TEST REPORT

SCOPE: EMISSIONS, EFFICIENCY AND OUTPUT

FUEL: CORDWOOD

TEST STANDARD: CSA B415.1-10

MODEL: EVEREST 2000 INBUILT FIREPLACE

002- Report 102160198MTL-001

TEST REPORT

REPORT NUMBER: 102160198MTL-001
REPORT DATE: July 29, 2015

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PRODUCT EVALUATED:

Model: Everest 2000

Report of Testing Model Everest 2000 Wood-fueled fireplace for compliance with the applicable requirements of the following criteria: CAN/CSA B415.1-2010 Performance Testing of Solid-Fuel-Burning Heating Appliances.

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I. INTRODUCTION

I.A. GENERAL

From July 2nd, 2015 to July 8, 2015 Polytests conducted tests on the model Everest 2000 wood-fired fireplace to determine emission and efficiency results for Stove Builder International.

Tests were conducted by (Maxime Martin) at the Services Polytests. laboratory located at 695-B Gaudette, St-jean-sur-Richelieu, Quebec, Canada. The laboratory elevation is 98 feet above sea level. Tests were evaluated to CAN/CSA B415.1-2010 Performance Testing of Solid-Fuel-Burning Heating Appliances. All tests were conducted using red oak (Quercus Ruba L) cordwood as specified in clause 8.3.

I.B. TEST UNIT DESCRIPTION

The model Everest is constructed of mild steel with a fire brick firebox. The unit weighs 400 lbs. It has a combustion chamber with a volume of 2.55 cu.ft. and double front glass doors and has no ash pan. The unit is a zero-clearance wood fireplace and the primary control is located on the lower right side of the unit. The stove must be installed with a 6 inch chimney. It is a non-catalytic fireplace and has five Stainless-steel tubes in the upper portion of the combustion chamber for the post combustion. All tests were performed with the optional convection fan.

I.C. RESULTS

The unit as tested produced an average emissions rate of 2.34 grams/ hr.

I.D. PRETEST INFORMATION

The test unit was received at Services Polytests on March 8th 2015. The unit was inspected upon receipt and found to be in good condition. It was set up following the manufacturer's instructions without difficulty. Following assembly, the unit was placed on the test stand and instrumented with thermocouples in the specified locations.
The chimney system and laboratory dilution tunnel were cleaned using standard wire brush chimney cleaning equipment. The unit as been pre-burnt for more than 10hr period during preliminary emission testing during the month of March 2015. Corresponding data is reproduced later in this report. On June 4th 2015, the unit was ready for testing.

SUMMARY OF TEST RESULTS

II.A CSA B415 Results

CAT	Load % Capacity	Burn rate (Kg/hr)	% of max burn rate	Test Duration (Hours)	WoodWt (Lb)	Q_{in} (Btu)	Q_{out} (Btu)	OHE (%)	E_T (g)	E (g/hr)
II	<35% of max	1.071	43.8*	9	25.23	180 922	122 00	67.42	31.47	3.5
II	35 – 53% of max	1.161	47.6	8.1	25.14	177 800	122 000	68.59	20.78	2.6
III	53 -76% of max	1.655	67.8	5.6	24.91	175 400	115 400	65.82	5.79	1
IV	Max capacity	2.439	100	4	25.94	185 226	116 000	62.59	7.72	1.9

*Note alternate category 2 burn rate per clause 7.1.4.3.

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II.B

Weighted Average

Run No.	Cat.	Burn Rate	(E) Ave. Emission Rate g/hr	(OHE)	Heat Output (BTU/HR)	Prob.	(K) Weighting Factor	(KxE)	KxOHE
2	2	1,071	3,500	67,42	13622	0,4293	0,5032	1,7612	33,93
3	2	1,161	2,600	68,59	15029	0,5032	0,3972	1,0328	27,25
4	3	1,655	1,000	65,82	26553	0,8265	0,4551	0,4551	29,96
1	4	2,439	1,900	62,59	28629	0,9583	0,1735	0,3297	10,86

Weighted average emissions rate: 2.34 gr/hr
Weighted Average OHE: 66.7 %

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II.D Summary of other Data

Category	2	2	3	4
Run Number	2	3	4	1
Test Date	2015-07-06	2015-07-07	2015-07-08	2015-07-02
Total Test Fuel Weight (lb)	25.23	25.14	24.91	25.94
Avg. Test Fuel Moisture (% dry)	19.4	20.99	21.6	19.11
Temp. Diff. in/out of Heat Exchanger (°F)	Na	Na	Na	Na
Test Duration (min)	537	487	337	243
Burn Rate (kg/hr)	1.07	1.16	1.66	2.44

Category	2	2	3	4
Emissions (g)	31.47	20.78	5.79	7.72
Average Barometric Pressure (“Hg)	30.12	29.93	30.03	29.81
Average Tunnel Delta p (inches of water)	0.2	0.218	0.21	0.21
Average Gas Velocity in Tunnel (feet/sec)	13.96	14.1	13.76	14.46
Average Gas Flow Rate in Dilution Tunnel (Qsd),(dscf/m)	267	266.17	259.4	266
Emissions g/hr	3.5	2.6	1.0	1.9
Efficiency (%)	67.42	68.59	65.82	62.59
Quercus Ruba L. Fuel Heating Value	8555.6	Btu/lb Higher Heating Value		

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III. PROCESS DESCRIPTION

III.A. DISCUSSION

RUN #1 2015-07-02. The fireplace was set to draw a category 4 burn rate. Settings were as follows: Primary air Fully opened. No control on secondary air and Fan on. The Test Load weighed 25.94 lbs. and utilized a 6.27 lb. coal bed. The average burn rate was 2.44 Kg/hr. Burn time was 4 hours. The test data indicated a Valid Test. The particulate emissions were 1.9 g/hr.

RUN #2 2015-07-06. The fireplace was set to draw a category 2 burn rate. Settings were as follows: Primary air Fully closed. No control on secondary air and Fan on. The Test Load weighed 25.23 lbs. and utilized a 6.07 lb. coal bed. The average burn rate was 1.07 Kg/hr. Burn time was 9 hours. The test data indicated a Valid Test. The particulate emissions were 3.5 g/hr.

RUN #3 2015-07-07. The fireplace was set to draw a category 2 burn rate. Settings were as follows: Primary air Fully closed. No control on secondary air and Fan on. The Test Load weighed 25.14 lbs. and utilized a 5.4 lb. coal bed. The average burn rate was 1.16 Kg/hr. Burn time was 8.1 hours. The test data indicated a Valid Test. The particulate emissions were 2.6 g/hr.

RUN #4 2015-07-08. The fireplace was set to draw a category 3 burn rate. Settings were as follows: Primary air opened by 3/16". No control on secondary air and Fan on. The Test Load weighed 24.91 lbs. and utilized a 5.4 lb. coal bed. The average burn rate was 1.66 Kg/hr. Burn time was 5.6 hours. The test data indicated a Valid Test. The particulate emissions were 1.0 g/hr.

III.B. UNIT DIMENSIONS

Overall dimensions are 35 ½ -in wide, 24 ½ -in deep, 37 ½ -in high.

III.C. AIR SUPPLY SYSTEM

There are 3 combustion air inlet primary (air wash) entering in the combustion chamber from each sides of the stove and controlled from 1.56sq inch fully open and 0 sq inch fully closed. The secondary air comes from the bottom of the stove, entering in the combustion chamber from each side's heat exchanger through five 3/4inch diameter stainless tubes. The third air inlet is a pilot located at the bottom front of the combustion chamber and has an 0.1875 inch diameter hole

III.D. OPERATION DURING TEST

The primary air inlet was set at least 1 hour before the insertion of the load and start of the test to maintain the desired burn rate.

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III.E TEST FUEL PROPERTIES

The fuel used was Quercus Ruba L. (Oak, Red). The fuel was split cordwood from 16 to 24-inches long. The fuel was dried to average moisture content between 18% and 28% on a dry basis. Cordwood fuel is to be loaded into the firebox in a random fashion.

III.F. START-UP OPERATION

Each test was started with a clean firebox and the scale zeroed. Fire was started with the pretest loads. The primary air inlet was set at least 1 hour before the insertion of the load in order to maintain the desired burn rate. The sampling system was started and was operated for the duration of the test run.

IV. SAMPLING SYSTEMS

The sampling procedure used was as specified in CAN/CSA B415.1-2010 and ASTM E2515-2011.

IV.A. SAMPLING LOCATIONS

Particulate samples are collected from the dilution tunnel at a point 16 feet from the tunnel entrance. The tunnel has two elbows ahead of the sampling section. (See Figure 3.) The sampling section is a continuous 14-foot with section of 8 inch diameter pipe straight over its entire length. Tunnel velocity pressure is determined by a standard Pitot tube located 96 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 36 inches downstream of the Pitot tube and 36 inches upstream from the end of this section. (See Figure 1.)

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

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V.A.(1) DILUTION TUNNEL

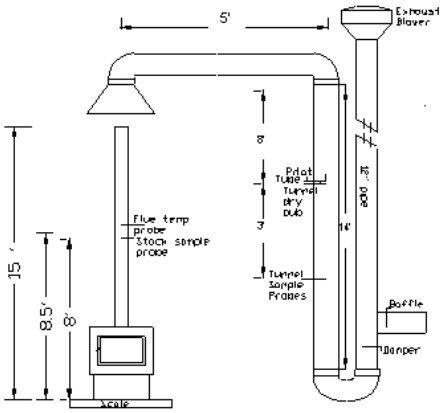

FIGURE 1

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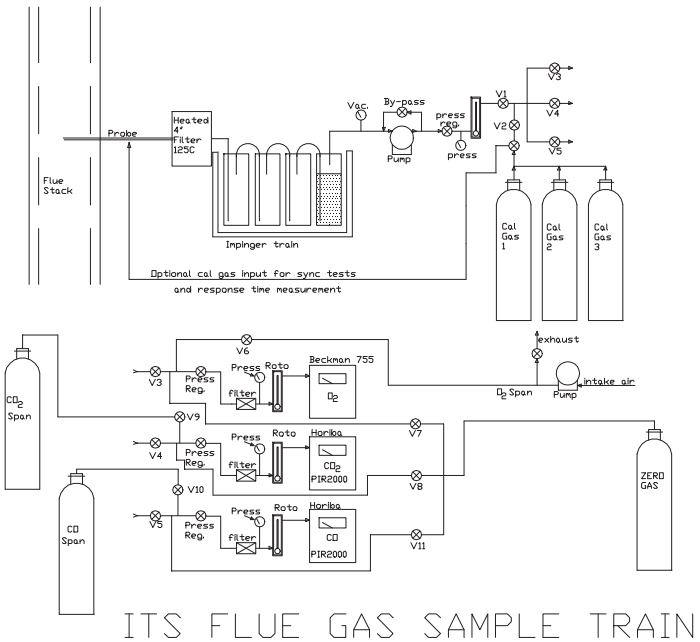
IV.B. OPERATIONAL DRAWINGS

IV.B.(1) STACK GAS SAMPLE TRAIN



ITS FLUE GAS SAMPLE TRAIN

FIGURE 2

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

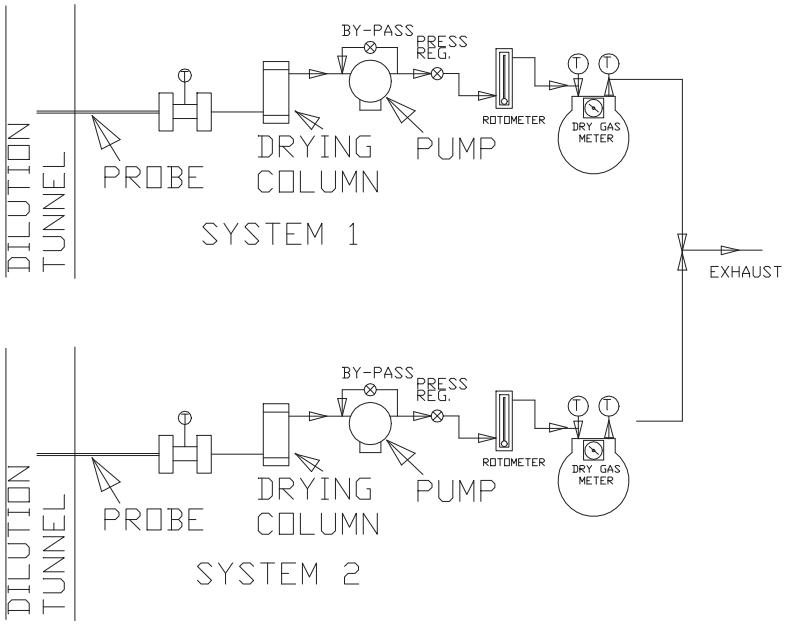

Figure 3

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V. SAMPLING METHODS

V.A. PARTICULATE SAMPLING

Particulates were sampled in strict accordance with ASTM E2515-11. 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.

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%, allowing for an accuracy higher than the ±2% required by the standard.

VI.A.(2). STACK SAMPLE ROTOMETER

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.

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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 five-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 over the entire sampling train, not just the dry gas meters. Pre-test and post-test leak checks are conducted with a vacuum of 10 inches of mercury. Vacuum is monitored during each test and the highest vacuum reached is then used for the post test vacuum value. If leakage limits are not met, the test run is rejected. During, these tests the vacuum was typically less than 2 inches of mercury. Thus, leakage rates reported are expected to be much higher than actual leakage during the tests.

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

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

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

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VI.B.(3). PM SAMPLING PROPORTIONALITY (ASTM E2515-11)
Proportionality was calculated in accordance with ASTM E2515-11. The data and results are included in Appendix C.

VII RESULTS AND OBSERVATIONS

The SBI Everest 2000 has been found to be in compliance with the applicable performance requirements of the following criteria:

"**CSA B415.1-2011 – Performance Testing of Solid-Fuel-Burning Heating Appliances**".

This standard requires that the weighted emissions rate for wood stove does not exceed 4.5 g/hr and that no single run produces an emissions rate over 18 g/hr.

Tests performed on this unit (Everest 2000) will also allow to qualify the following models which are only suffering aesthetic changes. Etna 2000, Equinox, Barcellone, Lisbonne, Malibu 2000.

INTERTEK TESTING SERVICES NA

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