	354.51	2757 03	2105.78	2053.46	2029.49 2	512.48 2459	2 293.71	107.75	932.92	205.54	3706.02	-514.25	1543.00	121.76	6105.23	1204.78	-60	1265.11	2538	538 -60	4.04	
				1023.1%												1268		41 2.01			79.09 20	98 0.44		0.02 0		5 440.27				350.86	2620.28		1945 50	1923 70 2		5 293.73	101.53	878.63	220.34	3492.30	-501.34	1537.41		5859.07	301.50		409.78				
180					20.89				4% 68.																																										-0.60



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 Project Manager, Energy & Utilities Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, ON L4W 5N6

Tel: 416-747-4035 Direct Fax: 416-401-6807 E-mail: tony.joseph@csa.ca

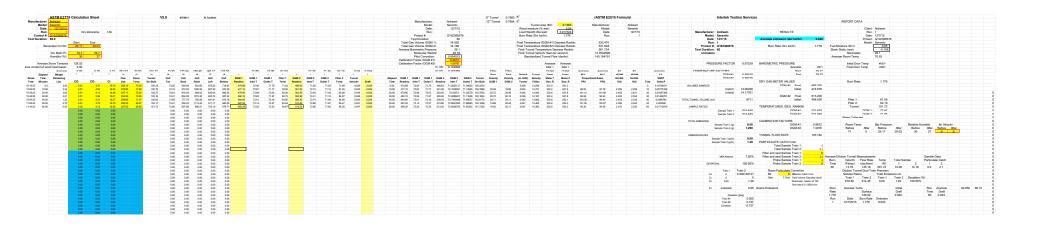
Spreadsheet created by: Rick Curkeet, PE, Intertek Testing Services, NA Inc.

	Room Tem	ηp	Bar Pressur	е	Relative Hu	midity	Air Velo	city
	Before	After	Before	After	Before	After	Before	After
	71	0	29.17	29.03	30.0	27.0	0	0
					<u> </u>			
	lution Tunnel M					Sample Da		
Burn	Velocity	Flow Rate		Total Samp		Particulate	,	
Time	(Ft/sec)	(dscf/min)	(R)	1	2	1	2	
60	13.76	145.18	561.72	14.06	14.18	0.00	2.10	
	Dilution Tunn	el Dual Train	Precision					
	Sample Rati	os	Total Emis	sions (g)				
	Train 1	Train 2	Train 1	Train 2	Deviation (%	%)		
	619.46	614.45	0.00	1.29	100.00%			
		<u> </u>						
Burn				Initial		Run	Average	
Rate		Surface		Draft		Time	Draft	
1.776		128.524		0.024		60.000	0.024	
						ļ		
Run	Date	Burn Rate	Emission			1	<u> </u>	
1	12/7/2015	1.776	0.645					

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

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

Fuel Moisture (% Wet) 0.04494



																				21.015535	21.0	0.00	0.00
Time	Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	DGM 1	DGM 1	Filter 1	DGM 2	DGM 2	Filter 2	Tunnel	CO	CO2	O2	scale	Corrected Calculat	ed		
10.0	Temp 1	Temp 2 D			Back 5	Right 6	Left 7	Bottom 8	In 17	Out 18	19	In 20	Out 21	22		%	%	%	Lbs	Scale Tunne			
0.0	292.19	70.93	100.23	73.05	605.48		879.32		72.09	71.79	71.92			71.69	1.16	0.01	4.37	16.10	24.93				
10.0	279.82	71.80	100.79	74.16	573.02				72.67	71.77	78.95				1.17	0.01	4.23	16.25	24.33				
20.0	297.17	72.22	102.37	74.61	879.24		620.04		73.08	72.03	82.26				1.18	0.01	4.13	16.36	23.64				
30.0	294.95	70.95	102.16	74.41	804.09		600.74		72.92	71.97	82.75		71.12	84.07	1.18	0.01	3.99	16.51	23.02				
40.0	299.69	71.07	102.62	73.60	777.79		841.61		73.01	72.16	83.95				1.17	0.01	4.21	16.27	22.32				
50.0	280.50	69.91	102.17	73.47	552.24		911.17		73.14	72.37	82.94			85.47	1.16	0.01	3.72	16.79	21.72				
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		15 0.0		
																				-21.02 -21.02		0.00	
																				-21.02	_	0.00	
																				-21.02		0.00	
																				-21.02	_	0.00	
																				-21.02	_	0.00	
																				-21.02		0.00	
																				-21.02		0.00	
																				-21.02		0.00	
																				-21.02		0.00	
																				-21.02		0.00	
																				-21.02		0.00	0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02 -21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00
																				-21.02			0.00



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	PITOT	
A2	0.047		0.2168	CONSTANT=	0.9545
A3	0.047		0.2168		
A4	0.035		0.1871		
B1	0.044		0.2098		
B2	0.048		0.2191		
В3	0.045		0.2121		
B4	0.039		0.1975		
AVERAGE		#DIV/0!	0.2102		

E&E PELLET FUEL DATA SHEET

Brand of pellets used:

Moisture Content: Wet: 4.49% Dry: 4.71%

Weight used during Test: 3.92 Lbs (wet) 1.78 kg (dry)

Burn Rate: 1.776088

Moisture Calculation:

0.89 Before weight of pellets - Wet
0.85 After weight of pellets - dry
Weight of moisture removed from oven

Weight added to Scale: 25.00

	Room Ten	ηp	Bar Pressur	е	Relative Hu	midity	Air Velo	city
	Before	After	Before	After	Before	After	Before	After
	71	69	29.17	29.03	30.0	27.0	0	0
Average	ilution Tunnal M	lo o o uromo o o to				Comple De	ļ	
	ilution Tunnel M					Sample Da		
Burn	Velocity	Flow Rate		Total Samp		Particulate		
Time	(Ft/sec)	(dscf/min)	(R)	1	2	1	2	
360	13.55	145.82	550.60	83.34	84.10	11.80	9.60	
	Dilution Tunn	el Dual Train	Precision					
	Sample Rati	os	Total Emis	sions (g)				
	Train 1	Train 2	Train 1	Train 2	Deviation (%	6)		
	629.93	624.20	7.43	5.99	10.73%			
	 	<u> </u>						
Burn				Initial		Run	Average	
Rate		Surface		Draft		Time	Draft	
1.099		570.204		0.024		360.000	0.021	
						ļ	ļ	
Run	Date	Burn Rate	Emission			ļ	ļļ	
1	12/7/2015	1.099	1.119			İ	<u> </u>	

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

Fuel consur	
	High
	Medium
5.22	Minimum

Fuel Moisture (% Wet)
0.04494

ASTM E2779 Ca	alculation Sh	eet			/3.0	97(2011	R. Curkeet													6" Tunnel					(ASTM E2515 F	ormula)		Int	tertek Testina S	Bervices								
Ardisam																	Manufacturer:	Ardisar		12" Tunnel	0.7854 ft ²												REPORT DATA					
Serenity																	Model:	Serenit	by .			Turnel area (\$2	21: 0.1963	M M	tanufacturer:	Ardsam												
12/7/2015																	Date:	12/7	715			moisture (% seet):	0.04		Model: Date:	Serenity								ent: Ardisam				
12/7/2015 1 G102366578	Dry kilogra	ETTE: 6.59															Run:		. 1			Veight (lbs wet):	0.04 14.53787	1	Date:	12/7/15		Manufacturer: Arc			RESULTS			ban: 1				
G102365578																	Protect #:	G1023			Burn R	tate (Drv ko/hr):	1.099		Run:			Model: Ser	renity					ote: 12/7/15				
360.0																	Test Duration:		360									Date: 12/	7/15		(refroit other molestime economic	1.112	Pro	lect: G102366578	8			
8	Start End																Gas Volume (DGM 1					mperature (DGM #			532.939			Run: 1					Mo	del: Serenity 0.05 -0.158				
meter (in.Hg):	29.17 2	2.03															Sas Volume (DGM 2	1: 84.0	62			mperature (DGM #			532.507			Project #: G1			Burn Rate (Drv kolhr):		el Moisture (Drv):	0.05				
																Average	Barometric Pressure	e: 2	9.1		Final To	unnel Temperature	e Decrees Ranki	n:	550.595			Test Duration: 360	0				ack Static (neo't	-0.158				
Dry Bulb (F):	72.7	78.7															Molecular Weigh	d: 28	178		Final To	unnel Velocity (fee	et per secondi:		13.5509518			(minutes)					Barometer:	29.1				
Humidity (%):	30	27															Pitot Correction:		515		Sta	indurdized Tunnel	i Flow (dacfm):		145.823144							A	versoe Room Temo:	69.45				
																	on Factor (DGM #1)		72																			
Stove Tempera 5																Calibrat	on Factor (DGM #2)		OTE .			Aver	race Average					PRESSUR	E FACTOR 0.	97259 B	AROMETRIC PRESSURE		Initial Door Temp	REP				
d (wet basis):																		(1) VS: 0.0177				Inle									Average:	29.1	Final Door Temp	PREFI				
Accesses	0.01	267 1785 2	28 17 RG 44	90.60	71 70	170 74 800 7	72 841 76	008 50	73	מיד כיד מחו	78 F.4	77	77 77 78		0.04 0.001			75 VR- 0.0174	WY	Filter	Filter	04		Lourana	Asserters 6	1 42	Lorens	TEMPERATURE FAC			Share	29 17						
Weight			4 4	-1	-4	46 46	-9	-4												Ewa	Ewa Rolls.0	Tropped Yes	mn Tamo	99.0	664 40		6.9			99073	Fine	20.03						
Remaining			Flue Room	Tunnel	Unit	Unit Unit	Unit	Unit D	GM 1 DGM	A1 DGM1	Fiber1	DGM 2 DG	M2 DSM2		annel	Elapsed DSM 1	DSM 1 DSM 1	DGM 2 DGM	2 DGM 2 Tunn	nel Velocity V	felocity (in H2O)	Welocity Man	mer 1 Meter 2	Preportion		Sed. Vol.Sed.	SORT		DGM#2- D									
Lbs. C	co co		Gas Temp	Dry Bulb	Too	Back Right	Left	Bottom Re	rading Inlet	T Outlet T	Temp	Reading Inte	eT Outlet T	Temp V	locity Draft	Time Reading	Inlet T Outlet T	Reading Inlet	T Outlet T Drv B	Bulb DSM 1	DGM 2 Tunnel	FtSec Dec	s.R Dec.R	PR1	PR2 n	d) (fd)	Time Delta-P			D	RY GAS METER VALUES		Burn Rate:	1.099				
			292.19 70.90	100.23	73.05	605.48 523.6	65 879.32	718.81	474.60 73	2.09 71.79	71.92	499.63	11.26 71.00	71.69	0.039 0.024	0.00 474.60	72.09 71.79	498.63 71.2635	0117 71.04025 100.2	2054	0.039	13.039 531	1.9 531.2				0 0.19738471	VOLUMES SAMPLED			DOM #1 Final	561 407						
13.94		4.23 16.25	279.82 71.80	100.79	74.16	573.02 1300.5	99 827.53	972.29	477.90 73	2.67 71.77	78.95	501.00	2.15 71.15		0.043 0.024	10.00 477.10	72.67 71.77	501.00 72.1526	0091 71.14565 100.70	7886 20.08	19.89 0.043	13.721 532	2.2 521.6	101.29		29 2,308	10 0.20775198		DGM#1: 83.		Initial	474.678						
13.24			297.17 72.22	102.37	74.01	879.24 966.0	05 620.04	963.02	479.00 73				244 71.20		0.044 0.024	2000 479.60	73.00 72.03	503.50 72.430	73 71.25579 102.3		20.96 0.044	13.943 532		103.11	103.43 2.4		20 0.21067306		DGM #2: 84.	10180								
12.63			294.95 70.90	102.16	74.41	804.09 1013.3	30 600.74	957.42		2.92 71.97		505.90	241 71.12		0.046 0.024	30.00 482.10	72.92 71.97	505.90 72.4080	227 71.11906 102.9	1004 20.72	20.12 0.046	14.197 532	2.4 521.8	101.35	97.59 2.4		30 0.21436751				DGM #2 Final:	585.180						
11.92	0.01	421 1627	299.69 71.00	102.62	73.60	777.79 706.5	58 941.61	974.70	494.60 73	3.01 72.10			274 71.66		0.043 0.024	40.00 484.60	73.01 72.16	508:30 72.7440	3948 71.46037 102.6	0172 20.71	20.11 0.043	13.692 532	2.6 532.1	105.12	101.14 2.4		40 0.2006792	TOTAL TUNNEL VOLUME (scfr		52495	Initial	495.625	Filter 1:	78.64				
11.32	0.01		290.50 69.91	102.17	72.47	552.24 1113.4	43 911.17	965.45		2.14 72.37			2.86 71.67	85.47	0.041 0.024	50.00 487.00	73.14 72.37	510.00 72.0047	1965 71.66985 102.9	19.00	2034 0.041	13.406 532	2.8 532.3	102.85	107.38 2.3	06 2.429	50 0.202582						Filter 2:	80.45				
10.62	0.00	4.13 16.36	297.05 69.00	101.73	72:80	937.99 666.5	51 750.10	979.71	489.30 73	3.26 72.33	94.97	513.20	2.66 71.60	85.26	0.047 0.024	60.00 489.30	73.26 72.33	513.20 72.6596	PS6 71.65335 101.73	7336 19.05	20.11 0.047	14.363 532	2.8 532.2	91.91	96.18 23	10 2.333	60 0.21712819	SAMPLE RATIOS			EMPERATURES (DEG. RANKIN)		Tunnet	90.60				
10.22	0.00	2.18 17.24	247.76 69.10	95.59	71.65	220.37 1105.6	81 896.00	972.62	491.80 73	290 72.21	77.76	515.60	264 7184	84.17	0.043 0.024	70.00 491.00	72.90 72.21	515.60 72.6383	1133 71.83621 96.58	883 20.71	20.11 0.043	13.650 532	2.6 532.2	104.06	100.06 2.4	69 2,332	70 0.20748772	Sa		770 00	DCM #1:	532 030	no					
9.73	0.01	2.89 17.65	244.85 69.70	94.26	72.41	208.05 1045.5	55 898.76	972.58	494.20 73	2.11 72.41	78.57	518.00	2.98 72.01	89.17	0.045 0.023	80.00 494.20	73.11 72.41	518.00 72.9766	072 72.0/057 94.20	9201 19.00 19.00	20.10 0.045	13.897 532	2.8 532.5	97.82	97.95 2.3	06 2331	80 0.21149611	Sa	ample Train 2 KC	24 200	DCM 42	532 507	no	M 2- 72.51				
9.22	0.00	281 17.71	252.14 69.20	93.39	70.66	529.52 624.0	08 674.54	992.36	496.60 73	292 72.48	79.12	520.40	261 7171	82.43	0.045 0.023	90.00 496.60	72.92 72.48	520.40 72.6115	0006 71.70525 99.38	8506 19.88	20.11 0.045	13.870 532	2.7 532.2	97.87	99.11 23	06 2,333	90 0.21126545						Water Collected:					
8.82	0.00	241 17.07	228.62 69.42	92.79	72.41	270.03 1169.5	94 564.36	946.34	499.00 73	293 72.59	79.19	522.90	2.80 72.09	82.33	0.044 0.023	100.00 499.00	72.90 72.59	522.80 72.8002	014 72.08514 92.78	19.00	20.10 0.044	13.697 532	2.8 532.4	99.05	99.21 23	06 2331	100 0.20858655	TOTAL EMISSIONS		C	ALIBRATION FACTORS							
831	-0.01	3.10 17.34	249.96 69.71	92.88	72.68	200.09 626.1	12 745.00	962.65		3.04 72.62	79.36	525.20	2.66 72.11	82.16	0.038 0.023	110.00 501.40	73.04 72.62	525.20 72.660	202 72.10545 92.88	8121 19.00	20.10 0.038	12.798 532	2.8 532.4	105.92		06 2.332	110 0.19501557		sia Train 1 (g):	7.43	DGM #1:	0.9972	Room Temp	Bar Pressure		elative Humidity	Air Velocity	
7.92	-0.01	3.18 17.32	243.12 69.73	92.75	7121	166.78 1667.4	42 850.19	942.57		3.08 72.81	79.45	527.60	2.67 72.26	81.50	0.043 0.023	120.00 503.80	73.08 72.81	527.60 72.8726	027 72.27722 92.74	478 19.97	20.09 0.043	13.544 532	2.9 532.6	100.02	100.20 2.3	05 2.331	120 0.2064052	Sampl	sia Train 2 (g):	5.99	DGM #2:	1.0076	Before Ab			Before After		
7.42	0.00	2.44 17.05	229.24 68.86	92.71	72.03	169.08 1190.2	23 769.28	920.99	506.20 73		79.50	530.00	2.50 72.00	82.05	0.044 0.023	130.00 506.20	72.75 72.57	530.00 72.5049	0057 72.00428 92.7%	1038 19.88	20.11 0.044	13.765 532	2.7 532.3	98.37	98.56 2.3	06 2.332	130 0.21009631						71 69	29.17	29.03	30 27	0 0	
7.02	0.01		245.45 60.50	92.87	71.27	264.31 935.0	02 474.71	935.99		2.07 72.85			2.88 72.20		0.046 0.023	140.00 508.60	73.07 72.65	532.40 72.8753	518 72.24667 92.87	7184 19.97	20.09 0.046	14.117 533	1.0 532.6	95.98	96.16 2.3		140 0.21511844	EMSSIONRATES		T	JINNEL FLOW RATE:	145.823						
6.51	0.00	2.82 17.69		92.60	71.15	217.28 727.1	11 839.35	994.70	\$11.00 73		79.70	534.90	2.82 72.33		0.040 0.023	150.00 511.00	73.09 72.76	534.80 72.8242	722 72.32507 92.59	19.97	20.09 0.040	13.064 532	2.9 532.6	103.67		05 2.331	150 0.19912965			1.24								
6.13		242 1812		91.98	71.28	258.34 1012.0	01 484.14			3.20 72.80			3.12 72.36		0.046 0.023	160.00 513.40	73.28 72.86	537.20 73.1241	1074 72.3636 91.96	19.97	20.09 0.046	14.121 533	3.1 532.8	95.75	95.91 23		160 0.21535217	Sample 1	Train 2 (g/hr):	1.00 P	ARTICULATE CATCH (mg)							
5.63		2.11 17.38		92.33	71.20	200.04 949.3	25 466.54		\$15.80 73	3.18 72.77	79.05	539.60	2.83 72.15		0.042 0.023	170.00 515.00	73.18 72.77	539.60 72.8347	1321 72.14927 92.33	1997	20.10 0.042	13.436 533	1.0 532.5	100.74	100.96 2.3		170 0.20494133				Total Sample Train 1:	11.8						
5.22	-0.01	299 17.49	243.74 69.00	92.47	71.62	294.46 873.3	27 468.15	901.06	\$18.20	3.25 72.77	80.12	542.00	2.89 72.41	81.94	0039 0023	180.00 518.20	73.25 72.77	542:00 72:8866	024 72.41299 92.49	19.97	20.09 0.039	13.027 530	1.0 532.6	103.91	104.10 2.3	GS 2,330	180 0.1965779				Total Sample Train 2:	9.6						
4.92	0.01	174 1892	203.76 68.96	97.41	69.98	201.07 1185.5	55 597.84	897.08	520.60 73	3.27 72.86	79.18	544.40	2.86 72.23	80.58	0.043 0.021	190.00 520.60	73.27 72.65	544.40 72.8636	956 72,22783 87.49	1035 19.97	2009 0.043	13.474 530	0.1 532.5	99.53	99.76 2.3	05 2,331	190 0.2963387				Filter and seal Sample Train 1:	11.8						
4.62	0.00	202 1852		85.77	69.97	267.24 564.6	61 650.92	932.04	523.00 73		78.50	545.90	279 7240		0.044 0.020	200.00 523.00	72.96 72.81	546.00 72.7001	1241 72.45261 85.775	7277 19.97	20.09 0.044	13.723 532	2.9 532.6	97.42	97.56 2.3		200 0.21062241		MAX Allowed	7.50%	Filter and seal Sample Train 2:		e Dilution Tunnel Measure			Sample		
432	0.02	190 1867		85.66	71.04	211.77 695.3	26 803.20	912.25	525.40 73		79.29	549.20	278 7247	79.52	0.041 0.020	210.00 525.40	73.16 73.03	549:20 72.7815	MS7 72.47009 MS.66		20.09 0.041	13.158 533	3.1 532.6	101.58		05 2.331	210 0.20182834				Probe Sample Train 1:	0 Bu			Total Sample			
4.01	0.00	173 1882		84.59	70.78	198.61 1171.6	89 576.97	879.96	527.80 73			551.60	2.86 72.54		0.043 0.020	220.00 527.80	73.22 72.93	551.60 72.8591	1156 72.54003 84.58		20.09 0.043	13.570 530	3.1 532.7	99.31	98.49 2.3		220 0.20834531	DEVATION		10.73%	Probe Sample Train 2:	O Tin	ne (Filmec) (dact)	min) (Rt)		2 1		
372	0.02	1.69 18.97		85.27	71.57	151.53 1154.0	02 690.67	870.12		3.15 73.26	77.64	554.00	13.15 72.76		0044 0019	230.00 530.20	73.15 73.26	554.00 73.1667	N38 72.79009 85.20	0514 19.00	20.08 0.044	13.600 533	12 533.0	98.16		04 2.329	230 0.20868155					36	13.55 145.	82 550.60	83.34	84.10 11.8	9.6	
351	0.00	1.65 18.91		94.77	71.35	249.04 1059.6	61 475.95	879.13	532.60 73	3.26 73.16	77.64	550.40	13.02 72.56		0040 0019	260.00 532.60	73.26 73.16	556.40 73.0197	749 72.58891 84.77	7388 19.86	20.08 0.040	13.054 530	1.2 532.8	102.18		04 2.330	240 0.20038852		Train 1 Train 2		Room Particulate Correction		Dilution Tunnel Dua	Train Precision				
3.22	0.00	2.11 18.40		93.88	7092	215.20 583.1	15 515.30	896.25	\$35.00 73	2.01 72.09	77.08	559.90	2.81 72.66	79.33	0040 0019	250.00 535.00	73.01 73.09	558.00 72.0001	523 72.65682 83.879	7697 19.97	20.09 0.040	12 966 530	1.0 532.7	102.76		GS 2.330	250 0.19921381		0.000141585 0.000	114147	Mr O Miligram Cato		Sample Ratios	Total Emiss				
292	0.00	200 1845		94.04	7196	277.05 554.5	56 581.10	901.65		3.52 73.20	77.15	561.20	2.06 72.84		0019	260.00 537.40	73.52 73.28	561.20 73.0556	243 72.83565 84.03		20.08 0.044	13.591 530	3.4 532.9	98.00	99.21 2.3		260 0.20963041	Cr			Viter 46.5364 Total Volume		Train 1 Trail	12 Train 1	Train 2 De	eviation (%)		
2.62	-0.01	2.56 17.95		94.29	71.03	206.96 556.9	96 540.99	900.51	539.80		76.79	563.60	2.79 72.56	79.35	0042 0019	270.00 539.00	73.33 73.15	563.60 72.7922	058 72.58571 84.29	19.00	20.09 0.042	13.202 533	12 532.7	100.32		04 2.330	270 0.20399391		7.43	5.99	Rotometer (s		629.93 624	20 7.43	5.99 1	10.73%		
231	0.00	129 1876		84.11	71.66	228.82 571.4	40 682.36	892.31		2.08 72.18	7691	566.00	2.04 72.00	78.11	0040 0019	290.00 542.30	73.00 73.10	566.00 73.0426	22.8664 84.10	0534 20.69	20.08 0.040	13.095 530	3.1 533.0	106.00	101.87 2.4		290 0.20114758				flow rate is 0.							
2.02	0.00	2.16 18.36		85.12	72.42	199.80 1114.9	99 467.33	858.90	544.60 73	3.09 72.99	76.06	568.40	2.01 72.63	78.11	0042 0019	290.00 544.60	73.09 72.93	568.40 73.0072	2174 72.60142 85.11	152 19.04	20.08 0.042	13.399 533	3.0 532.8	96.53	99.79 23		290 0.20562945		AVERAGE	6.71 Gran	ris Emissions	Bu			hitial	Run	Average	62.852
171	0.01	196 1857		83.90	71.17	147.49 1137.6	89 667.90	844.86	547.00 73	3.13 73.22	76.98	570.80	2.94 72.62	78.14	0043 0019	300.00 547.00	73.13 73.22	570.00 72.9079	662 72.61784 83.89	19.00	20.09 0.043	13.551 530	3.2 532.8	90.20		04 2.330	300 0.2001917					Ra	te Surfi	908	Draft	Time	Draft	
1.51	0.00	1.00 10.00		83.99	71.16	235.64 926.9	91 291.66	862.57	549.40 73		76.69	573.20	2.77 72.76		0049 0019	310.00 549.40	73.18 73.17	573.20 72.7749	9039 72.75858 83.93		20.09 0.049	14.435 533	3.2 532.8	92.27	92.45 2.3		310 0.22176726		Deviation (g/kg)			1.0	9 570.	20	0.024	360	0.021	
121	0.00	199 1855		83.79	7161	145.99 948.0	07 769.41	860.25		2.02 72.10	76.60	575.60	2.77 72.94		0038 0019	22000 551.80	73.03 73.10	575.60 72.7743	1078 72.90542 83.775		20.08 0.038	12:095 530	3.1 532.9	104.93	105.06 2.3		220 0.19506248			1.128		Pa Pa		tate Emission				
0.92	0.02	197 1857		94.19	7094	299.31 \$10.6	85 522.52	995-00		3.26 73.55	7647	579.00	2.91 72.80	79.04	0043 0019	230.00 554.20	73.26 73.55	578.00 72.9136	1718 72.86172 84.175		20.08 0.043	13.471 533	2.4 532.9	98.83		GS 2,329	200 0.2009067			0.909			12/7/2015 1.00	1.119				
0.60	0.01	1.86 18.69		83.80	69.67	171.47 1121.3				2.16 73.55			2.96 72.79		0043 0019	34000 556.50		580.40 72.9615	707 72.74834 83.80		2008 0.043	13.565 533		94.01	98.32 2.3		340 0.20942576		Daviation	0.219								
0.31		1.09 18.00		84.31	70.55	295.54 703.0			558.90 73	2.44 73.30			2.96 72.74		0044 0019	35000 SSE90		582.70 72.9606			1925 0.046	13.589 533		98.01	96.15 2.3		350 0.20968983											
		1.09 18.00	189.68 69.00	94.59	70.74	149.01 1125.2		824.22	591.41 73	3.30 73.49	76.53	585.18	2.90 72.70	79.00			73.30 73.49				20.75 0.045	13.824 530	2.4 532.8	100.68	99.94 2.4	06 2.407	300 0.21225855											

																				10.394991	21.02	15.62	10.39
Time	Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	DGM 1	DGM 1	Filter 1	DGM 2	DGM 2	Filter 2	Tunnel	CO	CO2	O2	scale	Corrected Calculated			
10.0	Temp 1	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	Scale Tunnel			
0.0	292.19	70.93		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		3.92		
10.0	279.82	71.80		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	3.32		
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		2.62		
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		2.01		
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	1.30		
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		0.70		
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		0.00	5.40	
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		5.01	
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		4.50	
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		4.11	
100.0	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		3.60	
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		3.09	
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		2.70	
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			2.20	
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			1.80	
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		1.29	
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			0.91	
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			0.41	5.00
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			0.00	5.22
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			4.93
200.0	203.85	68.38	85.77	69.87	287.24	564.61 695.26	650.92 803.20	932.04 912.25	72.96	72.81 73.03	78.59 78.29	72.79 72.78	72.45 72.47	79.96	1.18 1.16	0.00	2.02	18.52 18.67	15.02	4.62 0.044362 4.32 0.040735			4.62 4.32
210.0	201.44	69.00	85.66	71.04 70.78	211.77	1171.89		912.25 878.96	73.16 73.22	73.03	77.67	72.76		79.52	1.10	0.02	1.90	18.82	14.72				4.01
220.0 230.0	186.37 189.05	68.60 69.69	84.59 85.27	70.78	198.61 151.53	1171.69	576.97 690.67	870.12	73.22	73.26	77.44	73.15	72.54 72.79	78.96 78.93	1.17	0.03 0.02	1.73 1.68	18.87	14.41 14.12	4.01 0.043408 3.72 0.043548			3.72
240.0	188.30	69.13	84.77	71.37	249.04	1059.61	475.95	879.13	73.15	73.26	77.44	73.13	72.79	78.77	1.17	0.02	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	73.20	73.10	77.44	72.81	72.59	78.33	1.16	0.03	2.11	18.40	13.61	3.22 0.039686			3.22
260.0	194.49	68.76	84.04	70.92	277.05	554.56	581.10	901.65	73.52	73.09	77.15	73.06	72.84	78.26	1.17	0.00	2.11	18.45	13.31	2.92 0.043527			2.92
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			2.62
280.0	196.34	69.00	84.11	71.44	228.82	571.40	682.36	892.31	73.08	73.18	76.73	73.04	72.86	78.11	1.16	0.03	1.79	18.76	12.71	2.31 0.04046			2.31
290.0	188.41	69.82	85.12	72.42	199.80	1114.99	487.33	858.99	73.00	72.93	76.86	73.04	72.63	78.11	1.17	0.03	2.16	18.36	12.71	2.02 0.042283			2.02
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	0.00	1.96	18.57	12.10	1.71 0.043344			1.71
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			1.51
320.0	185.95	69.40	83.78	71.10	145.99	948.07	769.41	860.25	73.03	73.10	76.68	72.77	72.70	77.96	1.15	0.00	1.99	18.55	11.60	1.21 0.038049			1.21
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	0.00	1.97	18.57	11.31	0.92 0.04281			0.92
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
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	0.01	1.69	18.88	10.70	0.31 0.043551			0.31
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			0.00
550.0	100.00	33.04	04.00	10.14	140.01	1120.21	027.00	024.22	70.00	70.40	, 0.00	72.00	72.70	70.00	1.10	0.04	1.00	10.00	10.00	0.00			0.00



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	PITOT	
A2	0.047		0.2168	CONSTANT=	0.9545
A3	0.047		0.2168		
A4	0.035		0.1871		
B1	0.044		0.2098		
B2	0.048		0.2191		
В3	0.045		0.2121		
B4	0.039		0.1975		
AVERAGE		#DIV/0!	0.2102		

E&E PELLET FUEL DATA SHEET

Weight added to Scale:

25.00

1	2	3	5	6	7	8	9	17	18	19	20	21	22	24	25	26	27	28	
Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	DGM 1	DGM 1	Filter 1	DGM 2	DGM 2	Filter 2					Scale	Calculated
Gas	Temp	Dry Bulb	Тор	Back	R.Side	L.Side	Bottom	Inlet T	Outlet T	Temp	Inlet T	Outlet T	Temp	Tunnel	CO	CO ₂	O_2	weight	Tunnel
74.03684	66.74779	67.8808899	67.7247	589.7516	1031.277	706.0099	1065.979	70.64012	70.01096	69.5223	69.36166	69.49284	70.40315	1.169837	0.539594	1.636116	20.0	55.80667	0.042459
204.7263	68.08664	82.7009048	69.55827	638.2023	1422.385	608.534	826.5056	70.77903	70.48453	69.59428	69.64114	69.67745	70.78856	1.150647	0.150441	0.640401	20.0	55.20925	0.037662
250.1481	70.39545	92.2732773	71.33369	552.8004	1133.127	880.674	996.4724	70.8304	70.44219	69.0901	69.95354	69.99662	70.88016	1.166911	0.029054	3.300853	17.2	54.60939	0.041728
271.3455	71.04037	94.7462769	72.15862	771.7469	766.2589	891.705	1007.354	71.05681	70.63513	70.99654	70.07285	69.97416	70.7707	1.181773	0.028969	3.196243	17.3	54.01196	0.045443
280.0952	70.93591	97.5048904	72.64976	691.2613	1008.468	948.2971	1009.657	71.33707	70.82169	70.02513	70.23263	69.99472	70.74442	1.175348	0.013985	4.031294	16.4	53.39626	0.043837
273.3494	70.19016	98.2673416	72.74184	609.9943	1113.745	934.2366	996.6512	71.19115	70.80295	69.076	69.96622	70.14262	70.6112	1.160132	0.03198	3.398879	17.1	52.79883	0.040033
278.8978	69.24943	98.4326401	72.56275	795.9756	1171.318	630.6667	995.1905	71.18712	70.75874	69.50033	70.15629	70.10258	70.89244	1.175043	0.007949	4.181808	16.3	32.62664	0.043761
																			-0.25

-0.25 -0.25



Manufacturer_Ardisam	Model Castle Screwing	Page of Date 12-7-15
Job #G102366578	Run	TechKS

COMMENTS
9:20 Am 1 Ho POTES STARTED
10:10 Am - TEST STARTED
11:20 Am - Unit ABJUSTED TO Level 3
1'20 pm - UNIT ADJUSTED TO Level 1



Manufacturer: ARDISAM Job# C102366578

	Model: Screwit.	
	Wiodei. =	
≀un_		

DILUTION TUNNEL PARTICULATE SAMPLER DATA FILTER TYPE: Gelman 47mm A/E

		5	SYSTEM 1	/STEM 1		SYSTEM 2	2		SYSTEM			
Pre-test Weight Record		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	Temp	Humidity
Date	Time	C	27	28	D	29	30	6	31	32	°F	%
12/4/15	8'30A	90, 8894	3.3082	3,2970	0234	1.8422	3.2981	92,	3,3054	3,2987	71	31
R/7/15	850A	90. 8892		3.2967	91.	1.8418	3. 2979	5976	3.3052	3.2983	B	30
		Total:	1 1	046	Total:	61	3 G 7	Total:	11	035		

		SYS	TEM 1	SYS	TEM 2	SYS	STEM 3		
Post-test Weight Record		Probe & Housing Number	Combined Filter/gasket Number	Probe & Housing Number	Combined Filter/gasket Number	Probe & Housing Number	Combined Filter/gasket Number	Temp	Humidity
Date	Time	(.	27+28	5	29130	16	31+32	°F	%
12/7	4:309	8906	6.6174	91.	5.1431	5474	6.4119	79	27
12/8	8:30A	8892	6.6164	91.	5.1418		4.6110	69	32
12/11	8:40A	_	6,6164	_	5,1418	_	6,6110	68	25
1									

Dry Down Weight

				Diy Dollin 1		T		0.4
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		8	11.8	0	2.1	D.	7.5	1.119
12/11		0	11,8	0	2.1	0	7.5	



Manufacturer_Ardisam Job #G102366578	Model_CastleSerenty	Page
PRETEST DILUTION TUNNEL TRAVE Barometric pressure (P _{bar}) 29.17 (inches Inside diameter: Port A in Port B	Hg.) Static pressure (P_q) $\iota(Q)$	(inches w.c.)

Traverse Point	Position (inches)	Velocity Head $\Delta_{ m p}$ (inches ${ m H_2O}$)	Tunnel Temperature (°F)	١
A-Centroid	3.00	,048		
B-Centroid	3.00	1049		
A-1	0.50	.041		
A-2	1.50	,047		
A-3	4.50	,047		
A-4	5.50	50035		
B-1	0.50	,044		
B-2	1.50	,048		
B-3	4.50	,045		
B-4	5.50	,039		
		AVERAGE		

Adjustment	faatar		liontion
Aduistment	ractor	app.	ucation

Pitot correction	

u	/he	re
71	110	4 -

 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)

Ps = absolute dilution tunnel gas pressure or Pbar + Pg

$$P_2$$
 = static pressure inchesH₂O

 $\frac{13.6}{M_s} = 28.56$, wet molecular weight of stack gas (alternatively, it may be measured)

Adjustment factor for alternative Pitot tube placement:

$$V_{s} = K_{p}C_{p}F_{p}\left(\sqrt{\Delta_{p}}\right)AVG\sqrt{\frac{T_{s}}{P_{s}M_{s}}} \qquad V_{s} = K_{p}C_{p}\left(\sqrt{\Delta_{p}}\right)avg.\sqrt{\frac{T_{s}}{P_{s}M_{s}}}$$

$$V_{s} = K_{p}C_{p}F_{p}\left(\sqrt{\Delta_{p}}\right)avg.\sqrt{\frac{T_{s}}{P_{s}M_{s}}}$$

$$F_p = \frac{\left(\sqrt{\Delta_p}\right)avg}{\left(\sqrt{\Delta_p}\right)centroid}$$

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

$$(\sqrt{\Delta_p})$$
 avg. = Average of the square roots of the velocity heads $()_p$) 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 H_2O)



Manufacturer_Ardisam___

Job #_ G102366578

mn

Pre/Post Checks		
	Pre-Test	Post-Test
Facility Conditions:		
Air Velocity		fpm
Smoke Capture Check.		
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
Pitot Leak Check:		
Side A		
Side B		
Temperature System:		
Ambient (65°- 90°F)		°F
Proportional Checks:		
CO Analyzer Drift Check		
CO ₂ Analyzer Check		1/
O ₂ Analyzer Check	<u> </u>	
Thermocouple check		
Sampling Train ID Numbers:	Train I	Train 2
Probe	C	$\overline{\mathcal{D}}$
Filter Front	27	29
Filter Back	28	30
Filter Thermocouple	19	22
Filter 5G-3 (<90°F)		

Model _Castle__



Manufacturer_Ardisam	Model Castle Scralty Run	Page <u>Jof</u> / Date <u>/ 2 -)</u> - /_S TechKS
300 // G102300370	Kuii	reenRS

Pre-Test Scale Audit

Scale Type	Audit Weight	Measured Weight	
Platform	25.0 lbs., Class F	25.0 lbs.	
Wood	O. O lbs., Class F	(0 ° ibs.	
Analytical	/OO O mg, Class S	(OO . O mg.	

LIMITS OF WEIGHT RANGES

ANALYTICAL SCALE:	50%-150% of dry filter weight, $\pm 0.1 \text{ mg}$
PLATFORM SCALE	
WOOD SCALE	



Manufacturer_Ardisam Job #G102366578	Model_Castle_ScreaTy Run /	Page 6 of 1 Date 12 - 7 - 15 Tech KS
		10011

CONTINUOUS ANALYZERS

Pre-Test (Adjust and Record)

	ZF	ERO	SP.	AN	CAL. (Re	cord Only)
CO ₂	Ø	8	24.55	24.55	4.90	5,00
СО	8	0	9.20	9.195	1.00	0.998
O_2	D	B	22,00	22-00	4.97	5.00
	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	0	24.54	4.87	0	,01	.03	/	
СО	01	9.19	0.99	.6/	,0/	.01		
O_2	,04	22.02	5.00	.04	,02	,03		

^{*} Greater than \pm 5% of the range used.



Manufacturer_Ardisam	Date 12-7-15 Tech_KS	
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SAMPLING EQUIPMENT CHECK OUT

Leakage Checks Tunnel Samplers

	SAMPLE 1		SAMPLE 2	
Unplugged Flow Rate = .25cfm	Pre-Test	Post-Test	Pre-Test	Post-Test
Vacuum (inches Hg.)	10"	101	10"	10"
Final 1 minute DGM (ft³)	414.678	561.425	498628	585.196
Initial 1 minute DGM (ft ³)	474.678	561.425	498.628	585.196
Change (C) (ft³)	0	Ø	6	0
Allowable leakage .04 x Sample rate or .02cfm	0.0100	0.0100	0.0100	0.0100
Check OK				

Leakage Checks Flue Gas Sampler

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



Manufacturer_Ardisam	Model Castle Seren 174	Page 0 of 7 Date /2-7-/-
Job #G102366578	Run	TechKS

TEST DATA LOG

RAW DRY GAS METER READINGS

	System 1	System 2
Final (ft ³)	561.407	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



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

IP

Chris Wiberg, Densified Fuel Program Manager

Chis Wilberg

Timber Products Inspection, Inc.

1641 Sigman Road, Conyers GA 30012 770.922.8000



Intertek Pharmaceutical Services

P.O. Box 470 Salem Industrial Park Bldg. #5 Whitehouse, NJ 08888 Phone 908.534.4445 Fax 908.534.1054

Analytical Report

Report Number: 186096 Report Status: *Interim*

Brian Ziegler Intertek 8431 Murphy Dr. Middleton, WI 53562

Sample: Marth wood pellets

	С	н	N	0
-	46.87 %	6.41 %	0.06 %	To Follow.
	ROI	LOD		
-	< 0.1 %	4.32 %		



Intertek Pharmaceutical Services

P.O. Box 470 Salem Industrial Park Bldg. #5 Whitehouse, NJ 08888 Phone 908.534.4445 Fax 908.534.1054

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



☐ 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

recalibration, and measurement assu and Technology (NIST) or the Nation	rance. United Scale al Research Counc	comparison, realization of SI units, measureme e documents the traceability of measurements to il of Canada (NRC), or other recognized nationa atory, or accepted fundamental and/or natural ph	the SI units through the measurement institute	he National Institute of Standards es (NMI's) or international standard	McFarland, Wisconsin 53558-8701 608-838-8058 • 800-747-4474 FAX 608-838-9098	
Page of						
MODEL NO.	0	SERIAL NO.	10172		DEVICE ISO CODE: AND	
CAL DATE:	MANUFAC	TURER: (38E	101700	TOLERANCE:	CAL LOCATION: Customer Other	
NEXT DUE	CAPACITY	X RESOLUTION:		CUSTOME	R:	
FREQ. 2/2016		100 LG X.	<u> </u>	CERT/SO NBR.:	DIENTEL	
(omo	CALIBRATION REASON: Scheduled Demand Other DESCRIPTION:					
LOCATION:	R	ANT	DESCRIP	BENCH S	SCALE	
Parameter T	ested	Actual as Foun	d	Deviation	Final Reading	
126		1-00		0	1-00	
5		5.00		0	5.00	
10		10-00		Ü	1000	
50		149.90		-:02	50.00	
100	\	99.96		09	100.00	
		0				
		Mark Comment				
			Earl No.			
CORNER	Shift Test	ERROR FINAL READING			Vere actual values within olerance? Yes □ No	
1 2	311	491 2501	2			
2	3	-01 3499		V	/as device adjusted? Yes No	
3 3	3	-01 24.99		77	/ere final values within	
4 25	5	4.02 25.02	U	3	olerance? Yes No	
					946	
LABEL USED:	Calibration /	Tested	ion DON	OT USE - Out of Calib	ration Leveled Yes No	
United Scale's Operation	ns Procedure P	1511 is followed for device calibration	. TEST WEIGHT	STANDARDS USED (Test weigh	nts calibrated per NIST HANDBOOK 105-1):	
	ms	C WSY DY Co	1,40			
UNCERTAINTY ME	ASUREME	NT: 1006 L.				
COMMENTS:						
TESTED BY: (Tech	TESTED BY: (Technician):					

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:

DESRIPTION:

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

Total Uncertainty:

Reviewed by

0.0001 0.000437387

Date:

Measurement Uncertainty is calculated using the following formula:

O.M.U. = $k*sqrt ((A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2)$

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

DESRIPTION:

Audit weights

Model:Rice Lake

SERIAL #:n/a

WHI#: 160

Weight designation		Scale reading	Deviation
A	5.00	5.00	0.00
В	10.00	10.00	0.00
С	10.00	10.00	0.00
D	25.00	25.00	0.00
F	25.00	25.00	0.00

25.00

Average Deviation: 0.0000000
Standard Deviation: 0

25.00

Scale accuracy

Total Uncertainty:

Date:

0.01 0.01

Reviewed by

Measurement Uncertainty is calculated using the following formula:

O.M.U. = $k*sqrt ((A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2)$

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:

USING: Ice bath and boiling water in beakers

USE PROCEDURE: MID-OE-LAB-019

DESRIPTION: E&E Thermocouple System Asset #: 500

Room Temperature 71.7	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
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

Standard Deviation:

Overall MU at 95% CL:

0.5773

0.5796

1.28

0.58

Measurement Uncertainty is calculated using the following formula:

O.M.U. = $k*sqrt((A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2)$

O.M.U. = Overall Measurement Uncertainty

Reviewed by C

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 SERVICE RECORD



☐ 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

recalibration, and measurement assurance. United sand Technology (NIST) or the National Research Co	ain of comparison, realization of SI units, measurement unc Scale documents the traceability of measurements to the S ouncil of Canada (NRC), or other recognized national meas aboratory, or accepted fundamental and/or natural physical	I units through the National Institute of Standards surement institutes (NMI's) or international standard	4123 Terminal Drive, Suite 230 McFarland, Wisconsin 53558-8701 608-838-8058 • 800-747-4474 FAX 608-838-9098
MODEL NO. 212140	SERIAL NO.	258010639	DEVICE ISO CODE: 7/3
CAL DATE: MANUE	FACTURER:	TOLERANCE:	CAL LOCATION: Customer Other
NEXT DUE: CAPAC	CITY X RESOLUTION:	CUSTOME	RELIGIONER
FREQ.	RATION REASON: Scheduled Demand	CERT/SO NBR.:	SOK
LOCATION:	A . D	DESCRIPTION:	
MANT	upper Lever	BALANCE	
Parameter Tested	Actual as Found	Deviation	Final Reading
101006	.0100	6	10100
1.0000	1.000	0	1,0000
10.1888	10.0000	6	10.000
100.000	99.9997	-,008	99.9997
200,0000	200.000)	+.001	200:001
01.16.7			
Shift T	ERROR FINAL READING		Vere actual values within olerance? Yes □ No
1 506	0 50.000	V	Vas device adjusted? ☐ Yes ☐ No
3 50	-,001 499999		Vere final values within
4 50	0 300000	 3 1	olerance? Yes 🗆 No
LAREL LISED: Calibratio	on / Tested □ Limited Calibration	□ DO NOT USE – Out of Calib	ration Laveled Van D No
LABEL USED: Calibration			
United Scale's Operations Procedur	re P1511 is followed for device calibration. TE	ST WEIGHT STANDARDS USED (Test weigh	its camprated per NIST MANDBOOK 105-1):
	104/		
UNCERTAINTY MEASUREM	MENT: JOMOJ		
COMMENTS:			
TESTED BY: (Technician):	11/1	7	Date: o/n/

This calibration is accredited and meets the requirements of ISO/IEC /7025 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.



Calibration Date:

10/14/2015 Calibration By: BZ

Calibration Due:

Using: Omega - Model CL23A Calibrator #1240

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

Description: Omega (Data acquisition system) Model: 2289 Serial: E10706227003 986 Asset #:

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
			Ave	erage Deviation:	0.53
			Star	dard 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. = $k*sqrt ((A.D.)^2 + (S.D.)^2 + (R.M.U./2)^2)$

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.

Gae Analyzers

Channel	Analyzer	South tipes	Zero Gas	Span Gas	Cal Gas
		DAS	0.01	9.18	1
26	co	Meter	0	9.15	1
	Deviation	-0.10%	-0.28%	0.00%	
		DAS	0.01	24.57	4.91
27	CO ₂	Meter	0.02	24.55	4.91
	manatan manatan bahasa manatan	Deviation	0.10%	-0.08%	0.00%
		DAS	-0.01	22.07	5.03
28 O ₂	02	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

02

CALIBRATION SERVICE RECORD



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Date:

and Technology (NIST) o	rement assurance. United Sca or the National Research Coun- conditions created in our labor is standards.	le documents the tracea cil of Canada (NRC), or	other recognized national r	he SI units through	entation, competence, periodic the National Institute of Standards tles (NMI's) or international standard o type of calibration, or by	4123 Terminal Drive, Suite 230 McFarland, Wisconsin 53558-8701 608-838-8058 • 800-747-4474 FAX 608-838-9098
MODEL NO.	/ 3 -		SERIAL NO.	10.11	20.1	DEVICE
CAL DATE:	MANUFAC	CTURED:	12	19460	TOLERANCE:	ISO CODE: 1/34
2/19	115	R/C	& LAXS		TOLERANCE.	CAL LOCATION Customer DOther
NEXT DUE:	CAPACIT	Y X RESOLUTION	DIA 16	. 1	CUSTOME	RELATIV
FREQ.)/6		3(X) LY)	X . !-	CERT/SO NBR.:	1) reser rex
LOCATION	no CALIBRA	HON REASON:	Scheduled Demai		C750	K
LOCATION:	LANT LY	Sper La	full _	DESCRIP	FLOOR	SCACE
Parame	eter Tested	Actu	al as Found		Deviation	Final Reading
	1 26		1.0		0	1.0
	10		10.0		0	10.0
5	0		50.0		0	36.0
5	TO .	1 4	198.6		-14	500.0
100	0 - 0	9	47.2		-2.8	1000
		3350				
COPNED	Shift Test		THE PERSON OF	/		ere actual values within
CORNER 1	LOAD	0 1	INAL READING			lerance? Yes No
2	2000		000		W	as device adjusted? Yes No
3	300	13			W	ere final values within
4	5(7)	V 5	CO.0	4	to	lerance? Yes No
		0 7				
LABEL USED	D: d Calibration /	Tested L	imited Calibratio	n 🗆 DO N	OT USE - Out of Calibra	ation Leveled: Yes No
United Scale's (Operations Procedure P	1511 is followed for	device calibration.	TEST WEIGHT S	STANDARDS USED (Test weight	s calibrated per NIST HANDBOOK 105-1):
		M	SC B5	78		
UNCERTAIN	TY MEASUREME	NT: ,)/	16			
COMMENTS		, 00				

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.

TESTED BY: (Technician):





Certificate of Calibration

Architectural Testing 130 Derry Court York, PA 17406



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

Christine Schultze

CUSTOMER: Intertek LOCATION:

8431 Murphy Drive Middleton, WI 53562 TEST RESULT:

CALIBRATED BY:

PERFORMED ON: DUE DATE:

05/19/2015 5/19/2016 Ed Sullivan AS-FOUND

PASS

DATA TYPE: TEMPERATURE: 72.30 F HUMIDITY:

36 %

This calibration certificate has been approved by

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 #	<u>Description</u>	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	U	UT Operates; No Damag	e				33
Visual	U	UT Operates; No Damag	е				
Timer 1							
0.30 Min	30000 milli sec	29672	29000	31000	milli	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	300033	299000	301000	milli	Pass	

sec

Test Results				·			
Test Description	<u>Test Value</u>	Test Result	Lower limit	<u>Upper limit</u>	<u>Units</u>	Result	TUR
Timer 2							
0.30 Min	30000 milli	29630	29000	31000	milli	Pass	
	sec				sec		
0.30 Min	30000 milli	29630	29000	31000	milli	Pass	
	sec				sec		
1.00 Min	60000 milli	60269	59000	61000	milli	Pass	
	sec				sec		
l.00 Min	60000 milli	60269	59000	61000	milli	Pass	
	sec				sec		
0.30 Min	120000 milli	119582	119000	121000	milli	Pass	
	sec				sec		
).30 Min	120000 milli	119582	119000	121000	milli	Pass	
	sec				sec		
0.30 Min	180000 milli	180081	179000	181000	milli	Pass	
	sec				sec		
0.30 Min	180000 milli	180081	179000	181000	milli	Pass	
	sec				sec		
0.30 Min	300000 milli	299745	299000	301000	milli	Pass	
	sec				sec		
).30 Min	300000 milli	299745	299000	301000	milli	Pass	
	sec				sec		

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

Date Printed: May 19, 2015 Page 2 of 2





Certificate of Calibration

Architectural Testing 130 Derry Court York, PA 17406



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

Christine Schultze

CUSTOMER: Intertek LOCATION:

8431 Murphy Drive Middleton, WI 53562 TEST RESULT:

DATA TYPE:

PERFORMED ON: DUE DATE: CALIBRATED BY:

5/19/2016 Ed Sullivan AS-FOUND

05/19/2015

PASS

TEMPERATURE: 72.50 F HUMIDITY: 36 %

This calibration certificate has been approved by

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	9		3		
Visual	UUT Operates; No Damage)				
Timer 1						
0.30 Min 30000 mill se		29000	31000	milli sec	Pass	
0.30 Min 30000 mill se	i 30484	29000	31000	milli sec	Pass	
1.00 Min 60000 mill se		59000	61000	milli sec	Pass	
1.00 Min 60000 mill se		59000	61000	milli sec	Pass	
2.00 Min 120000 mill se		119000	121000	milli sec	Pass	
2.00 Min 120000 mill se		119000	121000	milli sec	Pass	
3.00 Min 180000 mill se		179000	181000	milli sec	Pass	
3.00 Min 180000 mill se		179000	181000	milli sec	Pass	
5.00 Min 300000 mill se		299000	301000	milli sec	Pass	
5.00 Min 300000 mill se		299000	301000	milli sec	Pass	

Test Results							
Test Description	<u>Test Value</u>	Test Result	Lower limit	<u>Upper limit</u>	<u>Units</u>	Result	TUR
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 *****

Date Printed: May 19, 2015 Page 2 of 2

Certificate Number A1992943 Issue Date: 09/21/15

Certificate of Calibration

Page 1 of 2

Customer: INTERTEK MIDDLETON

8431 MURPHY DR.

MIDDLETON, WI, 53562

608-824-7422

P.O. Number:

ID Number: 1340

Description:

PRECISION PSYCHROMETER

Calibration Date:

09/21/2015

Manufacturer: EXTECH

Calibration Due:

09/21/2016

Model Number: RH390

TMI-M-HYGROTHERMOGRAPHS

Procedure:

Rev: 2/22/2011

Serial Number: 13018340

Temperature:

67 F

Technician:

RICHARD PANKEY

Humidity:

35 % RH

On-Site Calibration:

As Found Condition: IN TOLERANCE

Calibration Results: IN TOLERANCE

Comments: Salts were useed 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.

This certificate shall not be reproduced, except in full, without the written permission of Technical Maintenance, Inc.

ANTHONY ROGERS, BRANCH MANAGER

atteny of they

JACK SHULER, QUALITY MANAGER

Jack Shules

Calibration Standards

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



Technical Maintenance, Inc.

Certificate Number A1992943 Issue Date: 09/21/15

Certificate of Calibration

Page 2 of 2

Data Sheet

<u>Parameter</u>	Nominal	Minimum	Maximum	As Found	As Left	Unit ADJ/FAIL
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.

Appendix D

Unit Installation Manual



Operator's Manual

Serenity **Pellet Stove**



A 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.

P/N: 22020

ECN: 10766 REV5: 02/23/2015

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Get parts online at www.CastleStoves.com



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

<u>Please read this section carefully.</u> 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

CHECKBUILDING 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.





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 INSPECTION 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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REGISTRATION, SERVICE AND MAINTENANCE LOG

Record the model number and serial number in the space provided for easy reference. Fill out and mail the registration card located in the parts packet or register online at www.castlepelletstoves.com. Warranty is valid only if the completed registration is received by Castle within 30 days of purchase.

OWNERSHIP RECORDS					
Dealer's Name:					
Dealer's Address:					
City:		State/Provi	ince:	Zip Code/Postal Code:	
Model Number:		Serial Num	ber:		
Date of Purchase:					
Notes:					
SERVICE DATE	SERVICE TECHNIC	IAN	SERVICE DESCRIPTIO	N	



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 feet, 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.



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

- 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.

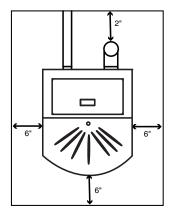
Proper installation of this stove is necessary for safe and efficient operation. Installing this product improperly may result in a house fire and personal injury. All applicable building codes for your location must be followed. In areas where building codes require additional steps to the installation 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.

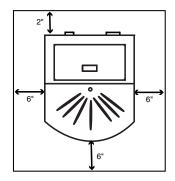
Stove Placement

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.)

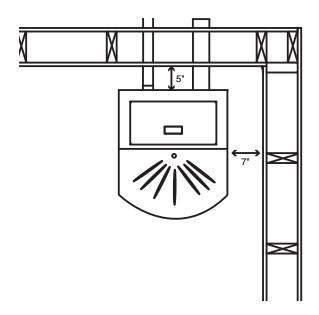


Figure 3: Straight Installation Through Wall

Figure 4: Corner Installation Through The Wall Vents

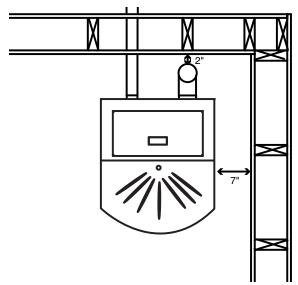


Figure 5: Straight Installation Interior Vertical Vents

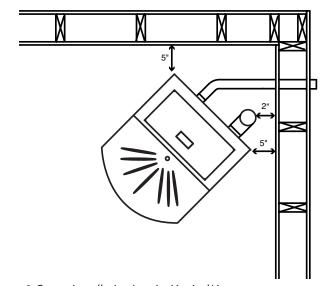


Figure 6: Corner Installation Interior Vertical Vents

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

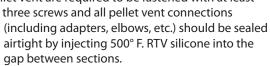
Vent termination **MUST** exhaust above air inlet elevation.

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



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 CLEARANCESSPECIFIEDBYVENTMANUFACTURER FOR CLEARANCE TO ANY COMBUSTIBLES.

INSTALL VENT AT CLEARANCES SPECIFIED BY THE VENT MANUFACTURER.

ALL VENTING, WHETHER VERTICAL OR HORIZONTAL, JOINTS SHOULD BE MADE GASTIGHT 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.

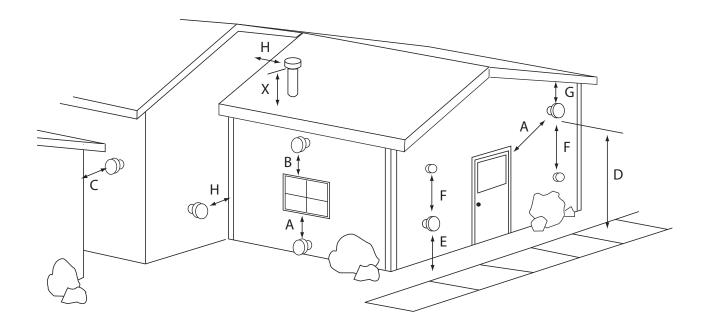


Figure 7: Vent Termination

- 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.

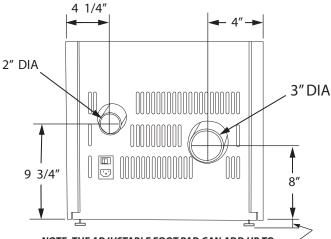
USE AN APPROVED WALL THIMBLE WHEN PASSING THE VENT THROUGH WALLS. USE A CEILING SUPPORT/FIRE STOP SPACER WHEN PASSING THE VENT THROUGH CEILINGS (MAKE SURE TO MAINTAIN CLEARANCE TO ANY COMBUSTIBLES.)

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

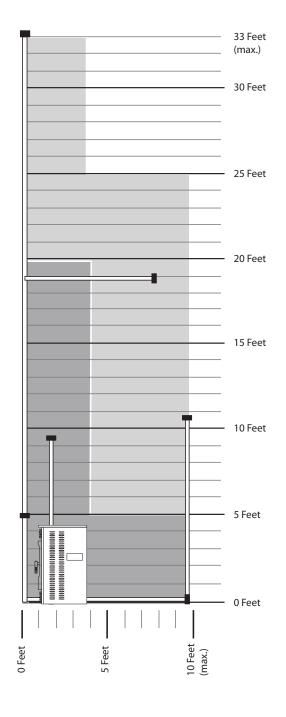


Figure 9: Venting and Combustion Motor Voltage Adjustment Chart



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 PELLET STOVE OF COMBUSTIBLE AIR CREATING A NEGATIVE PRESSURE IN THE ROOM. PROVIDE ADEQUATE VENTILATION IN THE ROOM ACCOMPANYING THE PELLET STOVE. IF NOT, THE PRESSURE SWITCH MAY SHUT OFF OPERATION OF THE PELLET STOVE.

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



SIMPLE STOVE VENTILATION EXAMPLES

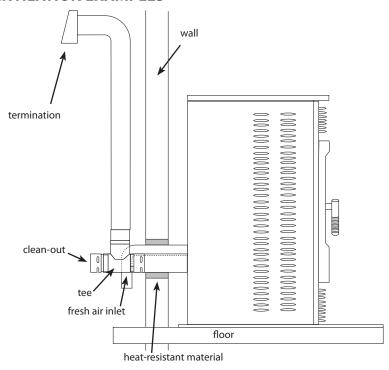


Figure 10: Straight Installation—Outside Vertical Rise, Horizontal Termination

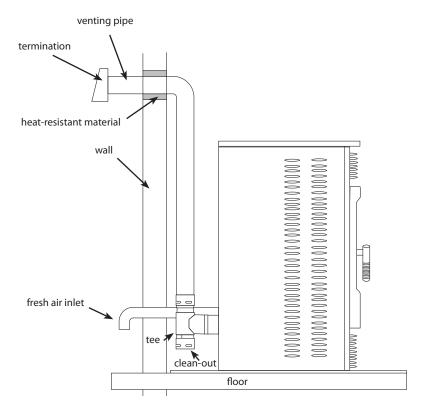
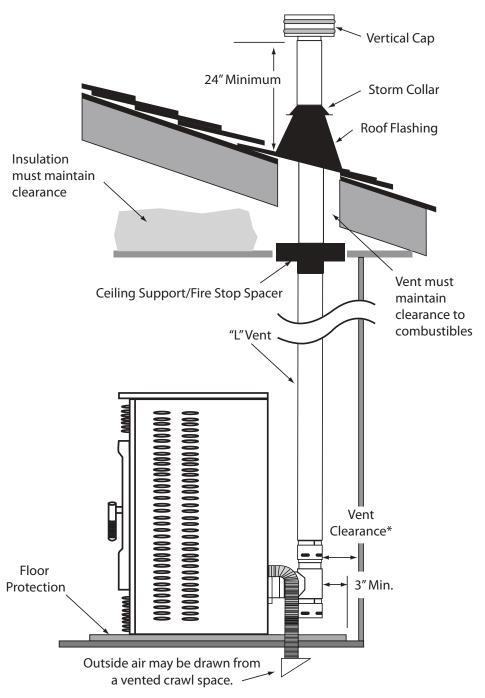


Figure 11: Straight Installation—Inside Vertical Rise, Horizontal Termination



COMPLEX STOVE VENTILATION EXAMPLES



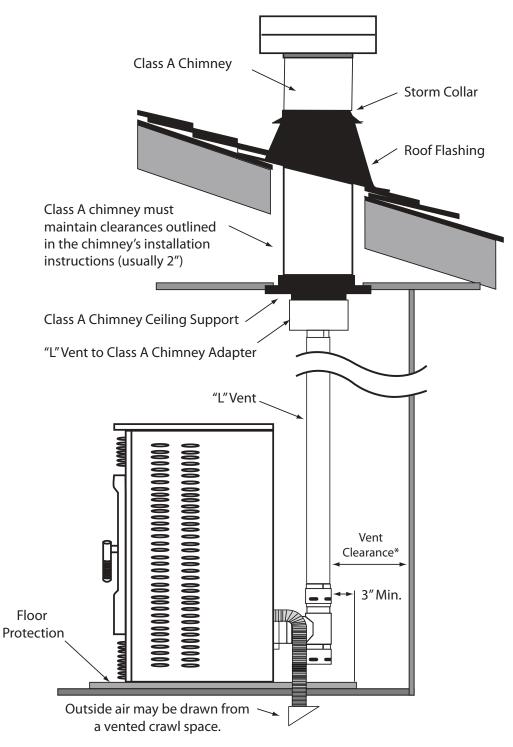
* Install a vent at clearance specified by the vent manufacturer

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

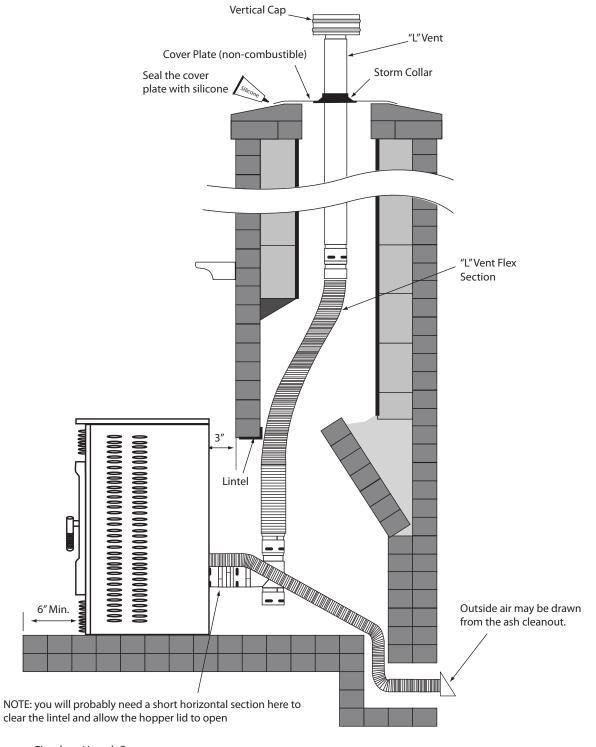


Figure 14: Masonry Fireplace Hearth Stove



ZERO-CLEARANCE (METAL) FIREPLACE HEARTH STOVE

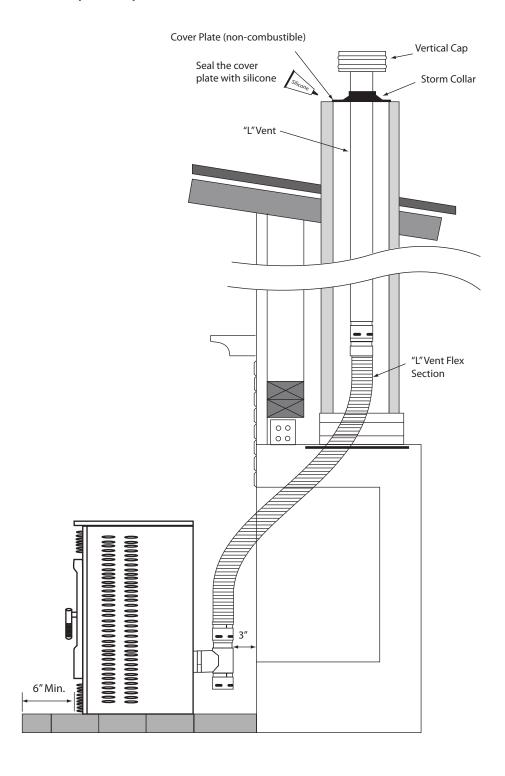


Figure 15: Zero-Clearance (Metal) Fireplace Hearth Stove



FREESTANDING MASONRY CHIMNEY

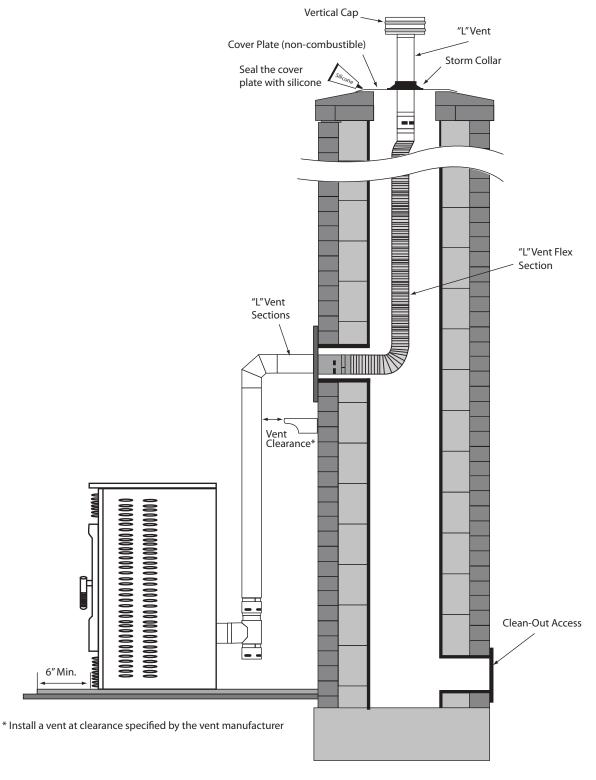


Figure 16: Freestanding Masonry Chimney



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.
- Power Indicator Illuminates when the main power switch is on.
- 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.
- 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.
- 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 simultaniously, 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

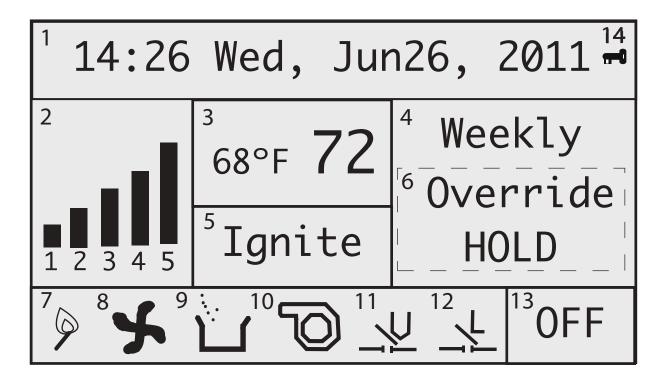


Figure 19: Main Operation Controller Screen Display

- 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.
- 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.
- 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.

NEVERTOUCH 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:

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.

SET DATA

- 1. Set Clock
- → 2. Set Weekly
 - 3. Set Temperature Units
 - 4. Set Blower Voltage

Figure 22: Set Data



 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.
- 4. 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.
- 5. "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.
- 7. 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.

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.
- 8. Once you've finished setting your schedule, without any of the options highlighted, press the **EXIT** button. This will save your schedule.
- 9. 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

- 1. 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.
- 4. Continue this process for selecting and setting the day, month, date and year.
- 5. When finished, and with nothing highlighted on the screen, press the **EXIT** button.

SET CLOCK

10:45 Fri. May 20, 2011

Figure 23

Figure 24



Setting The Temperature Units

- 1. Press and hold the **ENTER** button. This will take you to the **"SET DATA"** screen.
- 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.

Set Temperature Units

Temperature Units: C°

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:

- Press and hold the ENTER button. This will take you to the "SET DATA" screen.
- 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.

Set Blower Voltage

1.Stall1 Voltage:~85V

2.Stall2 Voltage:~90V

3.Stall3 Voltage:~95V 4.Stall4 Voltage:~100V

5.Stall5 Voltage:~110V

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.
- 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.
- 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.

View from back View from back View from back

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.
- Using the SCROLL DOWN key, move to option 6, "DIAGNOSTICS". Press ENTER. This will take you to the "DIAGNOSTICS" screen. SEE FIGURE 29.

Diagnostic Stalls: 01

Fire: ● Blower: ●

Exhaust: ● → Feeding: ○

Limit: ○ Vacuum ○

NTC1: ● NTC2: ●

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 class 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.

A 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. IJURY TO PERSONEL OR DAMAGE TO EQUIPMENT CAN OCCUR.



Figure 30 : Fire pot clean

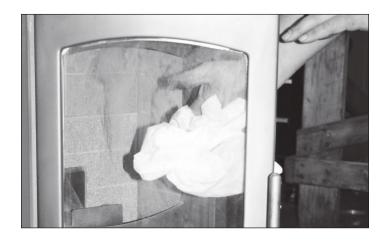


Figure 31: Wipe glass and inspect gasket



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.

A 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. IJURY TO PERSONEL
OR DAMAGE TO EQUIPMENT CAN OCCUR.



Figure 32: Empty Firepot

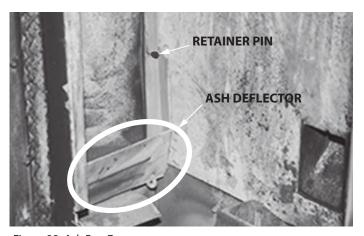


Figure 33: Ash Pan Dump



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.

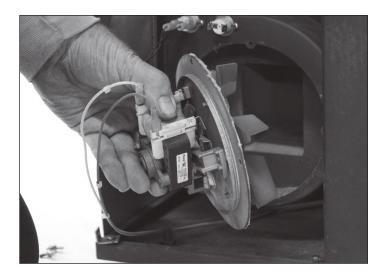


Figure 36: Remove exhaust motor and clean



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.



A 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



M 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.



A 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).

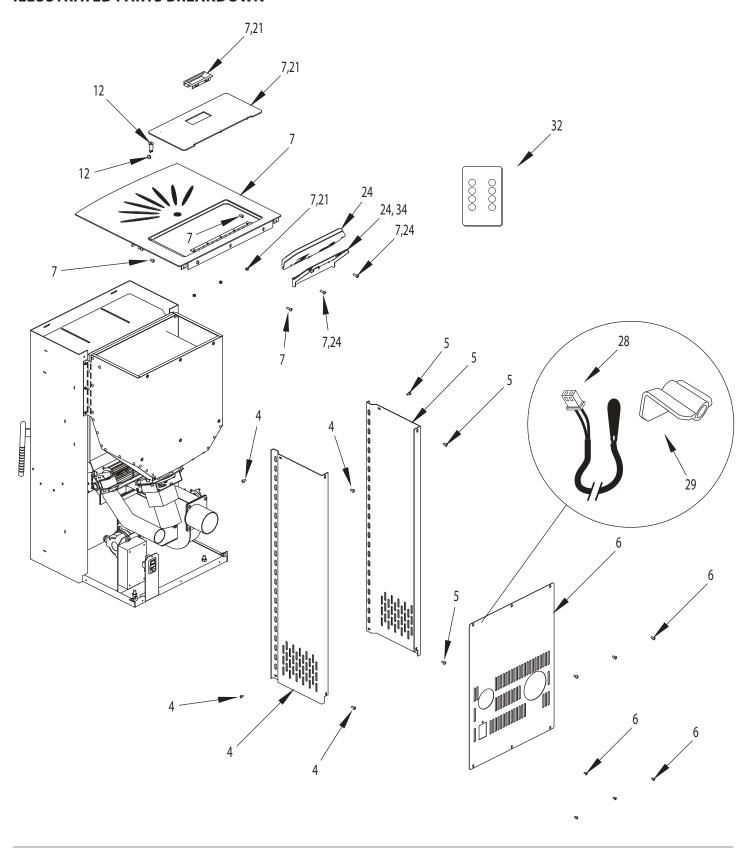
PROBLEM	CAUSE	SOLUTION
Fault light comes on	Fire goes out	Control reads out of fuel, check burn pot. Add fuel to the hopper.
		If the hopper is full, relight if it continues to give that signal. Then enter the diagnostic area of the controller. A circle next to "NTC1" should be highlighted. If not, replace the 52C proof of fire switch. Check pigtail leads, replace spade terminals as necessary.
PROBLEM	CAUSE	SOLUTION
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.
PROBLEM	CAUSE	SOLUTION
Fuel not feeding, no vacuum signal on the control	Main door or ash pan not sealed.	The pressure sensor shuts off the feed auger when there is no negative pressure in fire chamber.
	No negative pressure in fire chamber	Check door seals.
		Check viewing glass seals.
	Piping or stove may be plugged with ash	Clean venting and stove.
	Exhaust Motor has failed	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.



PROBLEM	CAUSE	SOLUTION
Fuel not feeding, vacuum and hopper lid signal present on the control.	Auger is obstructed	Remove auger from housing and clean obstruction first.
	Auger not working	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	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.
	Hopper lid switch not functioning correctly	Check hopper door seal.
		Replace hopper safety switch if not operating properly.
PROBLEM	CAUSE	SOLUTION
Fire burns lazy and smoky	Stove is dirty	Clean fire pot.
	Poor quality fuel	Clean ash pan.
		1
		Clean exhaust vent system.
		Clean exhaust vent system. Clean stove through cover plate clean-out hole.
		· ·
PROBLEM	CAUSE	Clean stove through cover plate clean-out hole.
PROBLEM Feeds fuel will not light all; control indicators are on	CAUSE Igniter tube or burn pot plugged with ash, Faulty igniter	Clean stove through cover plate clean-out hole. Increase exhaust motor voltage.

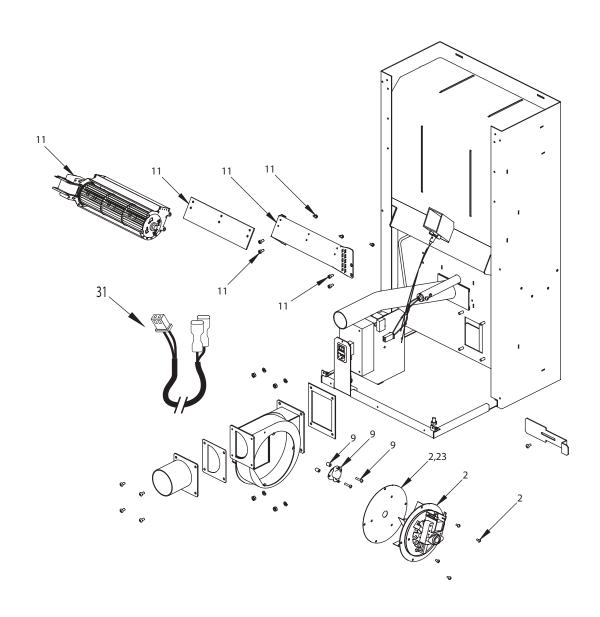


ILLUSTRATED PARTS BREAKDOWN



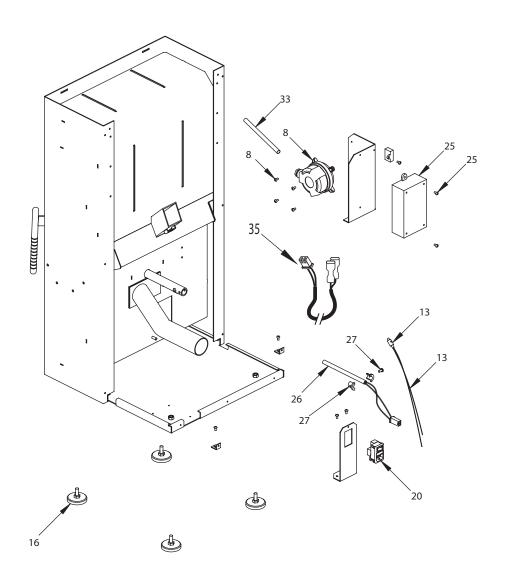


ILLUSTRATED PARTS BREAKDOWN

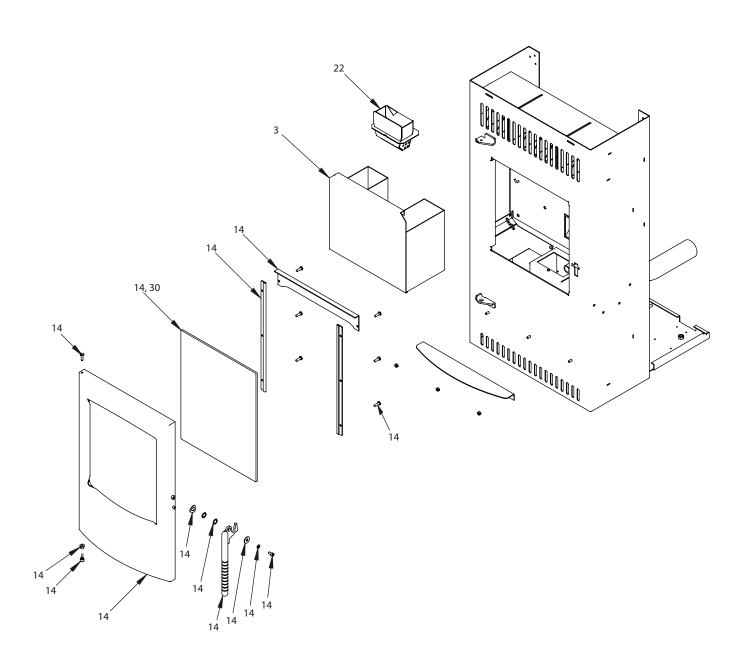






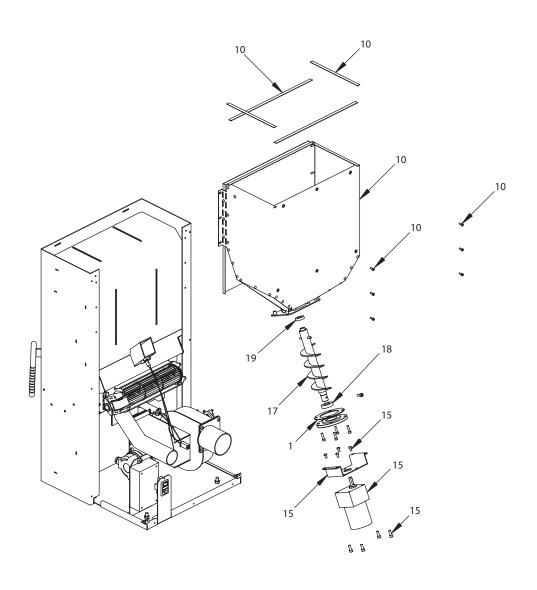










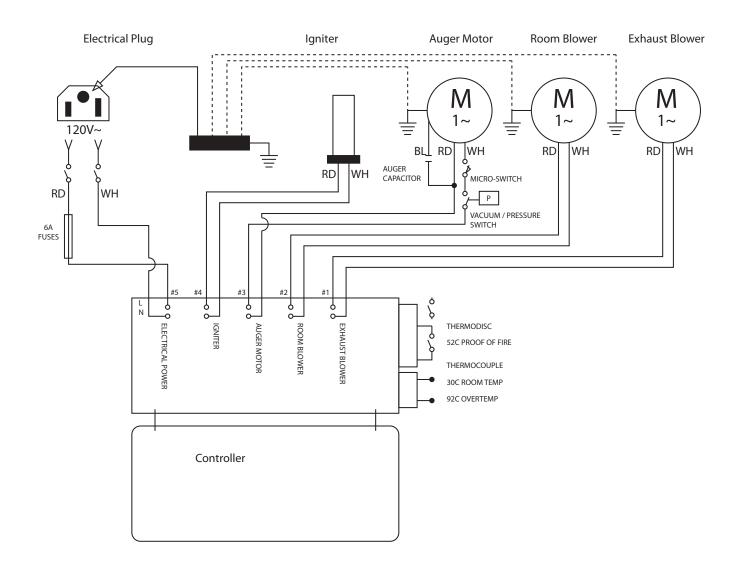




ITEM #	PART #	DESCRIPTION	QTY.
1	12225	GASKET AUGER HOUSING HPS FEED SYSTEM	1
2	720110	EXHAUST BLOWER	1
3	16135	ASH PAN WELDMENT	1
4	16278	PANEL RIGHT REPLACEMENT KIT	1
5	16279	PANEL LEFT REPLACEMENT KIT	1
6	16280	PANEL BACK REPLACEMENT KIT	1
7	16281	TOP AND HOPPER WELDMENT LID REPLACEMENT KIT	1
8	720238	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





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 and 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

Intertek

		>		0.9960	0.9994	0.9963	0.9972	0.0019	0.004	
		Meter	Final	696,903	697.919	698.936	AVERAGE	STDEV.	MU of Y	
		Spirometer	Volumn	1.0625	1.0682	1.0625	0.3447	0.5970		
		Measurement			23.5000	23.3750				
		Meter	Pressure	0.3	0.3	0.3				
1/20/2016	Rockwell	Meter	Temperature	73.2	73.7	74.2				
Calibration Due: 1/20/2016	Model: Rockwell WHI#: 12	Vapor Pressure	of H ₂ O (Hg)	1.0322	1.0526	1.0390				
S		Spirometer	Temperature	80.3	80.9	80.5				
Calibration By: KS	1141	Barometric	Pressure	28.78	28.78	28.78				
7/20/2015	WI-L-AMER-Cali-	Meter	Initial	695,888	696.903	697.920				
Calibration Date:	Using: Use Procedure: WI-L-AMER-Cali-1141 Description: Serial:	Run	Number	-	7	m				

0.739

Reviewed by:

Date: 7/20/15

Measurement Uncertainty is calculated using the following formula: 0.M.U. = K*sqrt ((A.D.)2 + (S.D.)2 + (R.M.U./2)2) 0.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, is considered as the measurement uncertainty as stated on calibration certificates of equipment, or the tolerance listed in the

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1/20/2016		tockwell	3
Calibration Due:		Model: Rockwell	WHI#: 13
Calibration By: KS	141		
7/20/2015	Using: Use Procedure: WI-L-AMER-Cali-114		
Calibration Date:	Use Procedure:	Description:	Serial:

>	-	1.0111	1.0054	1.0064	1.0076	0.003	0.0061
	Final	723.527	724.549	725.566	AVERAGE	STDEV.	MU of Y
	Volumn	1.0739	1.0739	1.0710	0.3447	0.5970	
Monthsom	Inches	23.6250	23.6250	23.5625			
Motor	Pressure	0.3	0.3	0.3			
Motor	Temperature	76.5	76.7	76.5			
Vanor Pressure	of H ₂ O (Hg) T	1.0630	1.0526	1.0630			
Spirometer	Temperature	81.2	80.9	81.2			
Barometric	Pressure	28.78	28.78	28.78			
Meter	Initial	722.513	723.528	724.550			
Run	Number	-	7	ო			

Reviewed by:

Date: 7/00/15

0.739

Measurement Uncertainty is calculated using the following formula:

O.M.U. = k*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 standard Measurement Uncertainty of Reference Measurement.

Appendix F

Unit Conditioning Documentation

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

	Flue temp Unit	Туре	Date	ime Fuel	
0 min	72.6 F	T	11/10/2015	13:50:50 40.0lbs Indeck premium	hardwood @ start
30	248.8 F	Т	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	Т	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	Ţ	11/10/2015	16:50:50	
210	277.1 F	Т	11/10/2015	17:20:50	
240	287.3 F	Т	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	Т	11/10/2015	19:20:50	
360	289.8 F	Т	11/10/2015	19:50:50	
390	295.4 F	Т	11/10/2015	20:20:50	
420	293.9 F	Т	11/10/2015	20:50:50	
450	296.7 F	Т	11/10/2015	21:20:50	
480	294.7 F	Т	11/10/2015	21:50:50	
510	294 F	Т	11/10/2015	22:20:50	
540	299.2 F	Т	11/10/2015	22:50:50	
570	298 F	Т	11/10/2015	23:20:50	
600	301.6 F	Т	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 T	11/11/2015	6:50:50	
1050	156.3 F	T 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	
1110	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		T	11/11/2015	10:50:50	
1290	306.1 F	T	11/11/2015		
				11:20:50	
1320		T	11/11/2015 11/11/2015	11:50:50	
1350		T		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
                         Т
                                     11/11/2015 17:20:50
1680
          293.9 F
                          Т
                                     11/11/2015 17:50:50
1710
            293 F
                          Т
                                     11/11/2015 18:20:50
1740
          294.5 F
                          Т
                                     11/11/2015 18:50:50
                          Т
1770
          295.7 F
                                     11/11/2015 19:20:50
                          Т
1800
          295.1 F
                                     11/11/2015 19:50:50
                          Т
1830
            287 F
                                     11/11/2015 20:20:50
1860
          293.5 F
                          Τ
                                     11/11/2015 20:50:50
                          Т
1890
            295 F
                                     11/11/2015 21:20:50
                          Т
                                     11/11/2015 21:50:50
1920
          297.9 F
                          Т
                                     11/11/2015 22:20:50
1950
          288.4 F
                          Т
                                     11/11/2015 22:50:50
1980
          295.6 F
2010
          297.5 F
                          Т
                                     11/11/2015 23:20:50
2040
          298.5 F
                          Т
                                     11/11/2015 23:50:50
2070
          293.1 F
                          Т
                                     11/12/2015
                                                  0:20:50
2100
          296.9 F
                          Т
                                     11/12/2015
                                                  0:50:50
2130
          296.5 F
                          Т
                                     11/12/2015
                                                  1:20:50
                          Т
2160
          304.6 F
                                     11/12/2015
                                                  1:50:50
2190
          293.5 F
                          Т
                                     11/12/2015
                                                  2:20:50
                          Т
2220
          303.9 F
                                     11/12/2015
                                                  2:50:50
                          Т
2250
          303.8 F
                                     11/12/2015
                                                  3:20:50
                          Т
2280
          302.1 F
                                     11/12/2015
                                                  3:50:50
                          Т
                                                  4:20:50
2310
          303.8 F
                                     11/12/2015
2340
          300.8 F
                          Т
                                     11/12/2015
                                                  4:50:50
                          Т
                                                  5:20:50
2370
          297.3 F
                                     11/12/2015
                          Т
2400
          267.8 F
                                     11/12/2015
                                                  5:50:50
2430
          234.9 F
                          Т
                                     11/12/2015
                                                  6:20:50
2460
          162.8 F
                          Т
                                     11/12/2015
                                                  6:50:50
2490
           86.5 F
                          Т
                                     11/12/2015
                                                  7:20:50 Add 37.4 lbs@ 7:30
2520
          273.6 F
                          Т
                                     11/12/2015
                                                  7:50:50
                          Т
2550
          300.1 F
                                     11/12/2015
                                                  8:20:50
                          Т
2580
          308.6 F
                                     11/12/2015
                                                  8:50:50
2610
          306.6 F
                          Τ
                                     11/12/2015
                                                  9:20:50
                          Т
2640
          303.7 F
                                     11/12/2015
                                                  9:50:50
2670
          310.9 F
                          Т
                                     11/12/2015 10:20:50
                          Т
                                     11/12/2015 10:50:50
2700
          308.2 F
                          Т
                                     11/12/2015 11:20:50
2730
          313.3 F
          314.9 F
                          Т
                                     11/12/2015 11:50:50
2760
2790
          310.8 F
                          Т
                                     11/12/2015 12:20:50
2820
          317.2 F
                          Т
                                     11/12/2015 12:50:50
2850
          304.4 F
                          Т
                                     11/12/2015 13:20:50
2880
          310.7 F
                          Т
                                     11/12/2015 13:50:50
                          Т
2910
          313.3 F
                                     11/12/2015 14:20:50
                          Т
2940
          316.9 F
                                     11/12/2015 14:50:50
                          Т
2970
          315.8 F
                                     11/12/2015 15:20:50
3000
          318.1 F
                          Т
                                     11/12/2015 15:50:50
                         Т
3030
          295.5 F
                                     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

