



TEST REPORT

TEST OF A HYBRID WOOD STOVE FOR EMISSIONS AND EFFICIENCY

PER EPA METHODS 28R AND ASTM E2515 and ASTM E2780, MAY 2015

Client:

Hearthstone

317 Stafford ave.

Morrisville, Vt 05661

Model name: Green Mountain 60 Model 8660, Shelburne Model 8372, Hipster 20 Model AMB8260

Attention: Rafaël Sanchez

TESTED BY:

Services Polytests Inc.

695-B Gaudette

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TEST DATES: January 15<sup>th</sup> to 22<sup>nd</sup> 2018

REPORT DATE: February 6<sup>th</sup> 2018

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Revision2: January 20<sup>th</sup> 2021

Project number: PI-20162

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Tested:

A handwritten signature in black ink, appearing to read "Maxime Martin".

Maxime Martin

written by:

A handwritten signature in black ink, appearing to read "Danick Power".

Danick Power, P. Eng

Verified by third party certifier (PFS):

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## List of Revision:

### Revision 1 (November 25<sup>th</sup> 2020):

- NCBI Report added Appendix 12: Volume Calculation
- CBI & NCBI Report added Appendix 13: operating instruction
- The section 3.4 p.12 updated for runs Anomalies, Validity and appropriateness detail.
- The section 3.4 p.12 updated to address the negative back filter weight.
- Updated Section 1.4 p.6 conditioning was done at medium hate draw.
- Appendix 9 updated for more detailed fuel load
- NCBI report updated to include Appendix 4 Pre-burn Data

### Revision 2 (January 20<sup>th</sup> 2021):

- appendix 1 molecular weight updated to 29 for all runs
- Updated names on report to match the EPA certificate, WHA and Coc

## List of appendixes

- APPENDIX 1: Raw data, forms and results
- APPENDIX 2: Proportionality results
- APPENDIX 3: Calibration data
- APPENDIX 4: Unit pre burn
- APPENDIX 5: Participants
- APPENDIX 6: Drawings and specifications
- APPENDIX 7: Operator's manual
- APPENDIX 8: Photographs of test set up
- APPENDIX 9: Test load photographs
- APPENDIX 10: Laboratory Operating Procedures
- APPENDIX 11: Sample calculations
- APPENDIX 12: Volume calculations
- APPENDIX 13: Operating instruction
- APPENDIX 14: Drawing Air flow pattern



## 1 INTRODUCTION

### 1.1 GENERAL

#### Laboratory

- Location: Services Polytests Inc., 695-B Gaudette St-jean-sur-Richelieu QC, Canada J3B 7S7
- Elevation: 100 feet above sea level

#### Test program

- Purpose: unit qualification NSPS 2020
- Test dates: January 15<sup>th</sup> to 22<sup>nd</sup> 2018
- Test methods used:
  - Particulate emissions: ASTM E2780-10 ; ASTM E2515-11 methods 28R as referred into 40 CFR Part 60 Subpart AAA
  - Efficiency: CSA B415.1-10

### 1.2 TEST UNIT INFORMATION

#### General

- Manufacturer: Hearthstone
- Product type: Hybrid wood stove
- Combustion system: catalytic, with pre-combustion
- Unit tested: Green Mountain 60 8660
- Option: optional convection fan can be installed on the wood stove
- Similar Model: Shelburne 8372, Hipster 20 AMB 8260
- In summary: rear-exit version of the stove, named the “Shelburne” (model# 8372) This rear-exit version has identical K-list firebox components, dimensions, and construction, the differences being a rear-exit option and revised cosmetics to the external shell. The “Hipster 20” (Model 8260) has identical K-list firebox components, dimensions, and construction, the difference being revised cosmetics. Refer Appendix 6 for all details.

### 1.3 RESULTS

#### Emission results obtained

- Weighted Average emission rate: 0.62 grams/hour
- Weighted Average Efficiency: 79.2 %
- Weighted Average Co: 0.39 grams/min

Conformity: NSPS Phase 2020

## 1.4 PRETEST INFORMATION

Unit condition: The unit was received first week of January 2018 in good condition. The 50hrs of aging was done by the manufacturer at medium heat draw (all data in Appendix 4).

Set up

- Venting system type: 6-inch diameter insulated chimney
- System height from floor: 15 feet
- Particularities: The unit was tested with the convection Fan ON for average numbers (Test #1, 2, 4 and 5), and one confirmation test is done without any convection fan (test #3).

Break in period

- Duration: the unit was pre burned by the manufacturer and run for at least 50 hours, adequate documentation of fuel additions, flue and unit temperatures recorded.
- Fuel: BC FIR between 19% and 25%

## 2 SUMMARY OF TEST RESULTS

### 2.1 EMISSIONS

Run Number	Test Date (AAA-MM-DD)	Emission Rate (g/hr)	Burn Rate (kg/hr)	1st hour Emission Rate (g/hr)	CSA B415.1 CO emission Gr/hr	CSA B415.1 CO emission Gr/Kg dry
1	2018-01-15	0,39	0,834	1,53	8,88	10,64
2	2018-01-16	0,20	1,239	0,41	21,14	17,05
3	2018-01-17	0,27	1,170	0,98	23,79	20,32
4	2018-01-18	0,78	1,604	2,35	32,83	20,45
5	2018-01-22	2,15	2,370	4,38	51,43	21,70

## 2.2 AVERAGE CALCULATION

Test No.	Burn Rate (Kg/hr)	(E) Ave. Emission Rate g/hr	(OHE) %	Heat Output (BTU/HR)	CSA B415.1 CO emission g/min
1	0,83	0,39	80,42%	12 608	0,15
2	1,24	0,199	80,29%	18 702	0,35
4	1,60	0,777	77,81%	23 468	0,55
5	2,37	2,153	75,37%	33 576	0,86
<b>Weighted particulate emission average of 4 test runs: 0.62 grams per hour.</b>					
<b>Weighted average HHV efficiency of 4 test runs: 79.2 %.</b>					
<b>Average Co 0.39 gr/min</b>					

## 2.3 TEST FACILITY CONDITIONS

Run Number	Room Temperature		Barometric pressure		Relative humidity		Air Velocity	
	Before (F)	After (F)	Before (in.Hg)	After (in.Hg)	Before (%)	After (%)	Before (ft/min)	After (ft/min)
1	68	69	30,357	30,298	19	22	6	9
2	71	73	30,327	30,298	16,8	16,9	5	3
3	71	73	30,268	30,121	19,1	20,1	4	6
4	72	72	29,914	29,855	18,7	19	4	8
5	71	73	30,268	30,180	27,1	22,4	4	5

## 2.4 FUEL QUALITIES

Run Number	Pre-test Load			Test Load						
	Loading Weight Wet Basis (lbs)	Moisture Content Dry Basis (%)	Coal bed Weight (lbs)	Weight Wet Basis (lbs)	Density Wet Basis (lbs/cuft)	Moisture Content Dry Basis (%)	Piece Length (in.)	Number of 2X4's	Number of 4x4's	Number of Spacers
1	16,24	20,49	2,7	13,07	6,439	20,50	17,25	2	2	12
2	15,98	21,55	2,6	13,29	6,547	20,61	17,5	2	2	12
3	16,55	21,67	2,7	13,09	6,450	20,37	17,25	2	2	12
4	16,88	21,49	2,9	13,28	6,540	20,45	17,25	2	2	12
5	15,48	22,34	2,7	13,59	6,694	20,03	17	2	2	12

## 2.5 DILUTION TUNNEL FLOW RATE MEASUREMENTS AND SAMPLING DATA (ASTM E2515)

Run Number	Average dilution tunnel measurements			Sample Data			
	Burn Rate (Min)	Volumetric Flow Rate (dscf/min)	Total Temperatures (°R)	Volume sampled (DSCF)		Particulate catch (mg)	
				1	2	1	2
1	354	175,47	545,21	61,090	61,665	2,40	2,20
2	242	176,34	547,59	42,193	42,845	0,80	0,80
3	253	171,49	550,62	44,253	44,804	1,20	1,10
4	187	165,15	559,40	32,827	33,546	2,80	2,50
5	130	160,60	577,05	22,384	22,838	5,30	4,80

## 2.6 DILUTION TUNNEL DUAL TRAIN PRECISION

Run Number	Sample Ratio		Total Emission (g)		
	Train 1	Train 2	Train 1	Train 2	% Deviation
1	1016,80	1007,31	2,44	2,22	4,82%
2	1011,39	996,00	0,81	0,80	0,77%
3	980,45	968,39	1,18	1,07	4,97%
4	940,80	920,63	2,59	2,26	6,91%
5	932,69	914,14	4,94	4,39	5,95%

## 2.7 GENERAL SUMMARY OF RESULTS

Run Number	Burn Rate (kg/hr)	Average Surface Temperature (F)	Change in surface Temperature (F)	Initial Draft (in. H <sup>2</sup> O)	static pressure tunnel (in. H <sup>2</sup> O) neg.	Primary Air Setting	Run Time (min)
1	0,834	298,35	-57,5	0,055	0.39	min	354
2	1,239	366,37	-61,1	0,067	0.40	Cat 2 setting	242
3	1,170	406,38	-59,3	0,065	0.39	Cat 2 setting	253
4	1,604	416,97	-75,9	0,075	0.39	Cat 3 setting	187
5	2,370	473,27	-51,4	0,084	0.37	Full open	130

### 3 PROCESS DESCRIPTION

#### 3.1 DISCUSSION

The unit was delivered by the client and received in a good condition. Four runs have been done for weighted average with the optional convection fan at “ON” position. One confirmation test was done without the optional convection fan.

#### 3.2 UNIT DIMENSIONS

##### Baffle

- Location: between top of combustion chamber and hearth
- Restriction: 2.5-inch X 18 inch at the front of the unit
- Dimensions: cover the hearth area minus the restriction at the front
- Material: Vermiculite 1 inch thick.

##### Bricks

- Inside firebox refractory brick 1¼ inch. thick cover all the sides and the back of the combustion chamber bottom covered by ½ thick refractory brick

##### Flue gas exhaust

- Location: top flue
- Dimensions: 6 in. diameter
- Material: Cast Iron

##### Gasket

- Window: 1/4 Round
- Door gasket against facing: fiberglass 3/8 round inch diameter
- Refer to appendix 6 for complete list and location of each gaskets

##### Overall unit dimension

- Overall dimensions: 25 7/8-inch-wide x 19 1/4-inch-deep x 29 ¼ inch high
- Firebox: Refer to appendix 12 for dimension and calculation
- Usable volume: 2.03 cuft

##### Convection fan

- Optional Convection fan blower:
  - Free air: 150 CFM 110-120V (ref.: PT#90-57000)

##### Catalyst (appendix 6 for details):

- Applied Ceramics – P/N WF-4150001076
- Cell density: 50 CPSI
- Material: 16 Ga SS430 or 304
- Catalyst temperature probe located on the right side of the stove just behind by-pass handle

### 3.3 AIR SUPPLY SYSTEM

#### Description

- Primary air: Window wash design in cast iron channel fully gasketed on the top and bottom of the combustion chamber. Air intake on the middle-left side of the unit (if facing door of stove)
- Secondary air: secondary tube design with air intake coming from the bottom rear of unit, then up through a steel riser tube to the secondary air tube.

#### Characterization

The following table shows the inlet and outlet sections of each system. The air introduction system number is referred to on a set of drawings in Appendix 6.

AIR INTRODUCTION SYSTEM		INLET (1) sq. in.			OUTLET
Identification	Type	Imin	Imax	Controlled	(sq. in.)
APPENDIX 14 SHARED and PA	Primary	(air control Slide) 0.312	(air control Slide) 4.610	yes	(Air Wash) 5.284
APPENDIX 14 SHARED and SA	Secondary	(Riser opening) 0.600	(Riser opening) 0.600	yes	(Secondary Tube holes) 2.071
Appendix 14 TA	Pilot	(Orifice) 0.028	(Orifice) 0.028	None	(Orifice) 0.096

\* This section would be filled by measuring and comparing with the manufacturer's drawings included in the test report.

#### Legend

Identification: Tag name referred to on drawings in Appendix 14, section airflow pattern

Type: Characterization of air intake

Imin: Minimum air intake of a particular air channel

Imax: Maximum air intake of a particular air channel

Controlled: Determines if a provision for air control is present

Outlet: Total air outlet of a particular air channel

### 3.4 OPERATION DURING TEST

All runs have been found appropriate, no anomalies happened and all runs below have been validate and found compliant. Negatives weight found on filters stick on gaskets and it were handled property, no negative weight on gaskets or probe.

#### Run #1

This run was performed on January 15<sup>th</sup> 2018. It lasted 354 minutes and a 0.83 kg/hr burn rate was obtained & emission at 0.39 gr/hr. The optional convection fan Option was operated as per user's manual during the test. Run 1 has been done with the combustion air control at the minimum setting and (fully closed) and achieved a burn rate of 0.83 kg/hr.

#### Run #2

This run was performed on January 16<sup>th</sup> 2018. It lasted 242 minutes and a 1.24 kg/hr burn rate was obtained & emission at 0.2 gr/hr. The optional convection fan Option was operated as per user's manual during the test.

#### Run #3

This run was performed on January 17<sup>th</sup> 2018. It lasted 253 minutes and a 1.17 kg/hr burn rate was obtained & emission at 0.27 gr/hr. The optional convection fan Option was at OFF position during the entire test. NO fan confirmation test

#### Run #4

This run was performed on January 18<sup>th</sup> 2018. It lasted 187 minutes and a 1.604 kg/hr burn rate was obtained & emission at 0.78gr/hr. The optional convection fan Option was operated as per user's manual during the test.

#### Run #5

This run was performed on January 22<sup>nd</sup> 2018. It lasted 130 minutes and a 2.37 kg/hr burn rate was obtained as maximum output & emission at 2.15gr/hr. The optional convection fan Option was operated as per user's manual during the test.

- Details: Refer to the front page of each test run data sheets found in appendix for the detailed test sequence showing air supply settings and adjustments, fuel bed adjustments and operational specifics of the test unit.

#### Test fuel cribs

- Type of wood: Douglas fir, grade c or better, 19 to 25% dry basis moisture content
- Description: for each test, description of the fuel crib is found on the front page of each test run data sheet together with photograph in appendix.



### 3.5 START-UP OPERATION

The complete manufacturer's firing procedure of each burn rate category is fully described in appendix 13.

### 3.6 SAMPLING LOCATIONS

Particulate samples are collected from the dilution tunnel at a point 15 feet from the tunnel entrance. The tunnel has two elbows and two mixing baffles in the system ahead of the sampling section. The sampling section is a continuous 15-foot section of 6-inch diameter pipe straight over its entire length. Tunnel velocity pressure is determined by a standard pitot tube located 48 inches from the beginning of the sampling section. Thermocouple is installed on the pitot tube to measure the dry bulb temperature. MC is assumed, as allowed, to be 4%. Tunnel samplers are located 56 inches downstream of the pitot tube and 16 inches upstream from the end of this section.

### 3.7 DRAWINGS

Various drawings of the stack gas sampling train and of dilution tunnel system are found in Appendix 1.

### 3.8 EMISSIONS EFFICIENCY TESTING EQUIPMENT LIST

The complete test equipment list together with all corresponding calibration data can be found in Appendix 3.

## 4 SAMPLING METHODS

### 4.1 PARTICULATE SAMPLING

Particulates were sampled in strict accordance with ASTM E2515. This method uses two identical sampling systems with Gelman A/E 61631 binder free (or equivalent), 47 mm diameter filters. The dryers used in the sample systems are filled with "Drierite" before each test run.

## 5 QUALITY ASSURANCE

### 5.1 INSTRUMENT CALIBRATION

#### 5.1.1 GAS METERS

At the conclusion of each test program the gas meters are verified using the reference dry gas meter. This process involves sampling the train operation for 1 cubic foot of volume. With readings made to .01 fr', the resolution is 1 %, giving an accuracy higher than the 2% required by the standard.

#### 5.1.2 SCALES

Before each test program, the different scales used are checked with traceable calibration weights to ensure their accuracy.

#### 5.1.3 GAS ANALYZERS

The continuous analyzers are zeroed and spanned before each test with NBS traceable 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.

### 5.2 TEST METHOD PROCEDURES

#### 5.2.1 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. Pre-test and post-test leak checks are conducted with a vacuum of 5 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 is typically less than 2 inches of mercury. Thus, leakage rates reported are expected to be much higher than actual leakage during the tests.

#### 5.2.2 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.

#### 5.2.3 PM SAMPLING PROPORTIONALITY (ASTM E2515)

Proportionalities were calculated in accordance with ASTM E2515. The data and results are found in appendix.

## APPENDIX 1: Raw data, forms and results

## Paramètres

Tous les facteurs de corrections et autres paramètres qui peuvent être modifiés par l'utilisateur du fichier sont regroupés ici.

Code verrouillage:

### Description du test

Test standard	EPA
Run #	1
Date	15-01-2018
Technicien	M.M
Project #	PI 20162

### Description de l'unité

Manufacturier	HEARTHSTONE	
Modèle	GM 60	
Combustion system	Cat	
Appliance type	WOOD STOVE	
Firebox volume	2,03	cu ft.
Appliance weight empty	N.A	lbs
Appliance weight full	N.A	lbs

### Paramètres du test

Logging time	1	min
Manufacturer's rated heat output		BTU/h Donnée fournie par le manufacturier
Targeted category	1	
Targeted output	N.A	BTU/h
Cp steel	N.A	BTU/lb-°F

### Échantillonnage

Blank sampling rate	0,20	cuft/min
Internal probe diameter	0,18	in.
Calibration Factor (DGM #1):	0,988	Dimensionless
Equipment number (DGM #1):	EM 178	
Calibration Factor (DGM #2):	0,988	Dimensionless
Equipment number (DGM #2):	EM 179	
Calibration Factor (DGM #3):	0,986	Dimensionless
Equipment number (DGM #3):	EM 070	Dimensionless

### Tunnel

Targeted tunnel flow rate	160	scfm
Tunnel diameter	6	in.
Molecular weight	29	
Pitot tube type	Standard	
Pitot tube coefficient	0,99	Dimensionless

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### Fuel data

Fuel type	Dimension	
Fuel specie	D. Fir	
HHV		19810,0 kJ/kg
%C		48,7
%H		6,9
%O		43,9
%Ash		0,5
HHV		8519,2 Btu/lb
LHV		7451,0 Btu/lb

Default Fuel Values		
	D. Fir	Oak/Maple
HHV	19 810	19 887
%C	48,73	50
%H	6,87	6,6
%O	43,9	42,9
%Ash	0,5	0,5
HHV (Btu/lb)	8519	8552
LHV (Btu/lb)	7451	7480





**Filter set weight**

	System 1 (g) 1st hour				System 1 (g)				System 2 (g)				Ambient blank (g)	Date	Heure
	probe	front	back	gasket	probe	front	back	gasket	probe	front	back	gasket	Filter		
Number	17	7	8	21	18	9	10	22	50	11	12	23	13		
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	108,9499	0,1289	0,1280	35,4196	108,9471	0,1281	0,1274	35,1414	107,6467	0,1256	0,1243	35,1863	0,1263	11/01/2018	17:00
Before (6)	108,9498	0,1288	0,1279	35,4195	108,9471	0,1280	0,1274	35,1413	107,6466	0,1256	0,1243	35,1864	0,1264	15/01/2018	10:00
After (1)	108,9514	0,1288	0,1270	35,4230	108,9486	0,1277	0,1269	35,1435	107,6478	0,1249	0,1233	35,1900	0,1264	15/01/2018	08:00
After (2)	108,9505	0,1285	0,1269	35,4222	108,9476	0,1277	0,1268	35,1429	107,6469	0,1248	0,1233	35,1894	0,1264	29/01/2018	08:00
After (3)	108,9505	0,1285	0,1269	35,4217	108,9476	0,1277	0,1268	35,1427	107,6470	0,1251	0,1234	35,1897	0,1264	01/02/2018	08:00
After (4)	108,9505	0,1285	0,1269	35,4216	108,9476	0,1277	0,1268	35,1426	107,6470	0,1251	0,1234	35,1896	0,1264	05/02/2018	08:00
After (5)															
After (6)	108,9505	0,1285	0,1269	35,4216	108,9476	0,1277	0,1268	35,1426	107,6470	0,1251	0,1234	35,1896	0,1264	05/02/2018	08:00
Difference	0,0007	-0,0003	-0,0010	0,0021	0,0005	-0,0003	-0,0006	0,0013	0,0004	-0,0005	-0,0009	0,0032	0,0000		
Total (mg)		1,5				2,4				2,2			0		
Total ajusté (mg)		<b>1,50</b>				<b>2,40</b>				<b>2,20</b>					

<b>Project nu.</b>	PI 20162
<b>Date</b>	15-01-2018
<b>Technicien</b>	M.M

SFBA EPA EMISSION RESULTS

RESULTS

**Average emission rate:** 0,4 g/hr  
 Burn Rate : 0,834 Dry kg/hr

**Test Duration:** 354 min

PRESSURE FACTOR: DGM 1 0,98829  
 DGM 2 0,98803  
 DGM 3 1,01361

BAROMETRIC PRESSURE  
 Average: 30,327299 in Hg  
 Start: 30,356829 in Hg  
 End: 30,297769 in Hg

TEMPERATURE FACTORS DGM 1 0,98793  
 DGM 2 0,98688  
 DGM 3 0,99725

DGM CONTROLLER VALUES  
 DGM 1 Final: 21850,412 Cuft  
 Initial: 21787,075 Cuft

VOLUMES SAMPLED DGM 1 61,090 SCft  
 DGM 2 61,665 SCft  
 DGM 3 43,034 SCft

DGM 2 Final: 19238,958 Cuft  
 Initial: 19174,976 Cuft

DGM #3 Final: 650,240 Cuft  
 Initial: 607,080 Cuft

TOTAL TUNNEL VOLUME : 62116

TEMPERATURES  
 DGM 1 534,450 °R  
 DGM 2 535,019 °R

SAMPLE RATIOS  
 Sample Train 1: 1016,804  
 Sample Train 2: 1007,314

CALIBRATION FACTORS  
 DGM 1 0,9879  
 DGM 2 0,9884  
 DGM #3 0,9864

Paticulate concentration  
 Sample Train 1 **0,000039** g/dscf  
 Sample Train 2 **0,000036** g/dscf  
 Room **0,000000** g/dscf

TUNNEL FLOW RATE: 175,469 Dscfm

TOTAL EMISSIONS  
 Sample Train 1 **2,44** g  
 Sample Train 2 **2,22** g

PARTICULATE CATCH  
 Total Sample Train 1: 2,40 mg  
 Total Sample Train 2: 2,20 mg  
 Total Sample Train 1 1st hour: 1,50 mg

EMISSION RATES  
 Sample Train 1 **0,41** g/hr  
 Sample Train 2 **0,38** g/hr

1st hour emission rate **1,53** g/hr

DEVIATION: 4,82%

Cs Train 1 Train 2  
 3,929E-05 3,56766E-05



		Average	0,04	9,91	#DIV/0!	215,02	69,46	84,29	320,65	219,48	311,15	296,92	343,56
*	*	*	*	*	*	*1	*2	*3	*4	*5	*6	*7	*8
Elapsed	Weight	Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit
Time	Raw data row	Remaining	CO	CO <sub>2</sub>	O <sub>2</sub>	Gas	Temp	Dry Bulb	Top	Back	R.Side	L.Side	Bottom
min	min	lbs	%	%	%	%F	°F	°F	°F	°F	°F	°F	°F
0,00	209,00	13,1	0,1	1,3	0,0	235,1	68,4	132,9	280,0	235,6	325,3	304,9	518,0
1,0	210,0	12,8	0,2	1,2	0,0	244,2	68,7	101,9	279,2	251,0	323,9	303,9	511,7
2,0	211,0	12,7	0,2	1,3	0,0	282,2	69,4	99,6	284,3	263,0	322,8	302,7	508,2
3,0	212,0	12,6	0,1	1,8	0,0	321,5	69,2	100,4	297,1	272,7	322,2	302,1	502,2
4,0	213,0	12,4	0,1	2,2	0,0	354,9	69,3	102,0	316,7	280,6	321,3	301,7	497,0
5,0	214,0	12,3	0,1	2,4	0,0	334,2	69,2	92,7	336,1	287,4	320,8	301,2	496,2
6,0	215,0	12,3	0,1	2,4	0,0	304,8	68,4	88,8	344,1	293,4	320,2	300,9	494,2
7,0	216,0	12,2	0,0	6,0	0,0	284,3	68,5	88,2	346,1	298,2	319,4	300,6	491,6
8,0	217,0	12,1	0,0	4,7	0,0	270,5	68,9	89,7	346,6	302,5	318,6	299,9	488,9
9,0	218,0	12,1	0,0	4,9	0,0	261,0	68,6	88,4	345,9	305,9	317,4	299,2	486,0
10,0	219,0	12,1	0,0	5,1	0,0	255,3	67,8	87,2	345,6	308,9	316,1	298,3	483,2
11,0	220,0	12,0	0,0	5,3	0,0	253,3	67,8	86,6	344,1	311,3	314,8	297,4	480,1
12,0	221,0	12,0	0,0	5,6	0,0	254,1	67,5	86,4	344,5	313,2	313,4	296,2	477,3
13,0	222,0	11,9	0,1	7,1	0,0	257,7	68,2	86,6	343,9	314,7	311,8	295,3	473,6
14,0	223,0	11,8	0,1	8,8	0,0	263,5	68,0	88,9	346,4	316,0	310,5	294,3	469,4
15,0	224,0	11,7	0,1	9,4	0,0	270,4	68,6	89,7	348,9	316,9	309,0	293,1	466,6
16,0	225,0	11,6	0,1	10,3	0,0	277,1	67,8	88,9	353,1	317,8	307,5	291,8	463,1
17,0	226,0	11,5	0,1	10,4	0,0	282,5	67,8	88,5	356,2	318,6	306,2	290,8	459,1
18,0	227,0	11,5	0,1	10,1	0,0	285,3	68,7	87,7	360,5	319,4	304,9	289,8	455,6
19,0	228,0	11,4	0,1	9,0	0,0	288,1	68,6	87,4	363,0	319,9	303,9	289,1	452,2
20,0	229,0	11,3	0,1	9,3	0,0	290,3	68,5	89,1	367,1	320,5	302,8	288,1	448,4
21,0	230,0	11,2	0,1	9,3	0,0	291,4	68,7	90,6	371,1	321,1	301,7	287,1	445,3
22,0	231,0	11,1	0,0	9,1	0,0	292,2	68,7	89,3	374,0	321,5	300,7	286,1	442,1
23,0	232,0	11,1	0,0	9,0	0,0	293,9	68,1	88,9	377,4	321,9	300,0	285,2	438,9
24,0	233,0	11,0	0,0	9,3	0,0	297,4	68,4	88,4	379,7	322,2	299,0	284,3	435,5
25,0	234,0	10,9	0,1	10,5	0,0	301,1	68,4	88,5	382,9	322,4	298,0	283,7	432,1
26,0	235,0	10,8	0,1	11,2	0,0	303,3	68,2	89,9	388,4	322,8	297,4	283,1	429,3
27,0	236,0	10,7	0,0	11,8	0,0	304,2	69,2	91,8	395,0	323,2	296,9	282,5	426,5
28,0	237,0	10,6	0,0	12,8	0,0	302,3	69,0	90,6	402,2	323,6	296,5	281,7	424,2
29,0	238,0	10,5	0,0	12,1	0,0	301,7	69,1	90,3	407,9	324,1	296,3	281,8	421,1
30,0	239,0	10,4	0,1	12,7	0,0	299,8	69,1	89,4	406,7	297,0	296,1	281,7	418,9
31,0	240,0	10,4	0,0	11,3	0,0	295,8	68,3	88,1	405,8	280,7	296,1	281,8	416,4
32,0	241,0	10,3	0,0	10,7	0,0	286,8	68,6	88,0	404,5	268,2	296,1	282,2	413,7
33,0	242,0	10,2	0,0	9,7	0,0	279,3	69,2	89,6	401,6	257,2	296,3	282,6	410,8
34,0	243,0	10,2	0,0	9,0	0,0	274,1	69,1	89,0	397,4	250,4	296,2	282,7	408,4
35,0	244,0	10,1	0,0	8,7	0,0	271,0	68,7	87,9	393,3	244,6	296,2	283,1	405,9
36,0	245,0	10,0	0,0	8,7	0,0	268,3	68,9	87,7	389,9	238,7	296,0	283,4	403,4
37,0	246,0	10,0	0,0	9,1	0,0	268,2	68,4	86,9	385,9	235,0	295,9	283,5	400,9
38,0	247,0	9,9	0,0	10,1	0,0	270,9	68,4	86,6	382,9	230,6	295,8	283,9	398,2
39,0	248,0	9,8	0,0	11,3	0,0	274,0	68,8	88,8	382,4	227,7	295,7	284,3	395,4
40,0	249,0	9,7	0,0	11,8	0,0	277,3	69,4	90,2	382,8	224,5	295,4	284,4	393,2
41,0	250,0	9,6	0,0	12,1	0,0	281,0	69,5	88,6	383,8	222,0	295,2	284,4	391,2
42,0	251,0	9,6	0,1	12,1	0,0	283,7	68,7	88,2	385,5	219,3	295,6	284,3	388,8
43,0	252,0	9,5	0,0	11,7	0,0	285,5	68,6	87,6	386,4	217,2	295,6	284,4	386,7
44,0	253,0	9,4	0,0	11,8	0,0	287,3	68,5	87,0	387,7	215,8	295,9	284,2	384,8
45,0	254,0	9,3	0,0	11,9	0,0	288,2	69,2	87,6	389,5	214,4	296,0	284,4	382,6
46,0	255,0	9,2	0,0	12,0	0,0	289,9	69,5	89,7	390,9	213,3	296,3	284,7	379,8
47,0	256,0	9,1	0,0	12,2	0,0	289,6	69,3	89,0	394,3	212,4	296,6	284,3	378,4
48,0	257,0	9,1	0,0	12,5	0,0	288,1	68,3	88,3	399,1	211,6	297,0	284,4	376,3
49,0	258,0	9,0	0,0	12,3	0,0	285,4	68,9	87,7	402,2	211,1	297,5	284,5	374,3
50,0	259,0	9,0	0,0	11,8	0,0	284,0	68,9	87,2	404,1	211,7	298,1	284,5	372,6
51,0	260,0	8,9	0,0	11,5	0,0	281,4	68,8	86,6	405,0	210,1	298,9	284,8	370,5
52,0	261,0	8,8	0,0	11,2	0,0	277,6	68,7	87,9	405,7	210,4	299,5	284,8	368,2
53,0	262,0	8,7	0,0	11,0	0,0	274,0	69,3	89,3	405,4	208,7	300,5	284,8	366,5
54,0	263,0	8,7	0,0	11,1	0,0	271,4	69,4	87,6	404,8	208,6	301,4	284,9	364,7
55,0	264,0	8,6	0,0	11,1	0,0	269,2	69,1	87,2	404,0	207,9	302,3	285,1	362,8
56,0	265,0	8,5	0,0	11,2	0,0	269,7	69,4	87,2	403,2	207,1	303,2	285,0	361,2
57,0	266,0	8,4	0,0	11,6	0,0	269,3	68,7	86,2	401,9	207,4	304,1	284,8	359,4
58,0	267,0	8,4	0,0	12,0	0,0	271,8	69,2	86,6	401,7	207,4	305,0	284,9	357,8
59,0	268,0	8,3	0,0	12,3	0,0	273,3	69,5	88,8	401,6	206,8	305,8	284,6	356,3
60,0	269,0	8,2	0,0	12,7	0,0	274,4	69,4	89,4	401,6	206,9	306,5	285,3	354,5
61,0	270,0	8,1	0,0	12,8	0,0	276,0	69,6	88,2	401,2	206,8	307,3	285,6	352,9
62,0	271,0	8,1	0,0	12,8	0,0	276,0	68,8	87,7	401,8	207,4	308,1	286,2	350,8
63,0	272,0	8,0	0,0	12,6	0,0	276,9	69,3	87,0	402,3	206,5	308,9	286,9	349,0
64,0	273,0	7,9	0,0	12,4	0,0	276,8	68,9	86,6	402,7	205,9	309,4	287,5	347,5
65,0	274,0	7,8	0,0	12,3	0,0	277,9	68,7	88,2	402,7	207,7	310,3	288,5	345,4
66,0	275,0	7,8	0,0	12,4	0,0	277,4	69,6	90,0	403,5	206,6	310,9	289,2	344,3
67,0	276,0	7,7	0,0	12,3	0,0	277,3	69,6	88,1	403,5	206,6	311,3	290,1	342,5
68,0	277,0	7,6	0,0	12,3	0,0	277,0	69,1	87,4	403,8	206,5	312,1	290,8	340,9
69,0	278,0	7,5	0,0	12,4	0,0	277,1	69,4	86,9	404,3	206,5	312,5	291,9	339,3
70,0	279,0	7,5	0,0	12,4	0,0	275,9	68,5	86,2	404,4	206,6	313,1	293,0	337,8
71,0	280,0	7,4	0,1	12,3	0,0	279,4	68,3	86,2	402,1	206,9	313,7	293,8	336,1
72,0	281,0	7,3	0,2	13,0	0,0	287,8	69,6	88,8	400,9	206,7	313,9	294,5	334,3
73,0	282,0	7,3	0,3	13,6	0,0	296,7	69,2	88,9	402,1	206,7	314,4	294,9	333,3
74,0	283,0	7,1	0,3	14,1	0,0	307,5	69,2	88,7	405,0	207,9	314,3	295,2	331,8
75,0	284,0	7,1	0,3	14,7	0,0	307,6	68,9	88,2	411,6	209,0	314,6	295,9	330,2
76,0	285,0	7,0	0,0	13,4	0,0	300,6	69,3	87,2	418,5	209,9	315,0	296,6	329,0
77,0	286,0	6,9	0,0	12,5	0,0	294,8	68,8	87,0	422,7	211,1	315,4	297,3	327,8
78,0	287,0	6,9	0,0	12,1	0,0	287,9	68,8	87,8	424,0	213,4	316,1	298,0	326,4
79,0	288,0	6,8	0,0	11,8	0,0	282,8	69,8	89,8	424,9	212,8	316,9	298,4	325,5
80,0	289,0	6,7	0,0	11,7	0,0	277,8	69,5	87,8	424,4	213,9	317,7	298,9	324,7
81,0	290,0	6,7	0,0	11,8	0,0	274,0	69,1	87,4	423,6	213,6	318,5	299,4	323,4
82,0	291,0	6,6	0,0	11,7	0,0	270,8	69,1	86,8	423,1	213,9	319,4	299,9	322,5
83,0	292,0	6,5	0,0	11,8	0,0	268,3	68,7	86,3	422,0	214,4	320,4	300,4	321,2
84,0	293,0	6,5	0,0	11,8	0,0	265,0	69,3	85,8	420,8	215,1	321,5	300,9	320,2
85,0	294,0	6,4	0,0	11,7	0,0	263,2	69,2	87,7	419,9	215,1	322,5	301,6	318,8
86,0	295,0	6,3	0,0	11,8	0,0	261,6	69,7	88,3					

101.0	310.0	5,4	0,0	11,8	0,0	244,4	68,9	86,1	394,0	214,0	339,9	308,0	304,1
102.0	311,0	5,4	0,0	11,8	0,0	243,5	69,2	85,4	393,3	214,1	341,0	308,4	303,5
103.0	312,0	5,3	0,0	11,9	0,0	243,3	68,3	85,0	392,9	214,2	341,6	309,0	302,5
104.0	313,0	5,3	0,0	12,0	0,0	242,2	69,2	84,5	392,8	213,5	342,2	309,6	301,7
105.0	314,0	5,2	0,0	12,0	0,0	241,6	69,1	86,1	392,3	214,6	342,9	310,3	300,7
106.0	315,0	5,1	0,0	11,9	0,0	246,2	69,9	88,3	389,6	213,9	343,4	310,6	300,2
107.0	316,0	5,1	0,1	13,6	0,0	258,4	69,9	86,6	387,1	214,1	343,7	310,7	299,7
108.0	317,0	5,0	0,1	14,6	0,0	274,8	69,1	87,6	388,3	214,2	343,8	311,2	298,8
109.0	318,0	5,0	0,1	15,1	0,0	280,0	69,9	86,3	394,1	214,8	343,9	311,6	298,0
110.0	319,0	4,9	0,0	13,4	0,0	276,5	69,1	85,9	400,3	216,2	344,0	312,0	297,4
111.0	320,0	4,8	0,0	12,8	0,0	270,8	69,4	85,3	405,1	216,5	344,3	312,4	296,9
112.0	321,0	4,7	0,0	12,5	0,0	265,3	69,0	86,8	407,5	217,3	344,5	313,0	296,0
113.0	322,0	4,7	0,0	12,3	0,0	260,1	70,0	88,0	408,7	217,5	344,9	313,6	295,7
114.0	323,0	4,6	0,0	12,1	0,0	256,2	70,0	86,2	409,1	218,4	345,4	314,2	295,2
115.0	324,0	4,5	0,0	12,2	0,0	253,5	69,7	86,0	409,4	218,1	345,9	314,9	294,5
116.0	325,0	4,5	0,0	12,2	0,0	250,6	70,0	85,3	408,5	218,5	346,3	315,6	294,3
117.0	326,0	4,4	0,0	12,2	0,0	248,4	69,5	84,9	407,7	218,2	346,8	316,3	293,9
118.0	327,0	4,3	0,0	12,0	0,0	246,3	69,6	84,3	406,4	218,7	347,3	317,2	293,2
119.0	328,0	4,3	0,0	12,1	0,0	245,0	70,3	86,5	405,8	218,8	347,8	318,1	292,2
120.0	329,0	4,2	0,0	12,0	0,0	242,5	70,2	86,4	404,8	219,1	348,3	318,5	292,0
121.0	330,0	4,2	0,0	11,5	0,0	240,5	69,9	85,4	403,0	219,7	349,1	319,6	291,4
122.0	331,0	4,2	0,0	11,1	0,0	238,7	70,0	84,9	400,7	219,9	349,5	320,0	290,7
123.0	332,0	4,1	0,0	11,0	0,0	236,8	70,0	84,7	398,9	219,5	350,2	320,5	290,4
124.0	333,0	4,1	0,0	10,9	0,0	235,3	69,5	83,8	395,5	220,0	350,5	321,2	289,6
125.0	334,0	4,0	0,0	10,6	0,0	234,0	70,2	83,7	392,5	219,7	350,9	321,8	288,9
126.0	335,0	4,0	0,0	10,5	0,0	232,6	70,2	86,3	389,7	219,4	351,2	322,4	288,3
127.0	336,0	3,9	0,0	10,5	0,0	230,7	70,6	85,2	387,5	219,2	351,3	322,6	288,1
128.0	337,0	3,9	0,0	10,7	0,0	229,2	69,8	85,0	384,3	219,4	351,5	322,9	287,9
129.0	338,0	3,9	0,0	10,7	0,0	228,3	70,3	84,5	381,9	219,7	351,7	323,1	287,7
130.0	339,0	3,8	0,0	10,7	0,0	227,2	69,6	83,9	379,5	219,4	351,7	323,5	287,4
131.0	340,0	3,8	0,0	10,9	0,0	226,5	69,5	83,7	377,3	219,7	351,7	324,0	287,0
132.0	341,0	3,7	0,0	11,0	0,0	225,4	70,1	83,6	376,1	219,5	351,6	324,3	286,7
133.0	342,0	3,7	0,0	11,1	0,0	224,8	70,3	86,0	375,0	219,1	351,4	324,8	286,1
134.0	343,0	3,6	0,0	11,2	0,0	223,9	70,6	84,8	373,6	219,8	351,4	324,9	286,2
135.0	344,0	3,6	0,0	11,5	0,0	223,3	69,8	84,5	372,4	220,3	351,2	325,7	285,6
136.0	345,0	3,6	0,0	11,3	0,0	222,5	70,6	84,6	371,5	220,1	350,9	325,9	285,7
137.0	346,0	3,5	0,0	11,3	0,0	222,0	70,1	83,5	371,0	220,0	350,6	326,2	285,6
138.0	347,0	3,5	0,0	11,3	0,0	221,2	69,9	83,0	370,5	220,4	350,5	327,0	285,3
139.0	348,0	3,4	0,0	11,4	0,0	220,1	70,5	83,0	370,1	220,5	350,2	327,8	284,7
140.0	349,0	3,4	0,0	11,3	0,0	219,0	70,3	85,4	369,8	220,6	349,8	328,5	284,5
141.0	350,0	3,4	0,0	10,9	0,0	218,5	70,7	84,7	369,3	220,2	349,6	329,0	284,5
142.0	351,0	3,3	0,0	10,8	0,0	217,6	69,6	84,0	368,3	220,8	349,2	329,6	284,5
143.0	352,0	3,3	0,0	10,2	0,0	216,2	69,9	83,8	367,1	220,7	348,9	330,0	284,5
144.0	353,0	3,2	0,0	10,1	0,0	215,5	70,0	83,0	364,5	220,8	348,4	330,4	284,3
145.0	354,0	3,2	0,0	10,4	0,0	215,2	69,3	82,5	362,1	219,7	347,7	331,0	284,3
146.0	355,0	3,2	0,0	10,5	0,0	215,0	70,6	82,4	360,7	220,7	347,1	331,3	284,3
147.0	356,0	3,2	0,0	10,6	0,0	214,6	70,1	85,0	359,1	220,1	346,4	332,0	283,9
148.0	357,0	3,1	0,0	10,9	0,0	214,5	70,6	84,7	358,3	220,3	345,7	331,9	284,3
149.0	358,0	3,1	0,0	11,0	0,0	214,3	70,3	83,7	357,3	220,0	345,0	332,5	283,9
150.0	359,0	3,0	0,0	11,1	0,0	214,0	69,8	83,5	356,4	220,0	344,3	332,9	284,2
151.0	360,0	3,0	0,0	11,1	0,0	213,8	70,4	82,8	355,9	220,3	343,6	333,1	284,4
152.0	361,0	3,0	0,0	11,2	0,0	212,9	69,4	82,5	355,6	219,5	342,9	333,6	284,3
153.0	362,0	3,0	0,0	11,1	0,0	212,3	69,9	82,1	355,1	219,9	342,0	334,2	284,4
154.0	363,0	2,9	0,0	11,1	0,0	211,8	70,5	84,7	354,3	220,0	341,1	334,8	284,1
155.0	364,0	2,9	0,0	11,2	0,0	211,1	70,4	84,8	354,0	219,8	340,4	335,4	284,5
156.0	365,0	2,8	0,0	11,2	0,0	210,1	70,0	83,6	353,4	220,1	339,7	335,8	284,7
157.0	366,0	2,8	0,0	11,1	0,0	209,5	70,3	83,6	353,2	219,6	339,0	336,4	284,8
158.0	367,0	2,8	0,0	11,0	0,0	208,4	69,9	82,7	352,1	219,5	338,5	336,7	285,2
159.0	368,0	2,8	0,0	10,8	0,0	207,7	69,5	82,1	350,8	219,0	337,7	337,0	285,5
160.0	369,0	2,8	0,0	10,5	0,0	207,3	70,1	81,8	349,0	218,5	337,1	337,8	285,5
161.0	370,0	2,7	0,0	10,2	0,0	207,4	69,9	84,3	347,0	219,8	336,4	338,1	285,5
162.0	371,0	2,7	0,0	10,1	0,0	207,1	70,5	84,0	344,4	219,3	335,7	338,0	286,3
163.0	372,0	2,7	0,0	10,0	0,0	206,6	69,9	83,5	341,9	219,0	335,0	338,3	286,5
164.0	373,0	2,7	0,0	9,6	0,0	206,6	70,0	83,3	339,5	218,8	334,4	338,2	286,8
165.0	374,0	2,6	0,0	9,6	0,0	206,5	69,6	82,3	337,1	219,2	333,6	338,0	287,3
166.0	375,0	2,6	0,0	9,4	0,0	206,2	70,2	82,1	335,0	219,0	332,9	338,0	286,9
167.0	376,0	2,6	0,0	9,3	0,0	205,9	69,8	81,6	332,4	219,5	332,0	337,2	287,6
168.0	377,0	2,6	0,0	9,3	0,0	205,4	69,8	84,0	330,5	219,7	331,1	336,9	287,8
169.0	378,0	2,6	0,0	9,3	0,0	204,7	70,1	84,8	327,8	220,4	330,5	336,3	288,4
170.0	379,0	2,5	0,0	9,3	0,0	204,2	69,9	83,2	326,1	220,1	329,7	335,5	288,6
171.0	380,0	2,5	0,0	9,3	0,0	203,9	70,0	83,6	323,8	220,6	328,9	334,7	288,7
172.0	381,0	2,5	0,0	9,2	0,0	202,9	70,6	82,6	321,3	220,3	328,2	333,9	289,4
173.0	382,0	2,4	0,0	9,2	0,0	202,3	70,2	82,4	319,8	221,0	327,3	333,3	289,7
174.0	383,0	2,4	0,0	9,1	0,0	201,7	69,8	81,7	318,1	221,0	326,7	332,7	290,2
175.0	384,0	2,4	0,0	8,9	0,0	201,3	69,7	83,2	316,4	221,4	326,0	332,0	290,6
176.0	385,0	2,4	0,0	9,0	0,0	200,5	70,5	85,0	314,0	222,4	325,4	331,3	290,9
177.0	386,0	2,4	0,0	9,0	0,0	200,0	70,4	83,2	312,2	221,9	324,9	330,4	291,5
178.0	387,0	2,4	0,0	8,9	0,0	199,1	70,3	83,4	310,4	221,7	324,2	329,5	291,8
179.0	388,0	2,4	0,0	8,7	0,0	198,6	69,9	82,3	308,7	221,8	323,7	328,5	292,3
180.0	389,0	2,4	0,0	8,8	0,0	197,9	70,4	82,1	307,1	222,4	323,2	328,0	292,2
181.0	390,0	2,3	0,0	8,7	0,0	197,6	69,9	81,2	305,5	221,8	322,6	326,8	292,9
182.0	391,0	2,3	0,0	9,1	0,0	196,3	70,2	82,4	303,8	222,6	322,1	325,8	293,1
183.0	392,0	2,3	0,0	9,2	0,0	195,1	70,6	84,8	302,0	222,6	321,4	325,0	293,1
184.0	393,0	2,3	0,0	9,1	0,0	193,6	70,4	83,0	300,5	223,0	320,6	323,9	294,0
185.0	394,0	2,3	0,0	9,2	0,0	192,4	69,7	82,9	298,7	223,3	320,2	323,1	294,3
186.0	395,0	2,2	0,0	9,2	0,0	191,6	70,2	82,2	297,4	222,0	319,7	322,1	295,1
187.0	396,0	2,3	0,0	9,3	0,0	190,6	69,5	81,3	296,2	222,0	319,4	321,3	295,6
188.0	397,0	2,2	0,0	9,2	0,0	189,9	69,6	81,3	295,0	221,8	319,1	320,3	296,2
189.0	398,0	2,2	0,0	9,2	0,0	188,9	70,1	82,0	293,5	222,4	318,7	319,4	296,6
190.0	399,0	2,2	0,0	9,1	0,0	187,7	70,1	84,4	292,1	222,4	318,3	318,7	297,4
191.0	400,0	2,2	0,0	9,1	0,0	187,0							

207,0	416,0	1,9	0,0	9,2	0,0	181,9	69,7	81,9	276,4	219,8	312,3	306,5	306,7
208,0	417,0	1,9	0,0	9,1	0,0	181,9	69,7	81,4	276,0	219,3	312,0	305,9	307,4
209,0	418,0	1,9	0,0	9,1	0,0	181,9	69,7	81,6	275,5	219,2	311,8	305,4	307,9
210,0	419,0	1,9	0,0	9,1	0,0	182,2	69,6	81,1	274,8	218,7	311,3	304,5	308,4
211,0	420,0	1,9	0,0	9,2	0,0	181,8	69,4	82,7	274,6	218,9	311,1	304,3	308,3
212,0	421,0	1,8	0,0	9,1	0,0	181,6	69,9	84,2	274,5	218,8	310,7	303,5	309,1
213,0	422,0	1,8	0,0	9,2	0,0	181,8	69,9	82,2	274,0	219,7	310,6	303,0	309,5
214,0	423,0	1,8	0,0	9,2	0,0	181,8	69,5	82,4	273,7	219,4	310,2	302,6	309,6
215,0	424,0	1,8	0,0	9,2	0,0	181,8	69,8	81,5	273,1	218,9	309,9	301,8	310,1
216,0	425,0	1,8	0,0	9,2	0,0	181,7	70,2	81,3	273,1	218,9	309,6	301,2	310,5
217,0	426,0	1,8	0,0	9,2	0,0	181,9	70,1	80,7	272,8	218,5	309,3	300,7	311,0
218,0	427,0	1,7	0,0	9,3	0,0	181,7	69,9	82,0	272,5	218,8	309,0	299,9	311,5
219,0	428,0	1,8	0,0	9,3	0,0	181,8	70,1	84,0	272,4	218,2	308,7	299,4	311,7
220,0	429,0	1,8	0,0	9,4	0,0	181,8	70,4	81,9	272,3	218,2	308,3	299,0	312,1
221,0	430,0	1,7	0,0	9,3	0,0	182,1	69,7	82,2	272,5	217,1	308,2	298,4	312,5
222,0	431,0	1,7	0,0	9,2	0,0	182,2	70,1	81,9	271,8	217,1	307,8	298,0	312,8
223,0	432,0	1,7	0,0	9,2	0,0	182,4	70,1	81,1	271,3	216,7	307,4	297,2	313,3
224,0	433,0	1,7	0,0	9,2	0,0	182,4	70,1	80,7	271,3	216,3	307,5	296,5	313,6
225,0	434,0	1,7	0,0	9,2	0,0	182,7	70,1	81,5	270,9	216,0	306,9	296,0	314,2
226,0	435,0	1,6	0,0	9,3	0,0	182,7	70,3	83,8	270,4	216,2	306,7	295,6	314,8
227,0	436,0	1,7	0,0	9,9	0,0	181,7	70,6	82,4	270,3	216,0	306,4	295,1	315,0
228,0	437,0	1,6	0,0	10,1	0,0	180,4	69,7	82,1	269,3	215,5	306,1	294,7	315,7
229,0	438,0	1,6	0,0	9,7	0,0	179,3	69,8	81,8	268,6	216,3	306,0	294,5	316,1
230,0	439,0	1,6	0,0	9,7	0,0	178,3	69,9	80,9	267,8	215,6	305,8	293,7	317,0
231,0	440,0	1,6	0,0	9,6	0,0	177,4	69,4	80,7	267,4	215,7	305,4	293,5	317,4
232,0	441,0	1,5	0,0	9,6	0,0	176,6	69,5	80,6	266,8	215,4	305,5	293,1	318,1
233,0	442,0	1,5	0,0	9,5	0,0	175,8	69,6	82,4	265,8	215,1	305,2	292,7	319,0
234,0	443,0	1,5	0,0	9,5	0,0	175,0	70,3	83,7	264,8	214,9	305,1	292,1	320,0
235,0	444,0	1,5	0,0	9,6	0,0	174,5	69,8	81,7	264,6	214,6	304,8	291,8	320,8
236,0	445,0	1,5	0,0	9,6	0,0	174,4	69,4	82,0	263,7	214,5	304,6	291,3	321,6
237,0	446,0	1,5	0,0	9,5	0,0	174,2	69,7	81,2	262,9	214,1	304,3	290,8	322,3
238,0	447,0	1,5	0,0	9,5	0,0	173,9	70,1	80,8	262,2	214,3	304,2	290,8	322,9
239,0	448,0	1,5	0,0	9,5	0,0	173,8	69,9	80,4	261,7	214,0	303,9	290,3	323,4
240,0	449,0	1,5	0,0	9,5	0,0	173,9	69,9	81,4	261,4	213,0	303,6	290,0	324,3
241,0	450,0	1,4	0,0	9,5	0,0	173,7	69,8	83,3	261,1	213,2	303,4	289,9	325,0
242,0	451,0	1,4	0,0	9,5	0,0	173,8	70,4	82,0	261,0	212,7	303,3	289,4	325,6
243,0	452,0	1,4	0,0	9,6	0,0	173,9	70,1	81,9	260,8	212,9	303,2	289,2	326,1
244,0	453,0	1,4	0,0	9,6	0,0	174,1	70,2	81,2	260,2	213,3	303,0	288,8	327,0
245,0	454,0	1,4	0,0	9,5	0,0	174,6	69,6	80,8	260,0	212,6	302,8	288,3	327,6
246,0	455,0	1,4	0,0	9,5	0,0	174,7	69,6	80,6	259,4	211,9	302,6	288,3	327,8
247,0	456,0	1,4	0,0	9,4	0,0	174,8	70,2	80,4	259,7	211,3	302,1	287,9	328,8
248,0	457,0	1,4	0,0	9,3	0,0	175,2	69,4	82,7	259,3	210,7	302,1	287,9	329,0
249,0	458,0	1,3	0,0	9,4	0,0	175,1	70,7	82,0	259,7	210,7	302,1	287,4	329,8
250,0	459,0	1,3	0,0	9,4	0,0	174,7	69,7	81,6	259,4	211,0	301,6	287,0	330,4
251,0	460,0	1,3	0,0	9,5	0,0	174,5	69,7	81,5	259,5	210,7	301,4	287,0	330,7
252,0	461,0	1,3	0,0	9,4	0,0	174,8	69,6	80,7	259,0	210,8	301,3	286,6	331,4
253,0	462,0	1,2	0,0	9,4	0,0	174,8	69,8	80,3	258,7	210,8	301,0	286,3	332,0
254,0	463,0	1,3	0,0	9,3	0,0	174,7	69,7	80,3	258,2	210,0	300,8	286,1	332,4
255,0	464,0	1,3	0,0	9,2	0,0	174,5	70,0	82,2	258,3	209,7	300,6	286,0	333,0
256,0	465,0	1,2	0,0	9,1	0,0	173,8	70,6	83,4	258,1	210,2	300,3	285,6	333,8
257,0	466,0	1,2	0,0	9,1	0,0	173,8	69,6	81,9	257,7	210,4	300,0	285,2	334,3
258,0	467,0	1,2	0,0	9,0	0,0	173,7	69,8	82,1	257,4	209,6	299,8	284,7	335,0
259,0	468,0	1,2	0,0	8,9	0,0	174,0	69,8	81,2	257,1	209,8	299,5	284,8	334,9
260,0	469,0	1,2	0,0	8,9	0,0	174,3	69,3	80,5	256,7	209,7	299,1	284,6	335,6
261,0	470,0	1,2	0,0	9,0	0,0	174,3	69,8	80,5	256,4	208,7	298,8	284,3	335,9
262,0	471,0	1,2	0,0	8,9	0,0	174,6	69,7	82,2	256,5	209,0	298,5	284,1	336,5
263,0	472,0	1,1	0,1	9,1	0,0	174,5	69,8	83,6	256,1	207,9	298,4	283,6	337,2
264,0	473,0	1,1	0,0	9,2	0,0	173,7	69,7	81,8	255,8	207,5	297,9	283,2	337,9
265,0	474,0	1,1	0,0	9,1	0,0	173,7	69,1	82,0	255,2	206,7	297,6	282,7	338,5
266,0	475,0	1,1	0,0	9,1	0,0	173,8	69,3	81,3	255,2	206,3	297,4	282,4	339,1
267,0	476,0	1,1	0,0	9,0	0,0	173,5	69,1	81,1	254,6	206,4	297,1	282,2	339,6
268,0	477,0	1,1	0,0	8,9	0,0	173,2	69,3	80,5	254,6	205,1	296,7	281,7	340,6
269,0	478,0	1,1	0,0	9,0	0,0	173,0	69,6	81,8	254,3	204,8	296,2	281,5	341,6
270,0	479,0	1,1	0,0	9,0	0,0	172,3	69,8	83,3	253,9	205,2	295,9	281,1	342,4
271,0	480,0	1,0	0,0	9,1	0,0	172,0	70,1	81,8	253,9	204,9	295,6	280,8	343,3
272,0	481,0	1,1	0,0	9,1	0,0	171,8	69,0	81,7	253,6	204,7	295,3	280,6	344,0
273,0	482,0	1,0	0,0	9,1	0,0	171,9	69,4	81,1	253,3	204,1	295,1	280,2	344,9
274,0	483,0	1,0	0,0	9,1	0,0	172,2	69,2	80,8	253,3	203,8	294,9	279,8	345,8
275,0	484,0	1,0	0,0	9,1	0,0	172,3	69,3	80,4	253,1	203,3	294,6	279,4	346,6
276,0	485,0	1,0	0,0	9,0	0,0	172,3	69,5	80,8	253,0	202,4	294,4	279,4	347,3
277,0	486,0	0,9	0,0	9,0	0,0	172,2	69,9	82,8	253,0	202,7	293,9	279,3	348,1
278,0	487,0	1,0	0,1	9,1	0,0	172,0	70,2	82,2	253,2	202,2	293,7	278,8	348,9
279,0	488,0	0,9	0,1	9,2	0,0	172,0	69,2	81,7	253,1	202,3	293,2	278,4	350,0
280,0	489,0	0,9	0,1	9,1	0,0	172,2	69,3	81,6	253,4	202,1	293,1	278,2	350,7
281,0	490,0	0,9	0,1	9,1	0,0	172,0	69,0	80,7	253,1	202,2	292,6	277,8	351,7
282,0	491,0	0,9	0,0	9,0	0,0	172,6	69,2	80,7	253,3	201,2	292,4	277,5	352,2
283,0	492,0	0,9	0,0	9,0	0,0	172,6	69,4	80,3	253,3	201,2	292,1	277,3	352,6
284,0	493,0	0,9	0,1	9,0	0,0	172,7	69,5	82,4	253,6	200,9	291,8	277,4	353,4
285,0	494,0	0,9	0,1	9,1	0,0	172,3	69,5	83,1	253,7	200,8	291,6	276,9	354,2
286,0	495,0	0,8	0,1	9,1	0,0	172,1	69,3	81,6	253,9	200,9	291,2	276,9	354,7
287,0	496,0	0,9	0,1	9,1	0,0	172,2	69,2	81,8	253,9	200,3	291,0	276,6	355,3
288,0	497,0	0,9	0,1	9,1	0,0	172,4	69,1	81,0	253,8	200,3	290,8	276,1	356,0
289,0	498,0	0,8	0,1	9,2	0,0	172,5	69,2	80,8	254,0	200,4	290,4	276,4	356,6
290,0	499,0	0,8	0,1	9,1	0,0	172,8	69,4	80,0	254,2	199,8	290,2	276,2	356,7
291,0	500,0	0,8	0,1	9,0	0,0	172,8	69,5	82,3	254,0	199,7	289,9	276,1	357,1
292,0	501,0	0,8	0,0	9,0	0,0	172,3	69,8	82,9	254,5	199,5	289,9	275,6	357,7
293,0	502,0	0,8	0,0	9,1	0,0	171,9	69,4	81,7	254,1	199,6	289,7	275,5	358,2
294,0	503,0	0,8	0,0	9,1	0,0	171,8	69,2	81,6	254,0	199,5	289,5	275,3	358,7
295,0	504,0	0,7	0,0	9,1	0,0	172,0	69,2	81,0	254,0	199,0	289,2	274,8	359,0
296,0	505,0	0,7	0,0	9,0	0,0	172,3	69,0	80,4	253,7	198,9	289,3	274,7	359,4
297,0	506,0	0,7	0,0	9,0	0,0	172,1	68,8	80,4	253,5	198,2	289,0	274,4	359,

313,0	522,0	0,5	0,0	9,0	0,0	169,7	69,7	83,5	249,8	194,1	285,9	271,9	370,6
314,0	523,0	0,5	0,0	9,1	0,0	169,2	69,4	81,7	249,7	194,0	285,6	272,0	371,6
315,0	524,0	0,5	0,0	9,2	0,0	168,6	68,8	81,7	249,6	194,0	285,4	271,9	372,3
316,0	525,0	0,5	0,0	9,1	0,0	168,0	69,2	81,2	249,3	193,8	285,4	271,3	373,4
317,0	526,0	0,5	0,0	9,0	0,0	167,5	68,8	80,7	248,7	193,9	285,1	271,6	374,2
318,0	527,0	0,4	0,0	8,9	0,0	167,1	68,8	80,2	248,6	193,2	285,0	271,2	375,4
319,0	528,0	0,4	0,0	8,9	0,0	166,8	69,2	81,7	247,9	193,3	284,6	271,1	376,0
320,0	529,0	0,4	0,0	8,9	0,0	166,0	69,5	83,1	247,5	193,0	284,3	270,9	377,2
321,0	530,0	0,4	0,0	8,9	0,0	165,5	69,4	81,5	247,0	192,9	284,1	270,5	378,6
322,0	531,0	0,4	0,0	8,9	0,0	164,8	69,0	81,5	246,9	192,5	283,9	270,5	379,8
323,0	532,0	0,4	0,0	8,8	0,0	164,8	69,3	81,1	246,3	193,2	283,6	270,1	381,1
324,0	533,0	0,4	0,0	8,9	0,0	164,2	68,9	80,6	246,0	192,3	283,3	270,2	382,3
325,0	534,0	0,3	0,0	8,9	0,0	164,3	68,8	80,3	245,7	192,0	283,2	269,9	383,6
326,0	535,0	0,3	0,0	9,0	0,0	164,1	69,0	80,8	245,1	191,7	282,9	269,9	384,5
327,0	536,0	0,3	0,0	9,0	0,0	163,7	69,1	82,8	245,0	191,2	282,6	270,0	385,7
328,0	537,0	0,3	0,0	9,0	0,0	163,1	69,5	81,5	244,5	191,3	282,5	269,6	387,1
329,0	538,0	0,3	0,0	9,0	0,0	162,7	68,9	81,3	244,3	190,6	282,1	269,5	388,4
330,0	539,0	0,3	0,0	9,1	0,0	162,7	68,9	81,1	243,9	190,7	282,0	269,0	389,7
331,0	540,0	0,3	0,0	9,1	0,0	162,7	68,9	80,6	243,7	190,9	281,7	269,1	390,6
332,0	541,0	0,3	0,0	9,1	0,0	162,5	68,9	79,9	243,6	190,9	281,5	268,9	391,7
333,0	542,0	0,2	0,0	9,0	0,0	162,4	69,4	80,5	243,8	190,4	281,2	268,9	392,3
334,0	543,0	0,3	0,0	9,1	0,0	162,8	69,1	82,6	243,5	189,7	281,1	268,9	393,1
335,0	544,0	0,2	0,0	9,1	0,0	162,6	69,8	81,8	243,7	189,6	280,9	268,5	394,2
336,0	545,0	0,2	0,0	9,2	0,0	162,8	69,0	81,2	243,5	189,3	280,5	268,7	394,8
337,0	546,0	0,2	0,0	9,1	0,0	162,6	69,2	81,1	243,5	188,8	280,4	268,2	395,8
338,0	547,0	0,2	0,0	9,1	0,0	162,4	68,9	80,5	243,6	188,8	280,0	268,2	396,6
339,0	548,0	0,2	0,0	9,1	0,0	162,6	68,6	80,1	243,3	188,5	279,8	268,2	397,3
340,0	549,0	0,2	0,0	9,1	0,0	163,1	68,6	80,8	243,8	188,4	279,7	268,3	397,2
341,0	550,0	0,2	0,0	9,0	0,0	163,0	69,5	82,5	243,7	188,4	279,2	268,3	397,9
342,0	551,0	0,2	0,0	8,9	0,0	163,0	69,0	81,7	243,2	188,4	279,1	267,8	398,7
343,0	552,0	0,1	0,0	8,9	0,0	162,9	68,6	81,1	243,4	187,6	278,6	267,8	399,2
344,0	553,0	0,1	0,0	8,9	0,0	162,9	69,3	81,1	243,3	187,3	278,5	267,5	399,9
345,0	554,0	0,1	0,0	8,9	0,0	163,1	68,6	80,5	243,3	187,2	278,2	267,5	400,3
346,0	555,0	0,1	0,0	8,9	0,0	163,7	68,6	80,2	243,1	186,9	278,0	267,4	400,6
347,0	556,0	0,1	0,1	9,0	0,0	163,7	68,9	80,6	243,0	186,7	277,5	267,4	400,7
348,0	557,0	0,1	0,1	9,1	0,0	163,9	68,9	82,5	243,0	186,1	277,4	267,6	400,9
349,0	558,0	0,1	0,1	9,1	0,0	163,8	69,0	81,9	243,4	186,0	277,1	267,2	401,6
350,0	559,0	0,1	0,1	9,1	0,0	164,2	68,7	81,3	244,0	186,1	276,7	267,3	401,8
351,0	560,0	0,1	0,1	9,1	0,0	165,0	69,2	81,1	244,1	186,1	276,6	267,0	402,2
352,0	561,0	0,1	0,1	9,1	0,0	165,4	68,7	80,4	244,8	186,4	276,1	267,4	402,1
353,0	562,0	0,1	0,1	9,1	0,0	165,8	68,9	79,6	245,3	186,0	275,7	267,2	402,2
354,0	563,0	0,0	0,1	9,0	0,0	166,4	68,9	80,6	245,6	186,0	275,3	267,2	402,0

Manufacturer: HEARTHSTONE  
 Model: GM 60

Run: 1  
 Project #: PI 20162  
 Test Duration: 354 min

	HHV	LHV
Eff	80,42%	86,92%
Comb Eff	99,50%	99,50%
HT Eff	80,83%	87,36%
Output	13 291	kJ/h
Burn Rate	0,83	kg/h
Grams CO	52	g
Input	16 526	kJ/h
MC wet	17,02	

Note: In the "Input data", "Calc. % O<sub>2</sub>", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a], [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3

Ultimate CO<sub>2</sub>  
 CO<sub>2-ut</sub> 19,64  
 F<sub>o</sub>  
 1,062

	Air Fuel Ratio (A/F)	
Overall Heating Efficiency:	80,42%	Dry Molecular Weight (M <sub>d</sub> ) 30,00
Combustion Efficiency:	99,50%	Dry Moles Exhaust Gas (N <sub>r</sub> ): 392,27
Heat Transfer Efficiency:	80,83%	Air Fuel Ratio (A/F) 11,26

Heat Output:	12 608 Btu/h	13 291 kJ/h
Heat Input:	15 676 Btu/h	16 526 kJ/h
Burn Duration:	5,90 h	
Burn Rate:	1,84 lb/h	0,834 kg/h
Stack Temp:	225,8 Deg. F	107,7 Deg. C

Date: 2018-01-15 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 20162 Run: 1 Tech: M M Reviewer: SP

- 30 LBS kindling STAND FIRE
- Fan low
- by pass open
- At 29 LBS close Door
- At 100 LBS insert pre load
- At 1500 LBS close Door
- At 1000 LBS close by pass
- At 63 LBS close air inlet (Drill bit 0.099")
- At 20 LBS
- open by pass
- open Door
- crunch the bed
- close Door
- close by pass
- after 2 min

TEST LOAD CONFIGURATION

- close Fan
- open by pass
- open air inlet
- open Door
- insert load
- close Door
- close by pass
- after 5 min close air inlet (drill bit 0.099")
- after 30 min Fan ON



**PRE / POST CHECKS**

Date: 2018-01-15 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 1 Tech: mm Reviewer: BP

Moisture Meter Calibration Check:

Equipment #	Time	12%	22%
EM-191	7:15	ok	ok

**Facility Conditions:**

Air Velocity from less than 2 feet .....  
 Smoke Capture Check.....  
 Picture.....

Pre-Test		Post-Test	
6 (max50 Fpm)		9 (max50 Fpm)	
ok		ok	
4 sides	ok	ok	

**Wood Heater Conditions:**

Date Wood Heater Stack Cleaned.....  
 Date Dilution Tunnel Cleaned.....  
 Induced Draft Check (max 0.005 H2O).....  
 Traverse before ignition.....  
 Flow Rate 140 cfm ±10%.....

2018-01-15
2018-01-15
ok
ok

ok

**Temperature System:**

Ambient (65°-90°F).....  
 Wood Heater Surface (±125°F).....

ok	°F
ok	°F

**Proportional Checks:**

Thermocouple check.....  
 Pitot Clean.....  
 Pitot verification.....

ok
ok
ok

**Sampling Train ID Numbers:**

Probe.....  
 Filter Front.....  
 Filter Back.....  
 Filter Thermocouple.....  
 Filter (<90°F).....

Train 1 <sup>st</sup> hour	Train 1	Train 2
17	18	50
07	09	11
08	10	12
11	11	12
ok	ok	ok



## SAMPLING EQUIPMENT CHECK OUT

Date: 2018-01-15 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 1 Tech: MM Reviewer: DP

### Leakage Checks Tunnel Samplers

	System 1 <sup>st</sup> hour		System 1		System 2	
	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)
Vacuum (inches Hg.)	-15	-15	-15	-15	-15	-15
Final 1minute DGM (Liter)	616940.41	618735.79	616940.92	618733.91	542969.75	544787.57
Initial 1minute DGM (Liter)	616940.40	618735.78	616940.88	618735.90	542969.70	544787.56
Change © (Liter)	0.01	0.01	0.04	0.01	0.05	0.01
Allowable leakage .04 x Sample rate or 0.28Lpm CSA B415 (0.56)						
Check OK	ok	ok	ok	ok	ok	ok

### Leakage Checks Flue Gas Sampler

Plugged Probe	Pre Test	Post Test
Vacuum (inches Hg.)	-5	-5
Rotometer Reading (mml/min.)	0	0
Flow Rate (lpm)	1.5	1.5
Allowable (.02 x Sample Rate)	30	30
Check OK	ok	ok

### Leakage Checks Pitot

Plugged Probe	Pre Test 3 H <sub>2</sub> O static	Pre Test 0.4-0.5 H <sub>2</sub> O velocity	Post Test 3 H <sub>2</sub> O Static	Post Test 0.4-0.5 H <sub>2</sub> O velocity
Vacuum (inches Hg.)	3	.5	3	.9
Check OK (no change after 15 sec.)	ok	ok	ok	ok



Date: 2018-01-15 Manufacturer: Heartstone Model: GM 60  
 Project #: PI 20162 Run: 1 Tech: MM Reviewer: DP

Scale Type	Audit		Measured Weight
	Equipment #	Weight	
Platform	EM-090	44 lbs, Class F	44 lbs
Wood	EM-090	44 lbs, Class F	44 lbs
Analytical	EM-128	100 mg, Class S	100 mg
Analytical	EM-129	200 g, Class S	200 g

**LIMITS OF WEIGHT RANGES**

**ANALYTICAL SCALE:** ..... 50%-150% of dry filter weight, ± 0.1 mg  
**PLATFORM SCALE:** ..... 20%-80% of ideal test load weight, ± 0.1 lbs or 1%  
**WOOD SCALE:** ..... 20%-80% of ideal test load weight, ± 0.01 lbs or 1%

Date: 2018-02-15 Manufacturer: Heartstone Model: GM 60  
 Project #: PT 20162 Run: 1 Tech: MM Reviewer: NP

FOR TUNNELS < 12 in

Barometric pressure ( $P_{bar}$ ) 102.8 (KPa.) Static pressure ( $P_q$ ) 0.39 (inches w.c.)  
 Inside diameter: Port A \_\_\_\_\_ Port B \_\_\_\_\_  
 Tunnel cross sectional area: .1963Ft<sup>2</sup>  
 Pitot tube type: Standard

Traverse Point	Position (inches)			Velocity Head $\Delta_p$ (inches H <sub>2</sub> O)	Tunnel Temperature (°F)
	6 po	7 po	8 po		
A - Centroid	3.00	3.50	4	0060	76.80
B - Centroid	3.00	3.50	4	0059	78.31
A-1	0.40	0.50	0.50	0049	76.71
A-2	1.50	1.75	2	0064	76.94
A-3	4.50	5.25	6	0048 0049	76.81
A-4	5.60	6.5	7.5	0049	76.73
B-1	0.40	0.50	0.50	0050	78.26
B-2	1.50	1.75	2	0053	78.54
B-3	4.50	5.25	6	0051	78.41
B-4	5.60	6.5	7.5	0050	78.86
				AVERAGE	

$$v_s = K_p C_p (\sqrt{\Delta_p})_{avg} \sqrt{\frac{(T_s)_{avg}}{P_s M_s}}$$

Where,

$C_p$  = pitot tube coefficient, dimension less = 0.99 for standard pitot.

$\Delta_p$  = manometer reading (inches H<sub>2</sub>O)

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

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

$P_q$  = static pressure in. H<sub>2</sub>O  
 { 13.6 }

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

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

$\Delta_p$  avg. = average of the square roots of the velocity heads ( $\Delta_p$ ) measured at each traverse point.



**CONTINUOUS ANALYZERS**

Date: 2018-01-15 Manufacturer: Hearthstone Model: GM 60  
 Project #: pI 20162 Run: 1 Tech: MM Reviewer: DP

Pre-Test (Adjust and Record)

	ZERO		SPAN		CAL. (Record Only)	
	Actual	Should Be	Actual	Should Be	Actual	Should Be
CO	0	0	3003	1800 300	1,006	100
Tolerance CO		+/- 0.02		+/- 0.15		+/- 0.05
CO <sub>2</sub>	0	0	1798	300 1800	9.76	1000
Tolerance CO <sub>2</sub>		+/- 0.02		+/- 0.5		+/- 0.5
O <sub>2</sub> informative CSA B415 calculated value	na	na	na	na	na	na
	Actual	Should Be	Actual	Should Be	Actual	Should Be

Post Test (Record Only)

	Zero	Span	Cal.	Zero Drift	Limit	Span Drift	Limit	Cal. Drift	Limit	OK?	Not OK*
CO	0	2999	1,001	0	0.02	0.009	0.15	0.005	0.05	✓	
CO <sub>2</sub>	0	1801	980	0	0.02	0.03	0.5	0.04	0.5	✓	

Date: 2018-01-15 Manufacturer: Aearthstone Model: GM 60  
 Project #: PT 20162 Run: 1 Tech: MM Reviewer: DP

**RAW DRY GAS METER READINGS**

	System 1	System 2	Blanck
Final (Liter)	618734.74	544786.61	650.24
Initial (Liter)	616941.24	542974.83	<del>600</del> 607.08

**AMBIENT CONDITIONS**

	Before	After
Barometer (kPa):	102.8	102.6
Dry Bulb (F):	66.02	68.79
Humidity (%):	19.0	22.0

**Flow Meter**

	Start	End
Flow meter reading	N.A	N.A

**Flow Meter Verification**

	Before	After
Flow meter Check (liters)	N.A	N.A
Scale Weight ( Kg)	N.A	N.A



**FUEL DATA**

Date: 2018-01-15 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 1 Tech: MM Reviewer: [Signature]

**FUEL DESCRIPTION:**

Type of wood:

**PRE-TEST LOAD**

Piece Size	Weight	Meter Moisture Content (% dry)*				
2 x 4 x 8 in.	1056 lbs.	20.6	20.3	20.9	21.0	20.9
2 x 4 x 8 in.	1340 lbs.	20.8	20.9	20.9	20.8	21.4
2 x 4 x 8 in.	1050 lbs.	21.3	21.6	21.2	21.3	21.2
2 x 4 x 8 in.	1390 lbs.	21.0	21.1	21.6	20.9	20.8
2 x 4 x 8 in.	1380 lbs.	20.4	20.3	20.8	20.4	20.7
2 x 4 x 8 in.	1040 lbs.	20.9	20.8	20.4	20.3	20.3
2 x 4 x 8 in.	107 lbs.	20.9	21.0	21.3	21.6	21.3
2 x 4 x 8 in.	1048 lbs.	20.9	20.8	20.6	20.9	20.8
2 x 4 x 8 in.	1052 lbs.	20.7	19.9	19.6	19.3	19.5
2 x 4 x 8 in.	1080 lbs.	19.6	19.4	20.0	20.1	20.2
2 x 4 x 8 in.	1084 lbs.	20.4	20.6	20.8	20.3	20.1
2 x 4 x 8 in.	1102 lbs.	20.8	20.3	20.4	20.6	20.8
2 x 4 x 8 in.	1036 lbs.	19.6	19.3	19.1	19.3	19.2
2 x 4 x 8 in.	1048 lbs.	19.6	19.4	19.9	19.8	19.9
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					

TEST LOAD WEIGHT: 1577 lbs



### FUEL DATA

Date: 2018-01-15      Manufacturer: Hearthstone      Model: GM 60  
 Project #: pI 20162      Run: 1      Tech: MM      Reviewer: DO

**FUEL DESCRIPTION:**

Type of wood :

**TEST LOAD**

Piece Size		Weight	Meter Moisture Content (% dry)*				
1 1/2	x 3 1/2 x 17 1/4 in.	1959 lbs.	201	206	203	208	206
1 1/2	x 3 1/2 x 17 1/4 in.	1892 lbs.	194	199	193	198	194
3 1/2	x 3 1/2 x 17 1/4 in.	4056 lbs.	206	201	199	201	203
3 1/2	x 3 1/2 x 17 1/4 in.	3898 lbs.	210	213	207	246	209
1 1/2	x 3/4 x 5 in.	0 102 lbs.			210		
1 1/2	x 3/4 x 5 in.	0 102 lbs.			213		
1 1/2	x 3/4 x 5 in.	0 100 lbs.			208		
1 1/2	x 3/4 x 5 in.	0 100 lbs.			209		
1 1/2	x 3/4 x 5 in.	0 100 lbs.			221		
1 1/2	x 3/4 x 5 in.	0 108 lbs.			223		
1 1/2	x 3/4 x 5 in.	0 112 lbs.			216		
1 1/2	x 3/4 x 5 in.	0 110 lbs.			214		
1 1/2	x 3/4 x 5 in.	0 102 lbs.			218		
1 1/2	x 3/4 x 5 in.	0 094 lbs.			216		
1 1/2	x 3/4 x 5 in.	0 108 lbs.			210		
1 1/2	x x 5 in.	0 108 lbs.			210		
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					
	x x in.	lbs.					

TEST LOAD WEIGHT: 1307 lbs      Min 20%: 201      Max 25%: 307





DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2018-01-11 Manufacturer: Health Solutions Model: GM 60  
 Project #: PI 20162 Run: 1 Tech: MM Reviewer: DP

		SYSTEM 1 - 1 <sup>st</sup> hour					SYSTEM 1				
Pre-test Weight Record	Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	BlancK
			17	07	08	21	18	09	10	22	13
	2018-01-11	17:00	108 9499	01289	01280	35 4196	108 9471	01281	01274	35 1414	01263
	2018-01-15	10:00	108 9498	01288	01279	35 4195	108 9471	01280	01274	35 1413	01264

		SYSTEM 1 - 1 <sup>st</sup> hour					SYSTEM 1				
Post-test Weight Record	Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	BlancK
			17	07	08	21	18	09	10	22	13
	2018-01-15	19:00	108 9514	01288	01270	35 4230	108 9486	01277	01269	35 1435	01264
	2018-01-29	9:00	108 9505	01285	01269	35 4222	108 9476	01277	01268	35 1429	01264
	2018-02-01	9:00	108 9505	01285	01269	35 4217	108 9476	01277	01268	35 1427	01264
	2018-02-05	8:00	108 9505	01285	01269	35 4216	108 9476	01277	01268	35 1426	01264





# DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2018-01-11 Manufacturer: Healthstone Model: GM 60  
 Project #: PI 2016 Run: 1 Tech: MM Reviewer: SP

SYSTEM 2					
Pre-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time				
2018-01-11	12:00	1076467	01256	01243	35, 1863
2018-01-15	10:00	1076466	01256	01243	35, 1864

SYSTEM 2					
Post-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time				
2018-01-15	19:00	1076478	01249	01233	35, 1900
2018-01-29	8:00	1076469	01248	01233	35, 1894
2018-02-01	8:00	1076470	01251	01234	35, 1897
2018-02-05	8:00	1076470	01251	01234	35, 1896



## Paramètres

Tous les facteurs de corrections et autres paramètres qui peuvent être modifiés par l'utilisateur du fichier sont regroupés ici.

Code verrouillage:

### Description du test

Test standard	EPA
Run #	2
Date	16-01-2018
Technicien	M.M
Project #	PI 20162

### Description de l'unité

Manufacturier	HEARTHSTONE	
Modèle	GM 60	
Combustion system	Cat	
Appliance type	WOOD STOVE	
Firebox volume	2,03	cu ft.
Appliance weight empty	N.A	lbs
Appliance weight full	N.A	lbs

### Paramètres du test

Logging time	1	min
Manufacturer's rated heat output		BTU/h Donnée fournie par le manufacturier
Targeted category	4	
Targeted output	N.A	BTU/h
Cp steel	N.A	BTU/lb-°F

### Échantillonnage

Blank sampling rate	0,20	cuft/min
Internal probe diameter	0,18	in.
Calibration Factor (DGM #1):	0,988	Dimensionless
Equipment number (DGM #1):	EM 178	
Calibration Factor (DGM #2):	0,988	Dimensionless
Equipment number (DGM #2):	EM 179	
Calibration Factor (DGM #3):	0,986	Dimensionless
Equipment number (DGM #3):	EM 070	Dimensionless

### Tunnel

Targeted tunnel flow rate	170	scfm
Tunnel diameter	6	in.
Molecular weight	29	
Pitot tube type	Standard	
Pitot tube coefficient	0,99	Dimensionless

Project nu.	PI 20162
Date	16-01-2018
Technicien	M.M

### Fuel data

Fuel type	Dimension	
Fuel specie	D. Fir	
HHV		19810,0 kJ/kg
%C		48,7
%H		6,9
%O		43,9
%Ash		0,5
HHV		8519,2 Btu/lb
LHV		7451,0 Btu/lb

Default Fuel Values		
	D. Fir	Oak/Maple
HHV	19 810	19 887
%C	48,73	50
%H	6,87	6,6
%O	43,9	42,9
%Ash	0,5	0,5
HHV (Btu/lb)	8519	8552
LHV (Btu/lb)	7451	7480





**Filter set weight**

	System 1 (g) 1st hour				System 1 (g)				System 2 (g)				Ambient blank (g)	Date	Heure
	probe	front	back	gasket	probe	front	back	gasket	probe	front	back	gasket	Filter		
Number	1	14	15	24	3	16	17	25	6	18	19	26	20		
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	61,0690	0,1270	0,1266	34,4169	61,4563	0,1263	0,1282	34,9448	61,3760	0,1294	0,1290	35,5631	0,1256	15/01/2018	17:00
Before (6)	61,0689	0,1270	0,1265	34,4169	61,4563	0,1264	0,1281	34,9449	61,3759	0,1293	0,1289	35,5632	0,1256	16/01/2018	09:30
After (1)	61,0692	0,1257	0,1261	34,6202	61,4568	0,1261	0,1281	34,9462	61,3765	0,1288	0,1284	35,5659	0,1257	16/01/2018	16:00
After (2)	61,0689	0,1252	0,1258	34,4194	61,4565	0,1258	0,1279	34,9458	61,3760	0,1285	0,1281	35,5655	0,1256	29/01/2018	08:00
After (3)	61,0690	0,1253	0,1259	34,4195	61,4565	0,1259	0,1279	34,9458	61,3760	0,1285	0,1281	35,5655	0,1256	01/02/2018	08:00
After (4)	61,0690	0,1253	0,1259	34,4195	61,4565	0,1259	0,1279	34,9458	61,3760	0,1285	0,1281	35,5655	0,1256	05/02/2018	08:00
After (5)															
After (6)	61,0690	0,1253	0,1259	34,4195	61,4565	0,1259	0,1279	34,9458	61,3760	0,1285	0,1281	35,5655	0,1256	05/02/2018	08:00
Difference	0,0001	-0,0017	-0,0006	0,0026	0,0002	-0,0005	-0,0002	0,0009	0,0001	-0,0008	-0,0008	0,0023	0,0000		
Total (mg)		0,4			0,8			0,8			0				
Total ajusté (mg)		<b>0,40</b>			<b>0,80</b>			<b>0,80</b>							

<b>Project nu.</b>	PI 20162
<b>Date</b>	16-01-2018
<b>Technicien</b>	

SFBA EPA EMISSION RESULTS

RESULTS

**Average emission rate:** 0,2 g/hr

Burn Rate : 1,239 Dry kg/hr

**Test Duration:** 242 min

PRESSURE FACTOR: DGM 1 0,98715  
 DGM 2 0,98609  
 DGM 3 1,01312

BAROMETRIC PRESSURE  
 Average: 30,312534 in Hg  
 Start: 30,327299 in Hg  
 End: 30,297769 in Hg

TEMPERATURE FACTORS DGM 1 0,98576  
 DGM 2 0,98457  
 DGM 3 0,99335

DGM CONTROLLER VALUES

DGM 1 Final: 21894,370 Cuft  
 Initial: 21850,478 Cuft

VOLUMES SAMPLED DGM 1 42,193 SCft  
 DGM 2 42,845 SCft  
 DGM 3 36,392 SCft

DGM 2 Final: 19283,875 Cuft  
 Initial: 19239,228 Cuft

DGM #3 Final: 686,900 Cuft  
 Initial: 650,240 Cuft

TOTAL TUNNEL VOLUME : 42673

TEMPERATURES

SAMPLE RATIOS  
 Sample Train 1: 1011,392  
 Sample Train 2: 996,000

DGM 1 535,627 °R  
 DGM 2 536,274 °R

Paticulate concentration  
 Sample Train 1 **0,000019** g/dscf  
 Sample Train 2 **0,000019** g/dscf  
 Room **0,000000** g/dscf

CALIBRATION FACTORS

DGM 1 0,9879  
 DGM 2 0,9884  
 DGM #3 0,9864

TUNNEL FLOW RATE: 176,336 Dscfm

TOTAL EMISSIONS  
 Sample Train 1 **0,81** g  
 Sample Train 2 **0,80** g

PARTICULATE CATCH  
 Total Sample Train 1: 0,80 mg  
 Total Sample Train 2: 0,80 mg  
 Total Sample Train 1 1st hour: 0,40 mg

EMISSION RATES  
 Sample Train 1 **0,20** g/hr  
 Sample Train 2 **0,20** g/hr

1st hour emission rate **0,40** g/hr

DEVIATION: 0,77%

Cs Train 1 Train 2  
 1,896E-05 1,86721E-05

		Average	0,12	10,65	#DIV/0!	287,90	71,54	87,59	392,63	255,89	382,56	372,89	427,87
*	*	*	*	*	*	*1	*2	*3	*4	*5	*6	*7	*8
Elapsed	Weight	Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit
Time	Raw data row	Remaining	CO	CO <sub>2</sub>	O <sub>2</sub>	Gas	Temp	Dry Bulb	Top	Back	R.Side	L.Side	Bottom
min	lbs	%	%	%	%	%F	%F	%F	%F	%F	%F	%F	%F
0,00	173,00	13,3	0,1	1,1	0,0	281,7	70,8	125,8	336,2	253,5	371,0	368,3	565,3
1,0	174,0	13,2	0,3	2,0	0,0	297,1	71,0	98,9	331,3	251,9	369,6	366,2	560,4
2,0	175,0	13,0	0,0	5,8	0,0	324,9	71,2	99,1	331,4	251,8	368,1	364,2	555,7
3,0	176,0	12,8	0,1	9,9	0,0	357,1	70,8	101,5	341,1	251,9	366,5	362,8	550,8
4,0	177,0	12,6	0,1	12,7	0,0	392,5	70,8	104,0	355,8	250,4	365,1	361,3	545,4
5,0	178,0	12,5	0,6	14,8	0,0	370,6	70,8	94,9	371,7	249,7	363,7	360,2	544,3
6,0	179,0	12,4	0,1	9,8	0,0	344,0	70,9	91,7	376,3	248,8	362,7	359,2	541,4
7,0	180,0	12,4	0,0	7,4	0,0	325,5	71,3	91,1	377,9	246,7	361,3	358,2	537,8
8,0	181,0	12,3	0,0	6,7	0,0	315,1	71,9	90,6	377,3	245,3	359,7	356,9	534,7
9,0	182,0	12,2	0,0	8,0	0,0	309,9	71,0	90,4	378,0	244,2	358,0	355,5	530,9
10,0	183,0	12,1	0,0	9,8	0,0	307,0	70,8	90,2	379,4	242,5	356,5	354,0	528,4
11,0	184,0	12,0	0,0	10,6	0,0	305,5	70,9	90,3	381,5	241,6	354,8	352,5	525,0
12,0	185,0	11,9	0,0	10,8	0,0	306,0	70,4	90,1	382,6	240,2	353,1	351,2	521,3
13,0	186,0	11,8	0,0	10,1	0,0	307,8	70,8	89,9	383,0	239,9	351,9	349,9	518,1
14,0	187,0	11,6	0,0	10,5	0,0	311,5	70,6	90,4	384,5	239,0	350,1	348,9	513,5
15,0	188,0	11,5	0,1	12,6	0,0	316,2	70,6	91,4	387,9	237,2	349,0	347,8	509,8
16,0	189,0	11,4	0,1	13,1	0,0	322,6	71,7	91,6	390,8	235,3	348,0	347,2	505,6
17,0	190,0	11,3	0,1	13,5	0,0	328,4	70,9	91,9	395,5	234,9	347,1	346,4	502,0
18,0	191,0	11,1	0,1	14,1	0,0	334,7	71,0	92,2	401,1	234,5	346,5	345,9	498,6
19,0	192,0	11,0	0,1	14,4	0,0	339,7	71,4	92,2	406,8	233,6	346,5	345,6	494,9
20,0	193,0	10,9	0,1	14,5	0,0	343,2	70,7	92,2	412,7	233,5	345,9	345,3	491,0
21,0	194,0	10,7	0,1	14,4	0,0	345,1	71,0	92,1	417,9	232,7	346,0	345,1	487,0
22,0	195,0	10,6	0,1	14,3	0,0	346,8	70,9	92,4	423,3	231,7	346,0	345,2	483,9
23,0	196,0	10,5	0,1	14,4	0,0	347,2	71,4	92,1	428,4	231,7	346,4	345,2	480,9
24,0	197,0	10,3	0,1	14,7	0,0	347,7	71,1	93,0	432,9	231,9	347,1	345,4	476,8
25,0	198,0	10,2	0,1	15,0	0,0	349,8	71,6	92,9	437,3	232,4	348,1	346,0	474,2
26,0	199,0	10,0	0,1	15,0	0,0	351,2	71,4	93,2	441,8	232,9	348,6	346,7	470,2
27,0	200,0	9,9	0,1	15,1	0,0	352,9	71,3	93,0	445,1	234,5	349,7	347,4	467,8
28,0	201,0	9,8	0,2	15,2	0,0	354,5	71,1	93,1	450,0	235,2	350,8	348,2	465,4
29,0	202,0	9,7	0,3	15,3	0,0	355,7	70,6	93,3	454,7	235,3	352,0	349,3	462,8
30,0	203,0	9,5	0,3	15,4	0,0	356,1	71,2	92,9	458,5	236,0	353,5	350,1	459,7
31,0	204,0	9,4	0,3	15,4	0,0	356,5	71,5	93,0	462,8	236,3	355,2	351,3	457,4
32,0	205,0	9,3	0,2	15,3	0,0	356,6	71,6	93,1	466,5	238,8	356,9	352,5	454,4
33,0	206,0	9,2	0,2	15,2	0,0	356,0	72,0	93,7	470,9	239,9	358,6	354,0	451,6
34,0	207,0	9,1	0,1	15,0	0,0	354,7	71,9	93,4	474,0	239,3	360,3	355,2	449,3
35,0	208,0	8,9	0,1	14,9	0,0	354,1	71,4	93,5	475,8	241,0	362,3	356,4	446,9
36,0	209,0	8,8	0,2	15,1	0,0	354,8	71,5	93,4	478,5	242,5	364,1	358,0	444,8
37,0	210,0	8,7	0,3	15,3	0,0	355,7	71,5	93,6	480,8	243,3	366,0	359,2	442,4
38,0	211,0	8,5	0,4	15,4	0,0	357,0	71,3	93,6	484,3	244,6	367,8	360,7	440,3
39,0	212,0	8,4	0,7	15,5	0,0	358,4	71,6	93,5	488,1	246,0	369,8	362,1	438,6
40,0	213,0	8,3	1,0	15,4	0,0	358,9	70,9	93,4	491,8	247,1	371,9	363,4	435,9
41,0	214,0	8,1	0,9	15,5	0,0	358,5	71,5	93,9	495,3	247,9	373,8	365,1	433,7
42,0	215,0	8,0	0,8	15,5	0,0	358,9	72,3	93,9	499,1	249,4	376,2	366,8	430,9
43,0	216,0	7,9	0,6	15,6	0,0	358,5	71,8	93,9	501,4	250,8	378,4	368,4	428,6
44,0	217,0	7,8	0,5	15,6	0,0	358,2	71,2	94,0	504,1	252,2	380,5	369,9	426,5
45,0	218,0	7,6	0,3	15,6	0,0	358,9	71,6	94,1	506,1	253,4	382,5	371,7	424,5
46,0	219,0	7,5	0,4	15,6	0,0	359,3	71,4	93,9	507,9	253,9	384,7	373,4	422,3
47,0	220,0	7,4	0,4	15,5	0,0	358,9	71,6	93,6	509,0	256,0	387,0	375,0	420,4
48,0	221,0	7,3	0,3	15,5	0,0	357,6	71,4	93,4	510,9	256,1	389,1	376,8	417,8
49,0	222,0	7,2	0,3	15,4	0,0	356,8	71,6	93,3	511,1	257,6	391,1	378,2	415,6
50,0	223,0	7,0	0,2	15,5	0,0	356,8	71,5	93,5	513,5	258,9	393,5	380,0	413,4
51,0	224,0	7,0	0,1	15,3	0,0	356,2	72,1	93,5	514,1	259,6	395,6	381,7	410,7
52,0	225,0	6,8	0,1	15,2	0,0	354,6	71,8	93,5	515,6	262,1	398,0	383,5	408,6
53,0	226,0	6,7	0,1	15,0	0,0	352,8	71,7	93,4	515,5	262,0	400,0	384,7	406,7
54,0	227,0	6,6	0,0	14,8	0,0	351,3	71,9	93,1	514,7	262,6	402,4	386,7	404,3
55,0	228,0	6,6	0,1	14,8	0,0	350,1	71,7	92,9	514,7	263,6	404,2	388,1	403,1
56,0	229,0	6,4	0,1	14,8	0,0	349,8	71,6	93,1	514,1	264,6	406,1	389,3	400,7
57,0	230,0	6,3	0,1	14,8	0,0	348,4	71,4	92,8	512,8	265,2	407,8	390,4	398,9
58,0	231,0	6,2	0,1	14,8	0,0	348,0	71,6	92,3	511,9	265,2	409,7	391,6	397,4
59,0	232,0	6,1	0,2	14,8	0,0	347,9	71,6	93,2	510,9	266,4	411,6	393,1	395,4
60,0	233,0	6,0	0,3	14,7	0,0	347,3	72,6	93,2	509,9	266,7	413,5	394,5	393,7
61,0	234,0	5,9	0,4	14,7	0,0	346,7	71,3	93,3	510,3	268,2	415,1	395,7	391,8
62,0	235,0	5,8	0,5	14,7	0,0	346,8	71,8	93,0	508,5	268,1	416,7	396,7	390,6
63,0	236,0	5,7	0,5	14,7	0,0	346,8	71,8	93,0	507,8	269,4	418,1	397,8	389,0
64,0	237,0	5,6	0,4	14,7	0,0	346,4	71,1	92,9	507,7	269,4	419,6	398,7	387,6
65,0	238,0	5,5	0,5	14,5	0,0	345,4	71,7	92,6	507,5	269,9	421,0	400,0	386,4
66,0	239,0	5,4	0,4	14,8	0,0	344,6	71,4	92,4	507,3	270,5	422,4	400,9	385,0
67,0	240,0	5,3	0,4	14,8	0,0	344,1	71,5	92,2	506,6	271,1	424,0	402,1	383,7
68,0	241,0	5,2	0,5	14,8	0,0	342,9	71,5	92,5	507,2	271,7	425,5	403,2	382,5
69,0	242,0	5,1	0,5	14,8	0,0	342,1	72,7	92,6	507,1	271,5	427,0	404,8	381,1
70,0	243,0	5,0	0,5	14,8	0,0	341,6	71,8	92,5	507,4	273,3	428,3	405,8	380,2
71,0	244,0	4,9	0,5	14,8	0,0	341,3	71,3	92,4	506,9	272,1	429,7	407,0	379,4
72,0	245,0	4,8	0,4	14,7	0,0	340,5	72,1	92,4	506,9	273,5	430,6	408,3	378,8
73,0	246,0	4,7	0,4	14,8	0,0	339,2	71,6	92,2	506,2	273,7	432,0	409,4	377,9
74,0	247,0	4,6	0,4	14,7	0,0	338,2	72,0	92,1	506,3	273,9	433,0	410,5	377,2
75,0	248,0	4,6	0,4	14,7	0,0	337,4	71,6	91,8	505,2	274,9	433,9	411,5	376,3
76,0	249,0	4,4	0,4	14,6	0,0	336,7	71,4	91,6	505,9	275,7	435,0	412,8	375,7
77,0	250,0	4,3	0,4	14,7	0,0	335,7	72,0	91,4	505,4	275,1	436,4	413,7	375,5
78,0	251,0	4,2	0,4	14,6	0,0	334,6	72,0	91,8	505,6	275,3	437,5	415,0	374,3
79,0	252,0	4,2	0,3	14,5	0,0	332,0	72,6	91,8	504,1	276,0	438,7	416,2	374,1
80,0	253,0	4,1	0,3	14,2	0,0	330,7	72,2	91,7	503,6	277,2	439,3	416,9	373,5
81,0	254,0	4,0	0,3	14,1	0,0	329,2	71,8	91,2	501,5	277,8	440,1	418,1	373,1
82,0	255,0	3,9	0,2	13,9	0,0	327,8	72,0	91,2	500,1	278,5	440,8	419,3	372,8
83,0	256,0	3,9	0,1	13,8	0,0	325,9	71,8	90,7	499,3	279,4	441,4	420,4	372,4
84,0	257,0	3,8	0,1	13,7	0,0	323,8	72,0	90,5	496,2	280,2	442,1	421,2	372,0
85,0	258,0	3,7	0,0	13,6	0,0	321,9	71,5	90,4	494,5	280,2	442,4	421,9	371,6
86,0	259,0	3,7	0,0	13,5	0,0	320,0	71,9	90,0</					

101,0	274,0	2,7	0,0	11,9	0,0	293,1	72,0	88,3	457,2	288,8	443,5	429,8	370,0
102,0	275,0	2,7	0,0	11,7	0,0	290,6	72,5	87,9	454,6	289,7	443,5	429,7	370,0
103,0	276,0	2,6	0,0	11,2	0,0	288,4	72,0	87,6	450,8	289,6	443,0	429,8	370,4
104,0	277,0	2,6	0,0	10,7	0,0	286,3	71,9	87,1	446,8	289,8	442,6	429,7	370,2
105,0	278,0	2,6	0,0	10,3	0,0	283,8	72,3	87,2	442,5	290,2	442,4	429,3	370,4
106,0	279,0	2,6	0,0	10,1	0,0	282,3	71,5	87,3	438,2	290,2	441,7	428,9	370,7
107,0	280,0	2,5	0,0	9,8	0,0	280,2	72,9	86,9	434,1	289,9	441,1	428,8	370,4
108,0	281,0	2,5	0,0	9,8	0,0	278,5	71,7	87,1	430,0	290,4	440,2	427,7	370,9
109,0	282,0	2,5	0,0	9,8	0,0	276,2	72,3	86,6	425,8	290,5	439,1	426,7	371,8
110,0	283,0	2,5	0,0	9,9	0,0	274,5	72,1	86,7	421,8	291,5	438,0	426,0	372,4
111,0	284,0	2,4	0,0	9,9	0,0	272,6	72,2	86,4	418,4	290,3	437,0	424,6	373,2
112,0	285,0	2,4	0,0	9,9	0,0	271,9	71,7	86,2	414,9	291,5	435,8	423,7	373,8
113,0	286,0	2,4	0,0	10,4	0,0	270,5	71,6	86,2	411,3	290,1	434,6	422,4	374,7
114,0	287,0	2,3	0,0	10,2	0,0	269,6	71,9	86,0	408,3	290,2	433,4	421,1	375,7
115,0	288,0	2,3	0,0	10,1	0,0	269,3	72,0	86,0	405,3	290,1	432,8	419,9	376,8
116,0	289,0	2,3	0,0	10,1	0,0	268,6	72,1	86,1	402,1	290,0	431,5	418,9	377,8
117,0	290,0	2,2	0,0	10,0	0,0	267,7	72,4	86,1	399,9	289,4	430,5	417,6	379,7
118,0	291,0	2,2	0,0	9,9	0,0	266,8	71,9	85,9	397,1	289,0	429,4	416,0	381,0
119,0	292,0	2,2	0,0	9,9	0,0	266,4	72,2	85,8	395,2	288,5	428,2	414,9	382,7
120,0	293,0	2,2	0,0	9,9	0,0	265,2	71,8	85,6	392,2	287,9	427,0	413,6	384,1
121,0	294,0	2,1	0,0	9,8	0,0	264,3	71,9	85,2	390,2	287,7	425,8	412,3	385,3
122,0	295,0	2,1	0,0	9,8	0,0	263,9	71,4	85,3	387,8	286,9	424,5	411,1	386,7
123,0	296,0	2,1	0,0	9,9	0,0	263,4	71,8	85,2	385,7	286,1	423,3	409,9	388,5
124,0	297,0	2,1	0,0	9,8	0,0	262,5	72,2	84,9	383,5	286,5	422,1	408,7	390,2
125,0	298,0	2,1	0,0	9,8	0,0	262,1	71,9	85,7	381,8	286,1	421,0	407,4	391,5
126,0	299,0	2,1	0,0	9,7	0,0	261,0	72,6	85,3	379,6	285,0	419,4	406,5	392,9
127,0	300,0	2,0	0,0	9,8	0,0	260,1	71,7	85,2	378,1	284,6	418,4	405,0	394,8
128,0	301,0	2,0	0,0	9,8	0,0	259,7	71,7	85,0	375,1	283,6	417,2	404,0	396,1
129,0	302,0	1,9	0,0	9,7	0,0	258,6	72,1	84,8	373,2	282,5	415,8	402,8	397,7
130,0	303,0	1,9	0,0	9,7	0,0	257,8	71,8	84,7	371,6	281,4	415,0	401,7	399,0
131,0	304,0	1,9	0,0	9,7	0,0	257,2	71,6	84,7	369,4	279,8	413,6	400,4	400,3
132,0	305,0	1,9	0,0	9,8	0,0	256,9	71,7	84,6	367,6	279,0	412,2	399,2	402,1
133,0	306,0	1,9	0,0	9,7	0,0	256,1	71,5	84,2	365,4	277,8	411,1	397,7	403,8
134,0	307,0	1,9	0,0	9,7	0,0	255,5	72,2	84,7	363,4	277,4	409,9	396,4	404,9
135,0	308,0	1,8	0,0	9,7	0,0	255,0	72,5	84,6	361,5	276,9	408,7	395,6	406,1
136,0	309,0	1,8	0,0	9,7	0,0	254,0	71,8	84,8	360,2	275,3	408,0	394,5	407,9
137,0	310,0	1,8	0,0	9,7	0,0	253,5	72,1	84,3	358,6	275,4	406,5	393,2	408,7
138,0	311,0	1,7	0,0	9,7	0,0	252,7	72,5	84,3	356,6	274,7	405,6	392,5	410,6
139,0	312,0	1,8	0,0	9,7	0,0	251,7	71,8	84,3	355,8	274,9	404,4	391,2	411,7
140,0	313,0	1,7	0,0	9,3	0,0	251,7	71,6	84,2	354,4	273,9	403,3	389,9	413,3
141,0	314,0	1,7	0,0	8,8	0,0	251,7	71,8	84,1	352,8	273,5	402,4	388,8	414,6
142,0	315,0	1,7	0,0	8,6	0,0	252,1	72,0	84,0	351,4	273,3	401,4	387,7	415,3
143,0	316,0	1,7	0,0	8,3	0,0	252,2	71,2	83,9	350,2	272,2	400,3	386,7	415,7
144,0	317,0	1,6	0,1	8,2	0,0	253,2	72,0	84,7	348,7	272,5	399,2	385,7	415,6
145,0	318,0	1,6	0,1	8,1	0,0	253,2	72,3	84,4	347,6	272,1	398,1	384,6	415,3
146,0	319,0	1,6	0,1	8,3	0,0	253,0	72,1	84,3	346,9	271,8	396,9	383,3	415,3
147,0	320,0	1,6	0,1	8,3	0,0	253,6	71,8	84,3	345,4	271,5	395,7	381,9	415,5
148,0	321,0	1,6	0,1	8,5	0,0	254,1	71,7	84,2	344,4	271,0	394,4	380,8	415,4
149,0	322,0	1,6	0,1	8,7	0,0	254,1	71,7	84,0	343,4	269,6	393,3	379,7	415,9
150,0	323,0	1,5	0,1	8,8	0,0	253,7	71,5	83,8	342,8	269,0	391,9	378,6	416,3
151,0	324,0	1,5	0,1	8,6	0,0	253,1	71,5	83,7	341,7	267,6	390,6	377,1	416,6
152,0	325,0	1,5	0,1	8,7	0,0	253,3	71,9	83,7	340,8	267,0	389,3	376,1	416,7
153,0	326,0	1,5	0,1	8,7	0,0	253,2	71,7	84,0	340,1	265,8	388,2	374,9	417,6
154,0	327,0	1,5	0,1	8,8	0,0	252,8	72,2	84,1	339,5	265,3	387,0	374,3	417,5
155,0	328,0	1,4	0,1	8,9	0,0	252,1	71,8	84,3	338,9	264,1	386,0	373,2	418,2
156,0	329,0	1,4	0,1	8,9	0,0	252,2	71,8	84,0	337,9	262,9	384,6	372,1	419,0
157,0	330,0	1,4	0,1	9,0	0,0	251,8	71,7	84,1	337,6	261,7	383,6	371,3	419,9
158,0	331,0	1,4	0,1	9,0	0,0	251,2	71,2	83,8	336,7	261,1	382,4	370,2	421,3
159,0	332,0	1,3	0,1	8,9	0,0	250,8	71,7	83,6	335,8	259,7	381,3	369,3	422,6
160,0	333,0	1,3	0,1	8,8	0,0	251,0	71,4	83,4	335,0	259,3	380,4	368,2	423,7
161,0	334,0	1,3	0,1	8,7	0,0	251,1	71,9	83,4	334,4	257,9	379,7	367,4	425,0
162,0	335,0	1,3	0,1	8,6	0,0	251,1	71,6	83,2	333,8	257,1	378,7	366,7	426,2
163,0	336,0	1,3	0,1	8,6	0,0	251,0	71,7	84,3	333,2	256,4	377,7	365,4	427,6
164,0	337,0	1,3	0,1	8,5	0,0	251,1	72,3	84,0	332,5	255,7	376,3	364,8	428,4
165,0	338,0	1,2	0,1	8,6	0,0	250,9	71,7	83,8	332,1	254,8	375,4	363,8	429,2
166,0	339,0	1,2	0,1	8,5	0,0	250,8	71,5	83,6	331,4	254,6	374,6	363,2	430,9
167,0	340,0	1,2	0,1	8,5	0,0	250,8	71,4	83,5	330,9	253,9	373,5	362,5	432,0
168,0	341,0	1,2	0,1	8,4	0,0	250,9	71,4	83,4	330,6	252,9	372,6	361,6	432,9
169,0	342,0	1,2	0,1	8,4	0,0	251,1	71,7	83,1	330,0	252,3	371,7	360,4	434,5
170,0	343,0	1,2	0,1	8,5	0,0	251,0	71,6	83,1	329,4	251,5	370,6	359,9	435,2
171,0	344,0	1,2	0,1	8,4	0,0	250,9	71,5	83,0	328,5	250,5	369,6	359,2	436,0
172,0	345,0	1,2	0,1	8,4	0,0	250,6	71,6	83,7	328,2	249,5	368,7	358,2	437,6
173,0	346,0	1,1	0,1	8,4	0,0	250,6	71,8	83,6	327,7	248,5	368,0	357,8	438,3
174,0	347,0	1,1	0,1	8,4	0,0	250,6	71,5	83,9	327,5	248,9	367,1	356,8	439,4
175,0	348,0	1,1	0,1	8,4	0,0	250,4	71,4	83,8	326,7	247,8	366,1	356,0	441,0
176,0	349,0	1,1	0,1	8,4	0,0	250,2	71,4	83,4	326,3	247,4	365,0	355,5	442,1
177,0	350,0	1,1	0,1	8,4	0,0	249,8	71,0	83,3	325,7	246,9	364,3	354,4	443,1
178,0	351,0	1,0	0,1	8,3	0,0	249,9	71,4	83,1	325,1	246,2	363,4	353,8	444,2
179,0	352,0	1,0	0,1	8,3	0,0	249,2	71,1	83,0	324,8	245,7	362,7	353,1	445,1
180,0	353,0	1,0	0,1	8,3	0,0	249,2	71,1	82,6	323,7	245,1	361,6	352,1	446,0
181,0	354,0	1,0	0,1	8,3	0,0	248,7	71,5	83,0	323,3	244,3	360,7	351,5	447,3
182,0	355,0	1,0	0,1	8,3	0,0	248,5	71,7	84,4	322,7	245,0	360,1	351,0	447,6
183,0	356,0	1,0	0,1	8,3	0,0	248,0	71,9	83,7	322,0	244,1	359,4	350,1	449,1
184,0	357,0	0,9	0,1	8,4	0,0	247,7	71,5	83,5	321,7	243,7	358,6	349,7	448,9
185,0	358,0	0,9	0,1	8,3	0,0	248,2	71,8	83,4	321,1	242,4	357,6	349,3	450,0
186,0	359,0	0,9	0,1	8,3	0,0	248,3	71,2	83,2	320,5	242,3	356,9	348,6	450,8
187,0	360,0	0,9	0,1	8,2	0,0	247,7	71,2	83,1	320,1	241,1	355,9	347,7	452,1
188,0	361,0	0,9	0,1	8,2	0,0	247,9	71,1	82,9	319,5	240,9	355,0	347,3	453,0
189,0	362,0	0,8	0,1	8,2	0,0	248,7	71,1	82,8	319,1	240,7	354,1	346,5	454,1
190,0	363,0	0,8	0,1	8,2	0,0	248,8	71,2	82,7	318,6	241,1	353,6	346,1	454,7
191,0	364,0	0,7	0,1	8,2	0,0	249,0	71,6	83,8	318,3	239,6	352,8	345,3	

207,0	380,0	0,5	0,1	7,5	0,0	248,9	70,7	82,8	310,8	230,4	339,0	335,6	453,7
208,0	381,0	0,5	0,1	7,4	0,0	248,9	71,2	82,6	310,0	229,8	338,0	334,8	453,0
209,0	382,0	0,5	0,1	7,3	0,0	248,9	71,2	83,1	309,5	229,5	337,1	333,9	452,5
210,0	383,0	0,5	0,1	7,3	0,0	248,3	71,1	83,8	308,7	227,8	336,0	333,7	451,2
211,0	384,0	0,5	0,1	7,3	0,0	247,9	70,8	83,4	308,9	229,0	335,3	332,7	450,8
212,0	385,0	0,5	0,1	7,2	0,0	247,9	70,8	83,4	308,1	229,1	334,3	331,9	449,7
213,0	386,0	0,4	0,1	7,3	0,0	248,3	71,0	83,1	307,4	228,8	333,2	331,6	449,0
214,0	387,0	0,4	0,1	7,3	0,0	248,4	70,8	83,1	307,3	228,1	332,2	330,9	447,6
215,0	388,0	0,4	0,1	7,4	0,0	248,0	70,7	82,7	307,4	228,5	331,5	330,1	447,1
216,0	389,0	0,4	0,1	7,4	0,0	247,1	71,0	82,4	307,0	227,9	330,6	329,7	446,1
217,0	390,0	0,4	0,1	7,4	0,0	246,4	70,9	82,5	306,4	228,0	329,8	329,0	446,1
218,0	391,0	0,4	0,1	7,4	0,0	245,3	70,9	83,0	305,9	227,2	328,8	328,2	445,6
219,0	392,0	0,3	0,1	7,4	0,0	244,3	71,2	83,9	305,3	226,3	328,1	327,6	444,8
220,0	393,0	0,3	0,1	7,3	0,0	242,9	71,3	83,3	304,6	225,8	327,2	327,1	444,8
221,0	394,0	0,3	0,1	7,3	0,0	242,2	70,7	83,0	303,9	226,0	326,2	326,2	443,7
222,0	395,0	0,3	0,1	7,3	0,0	241,7	71,3	82,8	303,4	225,4	325,5	325,6	443,7
223,0	396,0	0,3	0,1	7,3	0,0	241,5	70,9	82,5	302,4	224,9	324,5	324,7	443,1
224,0	397,0	0,3	0,1	7,3	0,0	240,9	71,2	82,5	301,4	224,4	323,7	324,3	442,8
225,0	398,0	0,3	0,1	7,3	0,0	240,3	70,7	82,4	300,7	223,5	322,8	323,7	441,7
226,0	399,0	0,2	0,1	7,3	0,0	240,6	70,8	82,2	300,1	222,6	322,1	323,3	441,1
227,0	400,0	0,2	0,1	7,3	0,0	241,0	71,0	82,5	299,6	222,7	321,5	322,5	441,0
228,0	401,0	0,2	0,1	7,3	0,0	240,7	71,2	83,5	299,2	222,4	320,6	322,1	440,2
229,0	402,0	0,2	0,1	7,3	0,0	240,8	71,3	83,2	299,2	221,8	320,0	321,6	440,3
230,0	403,0	0,2	0,1	7,3	0,0	240,6	71,3	82,9	298,4	221,6	319,1	320,7	439,5
231,0	404,0	0,2	0,1	7,3	0,0	240,9	71,3	82,6	298,3	222,0	318,4	320,6	439,7
232,0	405,0	0,2	0,1	7,4	0,0	239,7	71,1	82,5	297,8	221,9	317,5	320,1	440,1
233,0	406,0	0,1	0,1	7,8	0,0	238,4	71,1	82,3	297,4	220,3	317,0	319,6	440,7
234,0	407,0	0,1	0,1	7,6	0,0	237,4	71,0	82,0	297,0	220,0	316,4	319,1	442,4
235,0	408,0	0,1	0,1	7,4	0,0	236,1	70,7	82,1	295,9	220,0	315,4	318,5	443,7
236,0	409,0	0,1	0,1	7,4	0,0	236,0	71,0	82,5	295,4	219,3	314,6	317,9	445,7
237,0	410,0	0,1	0,1	7,3	0,0	235,0	71,1	83,1	294,3	219,7	314,4	317,4	447,0
238,0	411,0	0,1	0,1	7,3	0,0	234,1	71,2	82,7	293,6	218,9	313,8	316,7	449,0
239,0	412,0	0,1	0,1	7,3	0,0	233,5	71,0	82,7	293,1	218,6	313,1	316,1	450,5
240,0	413,0	0,1	0,1	7,2	0,0	233,1	70,9	82,3	292,0	218,2	312,3	315,9	451,7
241,0	414,0	0,1	0,1	7,2	0,0	232,9	70,4	82,1	291,5	217,5	312,2	315,4	453,3
242,0	415,0	0,0	0,1	7,2	0,0	232,6	70,6	82,1	290,7	217,2	311,7	314,9	454,4



Manufacturer: HEARTHSTONE  
 Model: GM 60

Run: 2  
 Project #: PI 20162  
 Test Duration: 242 min

	HHV	LHV
Eff	80,29%	86,78%
Comb Eff	98,96%	98,96%
HT Eff	81,13%	87,69%
Output	19 716	kJ/h
Burn Rate	1,24	kg/h
Grams CO	85	g
Input	24 557	kJ/h
MC wet	17,09	

Note: In the "Input data", "Calc. % O<sub>2</sub>", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a], [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3

Ultimate CO<sub>2</sub>  
 CO<sub>2-ut</sub> 19,64  
 F<sub>o</sub>  
 1,062

Overall Heating Efficiency: 80,29%  
 Combustion Efficiency: 98,96%  
 Heat Transfer Efficiency: 81,13%

	Air Fuel Ratio (A/F)	
	Dry Molecular Weight (M <sub>d</sub> )	30,08
	Dry Moles Exhaust Gas (N <sub>r</sub> ):	364,86
	Air Fuel Ratio (A/F)	10,47

Heat Output:	18 702 Btu/h	19 716 kJ/h
Heat Input:	23 295 Btu/h	24 557 kJ/h
Burn Duration:	4,03 h	
Burn Rate:	2,73 lb/h	1,240 kg/h
Stack Temp:	287,9 Deg. F	142,2 Deg. C

Date: 2018-01-16 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 20162 Run: 2 Tech: MM Reviewer: DP

- kindling 35 LBS start fire
- DJ 300 LBS close Door
- DJ 1,000 LBS insert pre load
- DJ 1400 LBS close Door
- DJ 1000 LBS close bypass
- Fan low
- bypass open
- DJ 78 LBS close air inlet (Drill bit 0.188" or 3/16)
- DJ 27 LBS
- open bypass
- open Door
- crunch the bed
- close Door
- close bypass
- after 2 min

TEST LOAD CONFIGURATION

- open bypass
- open air inlet
- open Door
- insert load
- close Door
- close bypass
- after 5 min close air inlet (drill bit 0.188" or 3/16)



# PRE / POST CHECKS

Date: 2018-01-16  
 Project #: PI 20162

Manufacturer: Healthstone  
 Run: 2 Tech: MM

Model: GM 60

Reviewer: DP

Moisture Meter Calibration Check:

Equipment #	Time	12%	22%
EM-191	7:00	ok	ok

Pre-Test

Post-Test

### Facility Conditions:

Air Velocity from less than 2 feet .....

Smoke Capture Check .....

Picture .....

	5 (max50 Fpm)	3 (max50 Fpm)
	ok	
4 sides	ok	ok

### Wood Heater Conditions:

Date Wood Heater Stack Cleaned .....

Date Dilution Tunnel Cleaned .....

Induced Draft Check (max 0.005 H2O) .....

Traverse before ignition .....

Flow Rate 140 cfm ±10% .....

2018-01-15
2018-01-15
ok
ok

ok

### Temperature System

Ambient (65°-90°F) .....

Wood Heater Surface (±125°F) .....

ok	°F
ok	°F

### Proportional Checks:

Thermocouple check .....

Pitot Clean .....

Pitot verification .....

ok
ok
ok

### Sampling Train ID Numbers:

Probe .....

Filter Front .....

Filter Back .....

Filter Thermocouple .....

Filter (<90°F) .....

Train 1 <sup>st</sup> hour	Train 1	Train 2
001	003	006
14	16	18
15	17	19
11	11	12
ok	ok	ok



### SAMPLING EQUIPMENT CHECK OUT

Date: 2018-07-16      Manufacturer: Hearthstone      Model: GM 60  
 Project #: PI 20162      Run: 2      Tech: MM      Reviewer: NP

#### Leakage Checks Tunnel Samplers

	System 1 <sup>st</sup> hour		System 1		System 2	
	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)
Vacuum (inches Hg.)	-15	-15	-15	-15	-15	-15
Final 1minute DGM (Liter)	618736.36	619980.46	618736.48	619980.57	544790.10	546059.59
Initial 1minute DGM (Liter)	618736.33	619980.46	618736.46	619980.55	544790.10	546059.57
Change © (Liter)	0.03	∅	0.02	0.02	∅	∅
Allowable leakage .04 x Sample rate or 0.28Lpm CSA B415 (0.56)						
Check OK	ok	ok	ok	ok	ok	ok

#### Leakage Checks Flue Gas Sampler

Plugged Probe	Pre Test	Post Test
Vacuum (inches Hg.)	-5	-5
Rotometer Reading (mml/min.)	0	0
Flow Rate (lpm)	1.5	1.5
Allowable (.02 x Sample Rate)	30	30
Check OK	ok	ok

#### Leakage Checks Pitot

Plugged Probe	Pre Test 3 H <sub>2</sub> O static	Pre Test 0.4-0.5 H <sub>2</sub> O velocity	Post Test 3 H <sub>2</sub> O Static	Post Test 0.4-0.5 H <sub>2</sub> O velocity
Vacuum (inches Hg.)	<del>0.3</del> 0.3 mm	<del>0.4</del> 0.4 mm	3	.9
Check OK (no change after 15 sec.)	ok	ok	ok	ok



Date: 2018-01-16 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 2016 Run: 2 Tech: MM Reviewer: DP

## Pre-Test (Adjust and Record)

	ZERO		SPAN		CAL. (Record Only)	
	Actual	Should Be	Actual	Should Be	Actual	Should Be
CO	0	0	3008	300	1008	100
Tolerance CO		+/- 0.02		+/- 0.15		+/- 0.05
CO <sub>2</sub>	0	0	1795	1800	973	1000
Tolerance CO <sub>2</sub>		+/- 0.02		+/- 0.5		+/- 0.5
O <sub>2</sub> informative CSA B415 calculated value	na	na	na	na	na	na
	Actual	Should Be	Actual	Should Be	Actual	Should Be

## Post Test (Record Only)

	Zero	Span	Cal.	Zero Drift	Limit	Span Drift	Limit	Cal. Drift	Limit	OK?	Not OK*
CO	0.003	3001	1006	0.003	0.02	0.007	0.15	0.002	0.05	✓	
CO <sub>2</sub>	0.0	1790	967	0	0.02	0.05	0.5	0.06	0.5	✓	

**TEST DATA LOG**

Date: 2018-01-16 Manufacturer: Hearthstone Model: GM 60  
 Project #: PJ 20162 Run: 2 Tech: MM Reviewer: SP

**RAW DRY GAS METER READINGS**

	System 1	System 2	Blank
Final (Liter)	619979.49	546058.51	686.90
Initial (Liter)	618736.62	544794.26	650.24

**AMBIENT CONDITIONS**

	Before	After
Barometer (kPa):	102.7	102.6
Dry Bulb (F):	69.98	72.86
Humidity (%):	16.8	16.9

**Flow Meter**

	Start	End
Flow meter reading	N.A	N.A

**Flow Meter Verification**

	Before	After
Flow meter Check (liters)	N.A	N.A
Scale Weight ( Kg)	N.A	N.A



### FUEL DATA

Date: 2018-02-16 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 2 Tech: MM Reviewer: DP

#### FUEL DESCRIPTION:

Type of wood:

#### PRE-TEST LOAD

Piece Size	Weight	Meter Moisture Content (% dry)*						
2 x 4 x 8 in.	1086 lbs.	226	218	213	214	218		
2 x 4 x 8 in.	1004 lbs.	216	218	219	223	216		
2 x 4 x 8 in.	1124 lbs.	223	224	228	224	226		
2 x 4 x 8 in.	1026 lbs.	218	216	219	223	229		
2 x 4 x 8 in.	1116 lbs.	210	213	214	219	223		
2 x 4 x 8 in.	1144 lbs.	223	224	219	218	223		
2 x 4 x 8 in.	1210 lbs.	214	212	210	216	212		
2 x 4 x 8 in.	1170 lbs.	213	224	223	220	224		
2 x 4 x 8 in.	1168 lbs.	224	228	224	226	226		
2 x 4 x 8 in.	1202 lbs.	231	230	236	228	224		
2 x 4 x 8 in.	1096 lbs.	219	214	213	215	212		
2 x 4 x 8 in.	1326 lbs.	208	204	209	204	205		
2 x 4 x 8 in.	1112 lbs.	196	192	192	196	198		
2 x 4 x 8 in.	1198 lbs.	194	198	193	193	198		
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							
x x in.	lbs.							

TEST LOAD WEIGHT: 15,986 lbs



**FUEL DATA**

Date: 2018-01-16 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 20162 Run: 2 Tech: MM Reviewer: DS

**FUEL DESCRIPTION:**

Type of wood :

**TEST LOAD**

Piece Size	Weight	Meter Moisture Content (% dry)*				
1 1/2 x 3 1/2 x 17 1/2 in.	1905 lbs.	218	202	216	213	209
1 1/2 x 3 1/2 x 17 1/2 in.	1956 lbs.	198	196	199	193	208
3 1/2 x 3 1/2 x 17 1/2 in.	4054 lbs.	211	213	208	200	206
3 1/2 x 3 1/2 x 17 1/2 in.	4108 lbs.	201	206	193	211	209
1 1/2 x 3/4 x 5 in.	0104 lbs.			206		
1 1/2 x 3/4 x 5 in.	6100 lbs.			203		
1 1/2 x 3/4 x 5 in.	0102 lbs.			204		
1 1/2 x 3/4 x 5 in.	0100 lbs.			208		
1 1/2 x 3/4 x 5 in.	0098 lbs.			209		
1 1/2 x 3/4 x 5 in.	0120 lbs.			210		
1 1/2 x 3/4 x 5 in.	0102 lbs.			213		
1 1/2 x 3/4 x 5 in.	0094 lbs.			218		
1 1/2 x 3/4 x 5 in.	0096 lbs.			211		
1 1/2 x 3/4 x 5 in.	0108 lbs.			218		
1 1/2 x 3/4 x 5 in.	0100 lbs.			216		
1 1/2 x 3/4 x 5 in.	<del>0114</del> 0144 lbs.			213		
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					

TEST LOAD WEIGHT: 13294 lbs Min 20%: 266 Max 25%: 332



Date: 2018-01-15 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 20162 Run: 2 Tech: MM Reviewer: DP

Pre-test Weight Record	SYSTEM 1 - 1 <sup>st</sup> hour						SYSTEM 1						
	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
Date	Time	001	14	15	24	003	16	17	25			20	
2018-01-15	17:00	610690	01270	01266	344169	614563	01263	01282	349448			01256	
2018-01-16	09:30	610689	01270	01265	344168	614563	01264	01281	349449			01256	

Post-test Weight Record	SYSTEM 1 - 1 <sup>st</sup> hour						SYSTEM 1						
	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
Date	Time	001	14	15	24	003	16	17	25			20	
2018-01-16	16:00	610692	01257	01261	344202	614568	01261	01281	349462			01257	
2018-01-29	8:00	610689	01252	01258	<del>344194</del> 344194	614565	01258	<del>01278</del> 01278mm	349458			01256	
2018-02-01	8:00	610690	01253	01259	344195	614565	01259	01279	349458			01256	
2018-02-05	8:00	610690	01253	01259	344195	614565	01259	01279	349458			01256	





# DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2018-01-15      Manufacturer: Hearthstone      Model: GM 60  
 Project #: PI 20162      Run: 2      Tech: MM      Reviewer: DP

SYSTEM 2					
Pre-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time				
		006	18	19	26
2018-01-15	17:00	61,3760	0,1294	0,1290	35,5631
2018-01-16	9:30	61,3759	0,1293	0,1289	35,5632

SYSTEM 2					
Post-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time				
		006	18	19	26
2018-01-16	16:00	61,3765	0,1288	0,1284	35,5659
2018-01-29	8:00	61,3760	0,1285	0,1281	<del>35,5635</del>
2018-02-01	8:00	61,3760	0,1285	0,1281	35,5655
2018-02-05	8:00	61,3760	0,1285	0,1281	35,5655

35,5655 MF

## Paramètres

Tous les facteurs de corrections et autres paramètres qui peuvent être modifiés par l'utilisateur du fichier sont regroupés ici.

Code verrouillage: 

HEA
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### Description du test

Test standard	EPA
Run #	3
Date	17-01-2018
Technicien	M.M
Project #	PI 20162

### Description de l'unité

Manufacturier	HEARTHSTONE	
Modèle	GM 60	
Combustion system	Cat	
Appliance type	WOOD STOVE	
Firebox volume	2,03	cu ft.
Appliance weight empty	N.A	lbs
Appliance weight full	N.A	lbs

### Paramètres du test

Logging time	1	min
Manufacturer's rated heat output		BTU/h Donnée fournie par le manufacturier
Targeted category	2	
Targeted output	N.A	BTU/h
Cp steel	N.A	BTU/lb-°F

### Échantillonnage

Blank sampling rate	0,20	cuft/min
Internal probe diameter	0,18	in.
Calibration Factor (DGM #1):	0,988	Dimensionless
Equipment number (DGM #1):	EM 178	
Calibration Factor (DGM #2):	0,988	Dimensionless
Equipment number (DGM #2):	EM 179	
Calibration Factor (DGM #3):	0,986	Dimensionless
Equipment number (DGM #3):	EM 070	Dimensionless

### Tunnel

Targeted tunnel flow rate	140	scfm
Tunnel diameter	6	in.
Molecular weight	29	
Pitot tube type	Standard	
Pitot tube coefficient	0,99	Dimensionless

Project nu.	PI 20162
Date	17-01-2018
Technicien	M.M

### Fuel data

Fuel type	Dimension
Fuel specie	D. Fir
HHV	19810,0 kJ/kg
%C	48,7
%H	6,9
%O	43,9
%Ash	0,5
HHV	8519,2 Btu/lb
LHV	7451,0 Btu/lb

Default Fuel Values		
	D. Fir	Oak/Maple
HHV	19 810	19 887
%C	48,73	50
%H	6,87	6,6
%O	43,9	42,9
%Ash	0,5	0,5
HHV (Btu/lb)	8519	8552
LHV (Btu/lb)	7451	7480





**Filter set weight**

	System 1 (g) 1st hour				System 1 (g)				System 2 (g)				Ambient blank (g)	Date	Heure
	probe	front	back	gasket	probe	front	back	gasket	probe	front	back	gasket	Filter		
Number	9	21	22	8	11	23	24	9	42	25	26	10	27		
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	61,4481	0,1263	0,1262	35,7852	93,7241	0,1245	0,1241	35,7870	110,3110	0,1246	0,1266	35,3365	0,1285	16/01/2018	17:00
Before (6)	61,4481	0,1263	0,1261	35,7851	93,7242	0,1246	0,1241	35,7869	110,3111	0,1245	0,1265	35,3366	0,1286	17/01/2018	10:00
After (1)	61,4487	0,1264	0,1262	35,7866	93,7257	0,1243	0,1236	35,7888	110,3113	0,1246	0,1260	35,3386	0,1288	17/01/2018	16:00
After (2)	61,4481	0,1261	0,1261	35,7863	93,7243	0,1240	0,1234	35,7883	110,3111	0,1244	0,1258	35,3383	0,1286	29/01/2018	08:00
After (3)	61,4481	0,1261	0,1261	35,7863	93,7243	0,1240	0,1234	35,7883	110,3112	0,1244	0,1259	35,3383	0,1286	05/02/2018	08:00
After (4)															
After (5)															
After (6)	61,4481	0,1261	0,1261	35,7863	93,7243	0,1240	0,1234	35,7883	110,3112	0,1244	0,1259	35,3383	0,1286	05/02/2018	08:00
Difference	0,0000	-0,0002	0,0000	0,0012	0,0001	-0,0006	-0,0007	0,0014	0,0001	-0,0001	-0,0006	0,0017	0,0000		
Total (mg)		1				1,2				1,1				0	
Total ajusté (mg)		<b>1,00</b>				<b>1,20</b>				<b>1,10</b>					

<b>Project nu.</b>	PI 20162
<b>Date</b>	17-01-2018
<b>Technicien</b>	mm

SFBA EPA EMISSION RESULTS

RESULTS

**Average emission rate:** 0,3 g/hr  
 Burn Rate : 1,170 Dry kg/hr

**Test Duration:** 253 min

PRESSURE FACTOR: DGM 1 0,98366  
 DGM 2 0,98299  
 DGM 3 1,00917

BAROMETRIC PRESSURE  
 Average: 30,194414 in Hg  
 Start: 30,268239 in Hg  
 End: 30,120589 in Hg

TEMPERATURE FACTORS DGM 1 0,98553  
 DGM 2 0,98425  
 DGM 3 0,99208

DGM CONTROLLER VALUES  
 DGM 1 Final: 21940,714 Cuft  
 Initial: 21894,505 Cuft

VOLUMES SAMPLED DGM 1 44,253 SCft  
 DGM 2 44,804 SCft  
 DGM 3 30,585 SCft

DGM 2 Final: 19330,921 Cuft  
 Initial: 19284,070 Cuft

DGM #3 Final: 717,870 Cuft  
 Initial: 686,900 Cuft

TOTAL TUNNEL VOLUME : 43388

TEMPERATURES  
 DGM 1 535,752 °R  
 DGM 2 536,447 °R

SAMPLE RATIOS  
 Sample Train 1: 980,451  
 Sample Train 2: 968,395

CALIBRATION FACTORS  
 DGM 1 0,9879  
 DGM 2 0,9884  
 DGM #3 0,9864

Paticulate concentration  
 Sample Train 1 **0,000027** g/dscf  
 Sample Train 2 **0,000025** g/dscf  
 Room **0,000000** g/dscf

TUNNEL FLOW RATE: 171,492 Dscfm

TOTAL EMISSIONS  
 Sample Train 1 **1,18** g  
 Sample Train 2 **1,07** g

PARTICULATE CATCH  
 Total Sample Train 1: 1,20 mg  
 Total Sample Train 2: 1,10 mg  
 Total Sample Train 1 1st hour: 1,00 mg

EMISSION RATES  
 Sample Train 1 **0,28** g/hr  
 Sample Train 2 **0,25** g/hr

1st hour emission rate **0,98** g/hr

DEVIATION: 4,97%

Cs Train 1 Train 2  
 2,712E-05 2,45516E-05

		Average	0,11	10,09	#DIV/0!	301,15	72,22	90,62	440,82	437,51	383,10	371,34	399,13
*	*	*	*	*	*	*1	*2	*3	*4	*5	*6	*7	*8
Elapsed	Weight	Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit
Time	Raw data row	Remaining	CO	CO <sub>2</sub>	O <sub>2</sub>	Gas	Temp	Dry Bulb	Top	Back	R.Side	L.Side	Bottom
min	min	lbs	%	%	%	%F	°F	°F	°F	°F	°F	°F	°F
0,00	203,00	13,1	0,0	4,5	0,0	279,2	71,5	121,2	364,4	440,9	369,6	335,2	581,2
1,0	204,0	13,0	0,2	1,1	0,0	297,6	71,7	99,3	358,4	440,6	368,7	334,5	574,3
2,0	205,0	12,8	0,1	4,5	0,0	326,2	71,5	99,9	357,4	439,7	367,9	333,4	569,3
3,0	206,0	12,7	0,1	6,0	0,0	347,7	71,8	101,6	359,7	438,6	366,5	332,4	562,1
4,0	207,0	12,6	0,1	8,3	0,0	340,5	71,6	95,7	366,6	437,1	365,2	331,5	559,7
5,0	208,0	12,5	0,1	9,0	0,0	321,0	71,7	92,0	368,5	435,3	363,7	330,4	554,6
6,0	209,0	12,5	0,0	5,0	0,0	307,5	71,6	91,1	368,8	433,4	361,9	329,2	550,7
7,0	210,0	12,4	0,0	4,7	0,0	299,2	71,2	90,5	367,6	431,0	360,1	328,0	546,8
8,0	211,0	12,4	0,0	4,8	0,0	294,4	71,2	89,8	366,3	428,5	358,3	326,8	543,0
9,0	212,0	12,3	0,0	5,1	0,0	291,7	71,5	90,0	366,2	425,9	356,1	325,3	538,2
10,0	213,0	12,2	0,1	7,8	0,0	292,8	71,7	90,4	368,6	423,0	353,8	323,9	533,7
11,0	214,0	12,1	0,1	10,6	0,0	302,0	71,6	91,9	371,8	420,3	351,8	322,5	528,9
12,0	215,0	12,0	0,2	11,6	0,0	307,7	72,1	92,1	377,1	417,6	349,4	321,3	523,6
13,0	216,0	11,9	0,1	11,0	0,0	306,8	71,6	91,8	383,1	415,0	347,4	320,2	519,4
14,0	217,0	11,8	0,1	10,7	0,0	303,3	71,4	91,5	386,8	412,3	345,8	319,3	516,1
15,0	218,0	11,7	0,1	9,3	0,0	302,7	71,4	91,6	390,0	409,7	344,4	318,7	511,2
16,0	219,0	11,6	0,1	8,8	0,0	304,1	71,3	91,5	393,7	407,3	342,8	318,2	506,8
17,0	220,0	11,5	0,1	11,3	0,0	309,5	71,3	92,3	398,8	405,0	341,6	317,6	502,0
18,0	221,0	11,3	0,3	12,1	0,0	315,6	71,7	92,8	405,1	402,9	340,7	317,4	497,2
19,0	222,0	11,3	0,3	12,5	0,0	321,4	71,7	93,1	412,2	400,9	339,7	317,3	493,0
20,0	223,0	11,1	0,2	13,0	0,0	325,7	71,9	93,0	418,3	399,2	338,8	317,2	489,0
21,0	224,0	11,0	0,1	12,7	0,0	328,7	72,1	93,2	424,8	397,6	338,4	317,6	485,0
22,0	225,0	10,9	0,1	13,3	0,0	332,3	72,1	94,0	431,5	396,2	338,3	317,6	481,4
23,0	226,0	10,7	0,2	13,5	0,0	334,6	71,9	93,8	436,5	395,1	338,2	317,9	476,8
24,0	227,0	10,6	0,2	13,3	0,0	336,6	72,0	94,0	441,7	394,2	338,4	318,5	474,0
25,0	228,0	10,5	0,1	13,5	0,0	339,3	72,2	94,3	447,4	393,4	338,9	318,9	469,2
26,0	229,0	10,4	0,1	13,9	0,0	342,9	72,2	93,6	454,0	393,0	339,5	319,6	465,5
27,0	230,0	10,2	0,1	14,0	0,0	346,9	72,2	94,0	459,2	392,7	340,2	320,5	461,9
28,0	231,0	10,1	0,1	14,4	0,0	351,4	72,0	94,3	465,3	392,5	340,9	321,3	458,5
29,0	232,0	10,0	0,1	15,0	0,0	354,9	71,8	94,5	471,7	392,6	341,9	322,3	454,3
30,0	233,0	9,8	0,2	15,2	0,0	357,2	72,3	94,8	477,4	392,9	342,9	323,4	450,7
31,0	234,0	9,7	0,4	15,2	0,0	359,3	72,1	95,4	483,4	393,4	344,0	324,8	447,3
32,0	235,0	9,6	0,5	15,1	0,0	360,8	72,4	95,9	488,7	394,1	345,4	326,1	444,2
33,0	236,0	9,4	0,6	15,4	0,0	362,9	72,2	96,0	495,8	395,0	347,1	327,5	441,5
34,0	237,0	9,3	0,6	15,5	0,0	365,1	72,3	96,1	502,2	396,0	348,5	329,3	439,0
35,0	238,0	9,2	0,7	15,6	0,0	366,8	72,1	96,4	508,1	397,1	350,3	331,1	436,2
36,0	239,0	9,1	0,7	15,6	0,0	369,3	72,5	96,7	513,6	398,4	352,1	333,0	433,0
37,0	240,0	8,9	0,7	15,8	0,0	370,6	72,4	96,4	519,5	399,6	354,2	335,0	430,2
38,0	241,0	8,8	0,7	15,8	0,0	372,0	72,0	96,9	523,7	401,2	356,3	337,0	427,7
39,0	242,0	8,6	0,8	15,8	0,0	373,4	72,4	97,2	528,6	402,7	358,6	338,9	424,8
40,0	243,0	8,5	0,9	15,8	0,0	374,3	72,7	97,0	533,8	404,5	360,8	341,0	421,1
41,0	244,0	8,3	0,9	15,9	0,0	375,8	72,7	97,6	538,5	406,3	363,5	343,1	418,8
42,0	245,0	8,2	1,3	15,8	0,0	376,8	72,1	97,7	542,2	408,2	365,8	345,0	415,7
43,0	246,0	8,1	1,4	15,8	0,0	376,8	72,5	97,8	545,8	410,1	368,3	347,2	414,7
44,0	247,0	7,9	1,2	15,8	0,0	377,4	72,1	98,1	548,7	412,2	370,7	349,7	412,1
45,0	248,0	7,8	0,9	15,9	0,0	377,2	72,3	98,2	551,2	414,3	373,4	351,9	409,5
46,0	249,0	7,7	0,6	15,8	0,0	377,8	72,7	97,8	554,3	416,4	375,9	354,3	407,6
47,0	250,0	7,6	0,4	15,5	0,0	377,1	72,8	97,6	556,8	418,6	378,6	356,7	405,2
48,0	251,0	7,4	0,3	15,4	0,0	376,9	72,4	97,5	556,5	420,6	381,0	359,3	403,0
49,0	252,0	7,3	0,3	15,4	0,0	376,4	72,8	97,7	557,6	422,9	383,7	361,6	400,8
50,0	253,0	7,2	0,2	15,3	0,0	375,1	73,2	97,3	559,3	425,1	386,1	363,9	398,1
51,0	254,0	7,1	0,2	15,2	0,0	374,4	73,0	97,9	561,0	427,4	388,5	366,3	396,0
52,0	255,0	7,0	0,2	15,2	0,0	373,1	72,7	97,4	561,2	429,6	390,9	368,4	393,4
53,0	256,0	6,9	0,2	15,2	0,0	373,0	72,9	97,2	561,0	431,7	392,3	370,5	392,9
54,0	257,0	6,8	0,1	15,2	0,0	372,6	72,4	98,3	563,7	433,8	395,4	372,9	390,9
55,0	258,0	6,7	0,2	15,2	0,0	372,1	72,6	97,6	562,5	435,8	397,6	374,8	388,7
56,0	259,0	6,5	0,2	15,3	0,0	372,4	72,9	97,5	561,9	437,7	399,5	377,0	387,3
57,0	260,0	6,4	0,1	15,3	0,0	371,5	72,6	97,7	563,7	439,9	401,6	378,8	385,6
58,0	261,0	6,3	0,1	15,3	0,0	371,4	72,1	96,6	563,4	441,8	403,8	380,6	384,0
59,0	262,0	6,2	0,1	15,2	0,0	370,6	72,8	96,9	564,5	443,7	406,1	383,0	382,1
60,0	263,0	6,1	0,2	15,3	0,0	370,6	73,0	97,0	565,5	445,6	408,2	384,4	379,8
61,0	264,0	6,0	0,2	15,3	0,0	370,8	73,3	97,8	566,8	447,4	410,4	386,1	378,1
62,0	265,0	5,9	0,3	15,4	0,0	370,7	72,2	97,8	567,1	449,3	412,0	387,8	376,7
63,0	266,0	5,8	0,3	15,4	0,0	370,6	72,8	97,8	566,4	450,9	414,2	389,3	376,3
64,0	267,0	5,7	0,3	15,5	0,0	370,6	72,6	98,2	567,9	452,6	416,1	390,9	374,9
65,0	268,0	5,5	0,4	15,5	0,0	371,3	72,8	97,9	567,2	454,5	418,1	392,6	373,5
66,0	269,0	5,4	0,4	15,5	0,0	371,3	72,9	97,2	568,3	456,1	419,9	394,1	372,4
67,0	270,0	5,4	0,3	15,6	0,0	371,2	73,1	97,1	567,9	457,8	421,6	395,5	371,1
68,0	271,0	5,2	0,3	15,7	0,0	371,1	72,8	96,9	568,8	459,6	423,2	397,1	369,9
69,0	272,0	5,1	0,2	15,7	0,0	371,0	72,8	96,9	569,8	461,4	425,1	398,7	368,8
70,0	273,0	5,0	0,1	15,8	0,0	370,1	73,5	96,7	570,9	463,3	426,8	400,1	366,7
71,0	274,0	4,9	0,1	15,7	0,0	368,5	73,2	97,1	572,1	465,0	429,0	401,7	365,6
72,0	275,0	4,8	0,1	15,8	0,0	367,0	73,0	97,0	573,7	466,8	430,8	402,9	364,7
73,0	276,0	4,7	0,1	15,8	0,0	366,2	73,0	96,6	572,3	468,6	432,8	404,5	363,9
74,0	277,0	4,6	0,1	15,7	0,0	364,6	73,0	97,3	573,3	470,5	434,7	405,9	363,4
75,0	278,0	4,6	0,1	15,6	0,0	363,3	73,5	97,1	571,9	472,2	436,5	407,4	362,7
76,0	279,0	4,4	0,2	15,6	0,0	361,3	73,3	96,6	571,1	474,0	438,6	408,8	361,9
77,0	280,0	4,3	0,2	15,4	0,0	359,4	73,3	96,2	569,4	475,8	440,1	410,5	361,1
78,0	281,0	4,3	0,1	15,3	0,0	358,0	72,9	96,3	569,3	477,5	442,0	411,7	360,2
79,0	282,0	4,2	0,1	15,0	0,0	355,3	73,1	95,7	568,4	479,3	443,4	413,3	359,1
80,0	283,0	4,1	0,0	14,5	0,0	353,0	73,3	95,5	568,1	481,1	445,3	414,7	358,0
81,0	284,0	4,0	0,0	14,1	0,0	349,5	73,1	94,8	567,8	482,9	446,9	416,2	356,8
82,0	285,0	4,0	0,0	13,7	0,0	346,7	73,5	95,6	566,2	484,4	448,5	417,4	356,9
83,0	286,0	3,9	0,0	13,4	0,0	343,3	73,6	94,9	565,2	486,1	449,8	418,6	355,3
84,0	287,0	3,8	0,0	13,2	0,0	340,6	73,2	94,9	560,5	487,4	450,9	419,8	356,0
85,0	288,0	3,7	0,0	13,1	0,0	338,1	73,3	95,3	557,7	488,9	451,8	420,9	355,3
86,0	289,0	3,6	0,0	13,0	0,0	335,5	73,6</						



101.0	304.0	2,8	0,0	12,5	0,0	308,5	72,8	91,4	512,5	500,9	454,0	432,4	351,6
102.0	305.0	2,7	0,0	12,4	0,0	307,0	72,9	91,6	510,4	501,2	453,7	432,7	351,5
103.0	306.0	2,7	0,0	12,2	0,0	305,3	72,0	91,6	508,1	501,6	453,7	432,9	352,0
104.0	307.0	2,7	0,0	11,9	0,0	303,5	72,3	91,6	505,8	501,7	453,6	433,2	352,4
105.0	308.0	2,6	0,0	11,3	0,0	302,4	71,8	91,4	502,5	501,8	454,1	433,5	353,7
106.0	309.0	2,6	0,0	10,8	0,0	301,5	72,2	91,1	500,0	501,7	454,1	434,1	354,5
107.0	310.0	2,5	0,0	10,8	0,0	300,5	72,1	90,9	496,6	501,5	454,0	434,3	355,4
108.0	311.0	2,5	0,0	10,6	0,0	299,9	72,2	90,5	494,3	501,1	453,6	434,7	356,0
109.0	312.0	2,5	0,0	10,6	0,0	298,8	72,3	90,4	490,5	500,7	453,3	434,7	356,3
110.0	313.0	2,5	0,0	10,4	0,0	297,1	71,8	90,4	488,3	500,3	452,5	434,8	356,9
111.0	314.0	2,5	0,0	10,3	0,0	296,1	71,6	89,9	484,8	499,4	451,6	434,6	357,1
112.0	315.0	2,4	0,0	10,3	0,0	295,0	71,6	89,6	481,2	498,3	451,1	434,8	357,9
113.0	316.0	2,4	0,0	10,3	0,0	294,1	72,2	90,3	478,4	497,5	450,3	434,4	359,2
114.0	317.0	2,3	0,0	10,2	0,0	292,9	71,8	89,9	476,7	496,5	449,6	433,8	359,7
115.0	318.0	2,3	0,0	10,2	0,0	292,3	72,3	89,9	472,1	495,3	448,6	433,5	361,0
116.0	319.0	2,3	0,0	10,1	0,0	291,4	71,8	90,1	470,0	493,9	448,1	433,1	361,9
117.0	320.0	2,3	0,0	10,1	0,0	290,8	71,9	90,0	467,7	492,8	447,2	432,7	362,7
118.0	321.0	2,3	0,0	10,1	0,0	290,1	72,0	90,1	465,3	491,5	446,4	432,3	362,9
119.0	322.0	2,2	0,0	10,0	0,0	289,5	72,4	89,5	463,9	490,2	445,7	431,7	364,3
120.0	323.0	2,2	0,0	10,0	0,0	288,6	72,1	89,2	460,2	488,9	445,0	431,3	364,8
121.0	324.0	2,2	0,0	9,8	0,0	288,5	72,4	89,0	458,4	487,8	443,8	430,0	365,5
122.0	325.0	2,2	0,0	9,7	0,0	288,1	72,7	88,8	456,4	486,4	442,5	429,4	366,0
123.0	326.0	2,2	0,0	9,7	0,0	287,4	73,0	90,0	454,7	485,2	441,7	428,7	367,5
124.0	327.0	2,1	0,0	9,7	0,0	286,8	72,5	89,3	451,9	484,0	440,5	427,9	368,0
125.0	328.0	2,1	0,0	9,6	0,0	286,6	72,6	89,2	450,3	482,8	439,6	427,2	368,3
126.0	329.0	2,1	0,0	9,6	0,0	286,1	72,6	89,7	448,4	481,5	438,6	426,4	369,2
127.0	330.0	2,0	0,0	9,5	0,0	285,8	72,4	89,2	447,1	480,4	437,7	425,5	370,2
128.0	331.0	2,0	0,0	9,4	0,0	285,5	72,5	88,7	445,4	479,1	436,5	424,5	370,4
129.0	332.0	2,0	0,0	9,3	0,0	284,9	72,6	89,1	443,9	477,9	435,5	424,0	371,0
130.0	333.0	2,0	0,0	8,3	0,0	285,0	72,5	88,3	441,7	476,8	434,1	422,9	372,4
131.0	334.0	2,0	0,0	7,9	0,0	284,5	72,8	88,9	439,6	475,4	433,2	422,0	373,3
132.0	335.0	2,0	0,0	7,8	0,0	284,1	72,8	88,8	437,3	474,3	431,9	420,9	372,9
133.0	336.0	1,9	0,0	7,8	0,0	283,7	73,0	89,3	435,7	473,0	430,7	419,6	373,6
134.0	337.0	1,9	0,0	7,8	0,0	283,3	72,6	88,7	433,9	471,8	428,9	418,3	374,2
135.0	338.0	1,9	0,0	7,8	0,0	283,0	72,5	89,3	432,1	470,5	427,8	417,1	375,4
136.0	339.0	1,9	0,0	7,8	0,0	282,3	72,6	89,1	430,8	469,4	426,4	415,8	375,8
137.0	340.0	1,9	0,0	7,8	0,0	282,5	72,7	89,0	428,4	468,2	424,5	414,7	376,2
138.0	341.0	1,9	0,0	7,7	0,0	282,5	72,5	88,6	427,4	466,9	422,7	413,2	376,7
139.0	342.0	1,8	0,0	7,7	0,0	282,4	72,5	88,7	425,6	465,8	421,7	411,7	377,2
140.0	343.0	1,8	0,0	7,7	0,0	282,5	72,1	88,5	423,4	464,6	419,7	410,4	377,7
141.0	344.0	1,8	0,0	7,7	0,0	282,4	72,4	88,2	422,8	463,5	417,9	409,0	377,9
142.0	345.0	1,8	0,0	7,7	0,0	282,4	72,5	88,3	420,3	462,3	416,1	407,5	378,6
143.0	346.0	1,8	0,0	7,7	0,0	281,4	72,6	88,2	418,5	461,3	414,1	405,9	377,6
144.0	347.0	1,8	0,0	7,7	0,0	280,7	73,0	88,8	418,0	460,3	412,5	404,2	378,2
145.0	348.0	1,8	0,0	7,7	0,0	280,8	72,6	88,4	416,5	459,2	410,8	402,8	378,3
146.0	349.0	1,7	0,0	7,7	0,0	280,7	72,4	88,3	414,4	458,3	409,1	401,2	379,5
147.0	350.0	1,7	0,0	7,6	0,0	280,5	72,3	88,0	413,5	457,4	407,5	400,0	379,6
148.0	351.0	1,7	0,0	7,6	0,0	280,2	72,1	87,7	412,2	456,6	405,7	398,5	379,8
149.0	352.0	1,7	0,0	7,6	0,0	279,7	72,1	87,7	411,3	455,7	403,9	397,1	380,1
150.0	353.0	1,7	0,0	7,6	0,0	279,3	72,0	88,1	410,0	454,7	402,4	395,7	380,1
151.0	354.0	1,6	0,0	7,6	0,0	279,1	72,2	87,6	408,5	454,0	400,7	394,5	380,5
152.0	355.0	1,6	0,0	7,5	0,0	279,1	71,9	87,7	407,7	453,1	398,9	393,0	380,3
153.0	356.0	1,6	0,0	7,5	0,0	278,6	72,7	87,6	406,3	452,2	396,9	391,4	380,4
154.0	357.0	1,6	0,0	7,5	0,0	278,5	72,4	87,5	405,6	451,4	395,7	390,3	380,9
155.0	358.0	1,6	0,0	7,6	0,0	277,5	72,4	88,1	404,4	450,7	393,9	389,0	380,8
156.0	359.0	1,6	0,0	7,6	0,0	277,6	71,9	87,9	402,4	449,7	392,3	387,2	380,7
157.0	360.0	1,6	0,0	7,6	0,0	277,6	71,9	87,5	402,1	448,8	390,6	385,8	380,2
158.0	361.0	1,5	0,0	7,6	0,0	277,1	71,8	87,1	400,3	448,1	389,1	384,5	381,0
159.0	362.0	1,5	0,0	7,6	0,0	277,1	72,1	87,3	399,9	447,2	387,8	383,1	381,5
160.0	363.0	1,5	0,0	7,6	0,0	276,6	72,1	86,8	399,5	446,5	386,2	382,1	381,5
161.0	364.0	1,5	0,0	7,5	0,0	275,8	72,1	87,0	398,4	445,6	384,7	380,9	381,5
162.0	365.0	1,5	0,0	7,5	0,0	276,1	71,7	87,9	397,5	444,9	383,3	379,5	381,2
163.0	366.0	1,5	0,0	7,5	0,0	275,7	72,2	87,4	396,5	444,1	381,9	378,3	382,0
164.0	367.0	1,5	0,0	7,4	0,0	275,4	72,1	87,6	395,7	442,9	380,4	377,3	381,5
165.0	368.0	1,4	0,0	7,4	0,0	274,8	72,4	87,8	394,0	442,2	379,1	376,2	382,2
166.0	369.0	1,4	0,0	7,4	0,0	274,4	72,2	87,2	394,3	441,4	377,8	375,1	382,0
167.0	370.0	1,4	0,0	7,3	0,0	274,2	72,2	87,5	393,7	440,5	376,7	374,2	382,4
168.0	371.0	1,4	0,0	7,3	0,0	274,5	72,0	88,3	392,5	439,7	375,3	373,0	382,0
169.0	372.0	1,4	0,0	7,3	0,0	274,7	71,9	87,8	392,5	438,9	374,1	372,0	382,2
170.0	373.0	1,3	0,0	7,3	0,0	275,2	71,8	87,4	391,7	438,1	373,0	371,2	382,2
171.0	374.0	1,3	0,0	7,2	0,0	275,0	71,7	86,9	390,7	437,3	371,7	370,3	382,4
172.0	375.0	1,3	0,0	7,2	0,0	275,2	71,9	87,3	389,8	436,6	370,5	369,1	382,1
173.0	376.0	1,3	0,0	7,2	0,0	275,0	71,8	87,3	388,9	435,6	369,2	368,2	382,3
174.0	377.0	1,3	0,0	7,2	0,0	274,4	72,4	87,5	388,2	434,6	367,9	367,1	381,1
175.0	378.0	1,3	0,0	7,2	0,0	274,2	72,6	87,2	387,5	433,8	366,7	366,0	380,7
176.0	379.0	1,2	0,0	7,1	0,0	273,3	72,3	87,4	386,9	433,0	365,4	365,2	380,2
177.0	380.0	1,2	0,0	7,1	0,0	273,4	72,1	87,6	386,4	432,2	364,5	364,2	380,9
178.0	381.0	1,2	0,0	7,1	0,0	272,8	72,2	87,2	385,7	431,3	363,1	363,3	381,0
179.0	382.0	1,2	0,0	7,1	0,0	272,2	72,0	86,7	384,9	430,3	361,8	362,2	379,5
180.0	383.0	1,2	0,0	7,0	0,0	272,2	71,8	87,1	384,4	429,5	360,8	361,3	379,8
181.0	384.0	1,2	0,0	7,0	0,0	272,0	71,9	87,3	383,1	428,7	359,7	360,4	379,1
182.0	385.0	1,1	0,0	6,9	0,0	271,4	71,8	86,6	382,7	427,9	358,5	359,5	379,0
183.0	386.0	1,1	0,0	6,8	0,0	271,6	71,7	86,1	381,9	426,9	357,7	358,5	378,1
184.0	387.0	1,1	0,0	6,8	0,0	270,9	72,1	86,7	380,2	426,2	356,2	357,4	378,0
185.0	388.0	1,1	0,0	6,8	0,0	270,4	72,1	87,0	379,3	425,0	355,3	356,8	377,3
186.0	389.0	1,1	0,0	6,8	0,0	269,6	72,2	86,8	378,3	424,1	354,2	355,7	376,7
187.0	390.0	1,1	0,0	6,8	0,0	268,9	71,9	87,5	378,2	423,3	353,0	354,7	376,1
188.0	391.0	1,1	0,0	6,9	0,0	268,9	71,7	87,1	377,9	422,4	352,0	353,9	376,0
189.0	392.0	1,0	0,0	7,2	0,0	268,5	71,6	87,3	377,1	421,3	350,9	353,4	375,5
190.0	393.0	1,0	0,0	7,2	0,0	268,7	71,5	87,0	376,9	420,5	350,0	352,4	374,7
191.0	394.0	1,0	0,0	7,2	0,0	268,3	71,8	87,0	376,2	419,7	349		

207,0	410,0	0,8	0,0	7,9	0,0	255,7	72,2	86,4	366,7	406,2	334,9	340,4	379,8
208,0	411,0	0,7	0,0	7,9	0,0	254,8	71,8	85,9	365,7	405,6	334,5	339,8	382,5
209,0	412,0	0,7	0,0	7,9	0,0	253,6	71,9	86,2	364,7	404,7	334,0	339,4	385,1
210,0	413,0	0,7	0,0	7,9	0,0	253,0	71,8	86,4	364,3	404,1	333,5	338,8	387,6
211,0	414,0	0,7	0,0	7,9	0,0	253,1	71,6	86,1	363,6	403,6	333,3	338,6	389,7
212,0	415,0	0,6	0,0	7,9	0,0	252,6	71,7	86,3	362,9	402,7	333,0	338,2	392,3
213,0	416,0	0,6	0,0	7,9	0,0	251,9	71,4	86,0	362,8	402,1	332,7	337,8	394,4
214,0	417,0	0,6	0,0	7,8	0,0	251,4	71,3	85,7	361,4	401,4	332,5	337,7	396,6
215,0	418,0	0,6	0,0	7,8	0,0	251,5	72,1	85,7	360,4	400,9	332,0	337,0	398,6
216,0	419,0	0,6	0,0	7,8	0,0	250,7	72,2	86,0	359,8	400,2	331,8	336,8	399,6
217,0	420,0	0,6	0,0	7,8	0,0	250,4	72,1	86,3	359,2	399,6	331,5	336,4	401,6
218,0	421,0	0,6	0,0	7,8	0,0	250,6	72,2	85,6	358,7	399,1	331,2	336,1	403,1
219,0	422,0	0,5	0,0	7,8	0,0	251,0	71,7	85,5	357,5	398,5	331,0	335,8	404,6
220,0	423,0	0,5	0,0	7,7	0,0	251,2	71,9	85,8	357,7	397,9	330,7	335,7	405,5
221,0	424,0	0,5	0,0	7,7	0,0	251,0	71,4	85,8	357,5	397,4	330,5	335,5	406,2
222,0	425,0	0,5	0,0	7,7	0,0	252,0	71,5	85,6	357,8	396,8	330,3	335,3	407,8
223,0	426,0	0,5	0,0	7,7	0,0	252,2	71,4	85,3	357,6	396,4	330,0	335,1	408,5
224,0	427,0	0,4	0,0	7,7	0,0	252,0	71,3	85,7	357,4	395,9	330,0	334,7	409,5
225,0	428,0	0,4	0,0	7,6	0,0	252,2	72,0	85,8	356,6	395,3	329,8	334,6	411,0
226,0	429,0	0,4	0,0	7,6	0,0	252,7	72,1	85,7	357,2	395,0	329,5	334,2	410,6
227,0	430,0	0,4	0,0	7,5	0,0	252,4	72,3	85,7	356,9	394,5	329,1	334,1	411,4
228,0	431,0	0,4	0,0	7,5	0,0	252,1	71,9	85,6	357,0	394,1	328,8	333,7	412,1
229,0	432,0	0,4	0,0	7,4	0,0	252,6	71,5	85,8	356,6	393,6	329,0	333,3	413,5
230,0	433,0	0,3	0,0	7,4	0,0	253,1	71,4	85,1	356,4	393,1	328,5	333,3	414,1
231,0	434,0	0,4	0,0	7,4	0,0	253,6	71,4	85,2	356,6	392,7	328,4	333,2	414,0
232,0	435,0	0,3	0,0	7,4	0,0	254,2	71,5	85,1	355,9	392,2	328,3	333,0	414,7
233,0	436,0	0,3	0,0	7,3	0,0	254,0	71,3	85,4	355,6	391,6	328,0	332,8	415,0
234,0	437,0	0,3	0,0	7,2	0,0	253,8	71,3	85,6	355,4	391,2	327,7	332,5	415,1
235,0	438,0	0,3	0,0	7,2	0,0	253,2	71,8	85,5	354,6	390,7	327,4	332,3	416,1
236,0	439,0	0,2	0,0	7,1	0,0	252,9	71,8	85,8	354,6	390,2	327,1	331,7	415,5
237,0	440,0	0,3	0,0	7,1	0,0	252,7	72,2	85,8	354,4	389,7	326,9	331,4	416,0
238,0	441,0	0,2	0,0	7,1	0,0	252,2	72,0	85,4	353,7	389,3	326,5	330,9	415,6
239,0	442,0	0,2	0,0	7,1	0,0	252,2	71,7	85,3	354,1	388,7	326,1	330,6	417,1
240,0	443,0	0,2	0,0	7,1	0,0	251,7	71,8	85,4	352,9	388,2	326,1	330,5	416,6
241,0	444,0	0,2	0,0	7,0	0,0	252,0	71,5	85,5	353,0	387,7	325,7	329,9	417,1
242,0	445,0	0,1	0,0	7,1	0,0	251,7	71,2	85,2	352,5	387,1	325,5	329,6	417,8
243,0	446,0	0,2	0,0	7,1	0,0	251,7	71,5	85,3	352,8	386,6	325,2	329,3	417,8
244,0	447,0	0,1	0,0	7,0	0,0	252,0	71,3	85,2	351,5	386,0	324,9	328,8	418,2
245,0	448,0	0,2	0,0	7,0	0,0	251,8	71,8	85,6	350,8	385,4	324,6	328,4	419,0
246,0	449,0	0,1	0,0	7,0	0,0	251,7	71,7	85,6	350,5	384,9	324,2	327,8	418,3
247,0	450,0	0,1	0,0	7,0	0,0	251,1	72,3	85,3	350,1	384,4	323,7	327,2	418,0
248,0	451,0	0,1	0,0	6,8	0,0	250,5	72,1	85,4	349,8	383,7	323,4	326,7	418,7
249,0	452,0	0,1	0,0	6,7	0,0	250,4	71,8	85,1	349,4	383,2	323,0	326,3	419,6
250,0	453,0	0,1	0,0	6,8	0,0	250,4	71,6	84,6	349,0	382,5	322,8	325,6	419,6
251,0	454,0	0,1	0,0	6,7	0,0	251,0	71,5	84,7	349,0	382,0	322,5	325,2	419,8
252,0	455,0	0,1	0,0	6,7	0,0	251,0	71,6	84,9	348,6	381,3	322,2	325,0	419,7
253,0	456,0	0,0	0,0	6,7	0,0	250,9	71,6	84,3	347,9	380,7	321,8	324,5	419,5

Manufacturer: HEARTHSTONE  
 Model: GM 60

Run: 3  
 Project #: PI 20162  
 Test Duration: 253 min

	HHV	LHV
Eff	79,12%	85,51%
Comb Eff	98,78%	98,78%
HT Eff	80,09%	86,57%
Output	18 346	kJ/h
Burn Rate	1,17	kg/h
Grams CO	100	g
Input	23 188	kJ/h
MC wet	16,92	

Note: In the "Input data", "Calc. % O<sub>2</sub>", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a], [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3

Ultimate CO<sub>2</sub>  
 CO<sub>2-ut</sub> 19,64  
 F<sub>o</sub>  
 1,062

Overall Heating Efficiency: 79,12%  
 Combustion Efficiency: 98,78%  
 Heat Transfer Efficiency: 80,09%

	Air Fuel Ratio (A/F)	
	Dry Molecular Weight (M <sub>d</sub> )	30,02
	Dry Moles Exhaust Gas (N <sub>r</sub> ):	383,40
	Air Fuel Ratio (A/F)	11,00

Heat Output:	17 403 Btu/h	18 346 kJ/h
Heat Input:	21 997 Btu/h	23 188 kJ/h
Burn Duration:	4,22 h	
Burn Rate:	2,58 lb/h	1,171 kg/h
Stack Temp:	301,2 Deg. F	149,6 Deg. C

NO Fan

Date: 2018-01-17

Manufacturer: Heathstone

Model: GM 60

Project #: PI 20162

Run: 3

Tech: mm

Reviewer: JP

- At - kindling 32 LBS START FINE
- At 29 LBS close Door
- Fan off
- Bypass open
- At 100 LBS instl preload
- At 154 LBS close Door
- At 1900 close bypass
- At 36 LBS close air inlet (drill bit 0.188 in 3/16)
- At 27 LBS
  - open bypass
  - open Door
  - crunch the bed
  - close Door
  - close bypass
  - after 3 min

TEST LOAD CONFIGURATION

- open bypass
- open air inlet
- open Door
- instl load
- close Door
- close bypass
- after 4 min close air inlet (Drill bit 0.188 in 3/16)

**PRE / POST CHECKS**

Date: 2018-01-17 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 3 Tech: mm Reviewer: DP

Moisture Meter Calibration Check:

Equipment #	Time	12%	22%
EM-191	7:00	ok	ok

Pre-Test

Post-Test

**Facility Conditions:**

Air Velocity from less than 2 feet .....

Pre-Test	Post-Test
4 (max 50 Fpm)	6 (max 50 Fpm)
ok	ok
4 sides ok	ok

Smoke Capture Check.....

Picture.....

**Wood Heater Conditions:**

Date Wood Heater Stack Cleaned.....

Date Dilution Tunnel Cleaned.....

Induced Draft Check (max 0.005 H<sub>2</sub>O).....

Traverse before ignition.....

Flow Rate 140 cfm ±10%.....

2018-01-15 mm  
~~2018-01-15~~  
 2018-01-15  
 ok  
 ok

ok

**Temperature System:**

Ambient (65°-90°F).....

Wood Heater Surface (±125°F).....

ok °F  
 ok °F

**Proportional Checks:**

Thermocouple check.....

Pitot Clean.....

Pitot verification.....

ok  
 ok  
 ok

**Sampling Train ID Numbers:**

Probe.....

Filter Front.....

Filter Back.....

Filter Thermocouple.....

Filter (<90°F).....

Train 1 <sup>st</sup> hour	Train 1	Train 2
009	11	42
21	23	25
22	24	26
11	11	12
ok	ok	ok



## SAMPLING EQUIPMENT CHECK OUT

Date: 2018-01-18 Manufacturer: Hearthstone Model: GM60  
 Project #: pJ 20162 Run: 3 Tech: MM Reviewer: RP

### Leakage Checks Tunnel Samplers

	System 1 <sup>st</sup> hour		System 1		System 2	
	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)
Unplugged Flow Rate = .25cfm						
Vacuum (inches Hg.)	-15	-15	-15	-15	-15	-15
Final 1minute DGM (Liter)	619980.98	612292.80	619983.24	612292.93	546060.66	547391.71
Initial 1minute DGM (Liter)	619980.88	612292.78	619983.18	612292.93	546060.65	547391.69
Change © (Liter)	0.10	0.02	0.06	∅	0.01	0.02
Allowable leakage .04 x Sample rate or 0.28Lpm CSA B415 (0.56)						
Check OK	ok	ok	ok	ok	ok	ok

### Leakage Checks Flue Gas Sampler

Plugged Probe	Pre Test	Post Test
Vacuum (inches Hg.)	-5	-5
Rotometer Reading (mml/min.)	0	0
Flow Rate (lpm)	1.5	1.5
Allowable (.02 x Sample Rate)	30	30
Check OK	ok	ok

### Leakage Checks Pitot

Plugged Probe	Pre Test 3 H <sub>2</sub> O static	Pre Test 0.4-0.5 H <sub>2</sub> O velocity	Post Test 3 H <sub>2</sub> O Static	Post Test 0.4-0.5 H <sub>2</sub> O velocity
Vacuum (inches Hg.)	3	-5	3	-4
Check OK (no change after 15 sec.)	ok	ok	ok	ok

Date: 2018-01-17      Manufacturer: Acauthstone      Model: GM 60  
 Project #: PI 20162      Run: 3      Tech: MM      Reviewer: [Signature]

Scale Type	Audit		Measured Weight
	Equipment #	Weight	
Platform	EM-090	44 lbs, Class F	44 lbs
Wood	EM-090	44 lbs, Class F	44 lbs
Analytical	EM-128	100 mg, Class S	100 mg
Analytical	EM-129	200 g, Class S	200 g

**LIMITS OF WEIGHT RANGES**

**ANALYTICAL SCALE:** ..... 50%-150% of dry filter weight, ± 0.1 mg  
**PLATFORM SCALE:** ..... 20%-80% of ideal test load weight, ± 0.1 lbs or 1%  
**WOOD SCALE:** ..... 20%-80% of ideal test load weight, ± 0.01 lbs or 1%



Date: 2018-01-17 Manufacturer: Hearthstone Model: GM 60  
 Project #: pI 20162 Run: 3 Tech: MM Reviewer: SP

FOR TUNNELS &lt; 12 in

 Barometric pressure ( $P_{bar}$ ) 102.5 (KPa.) Static pressure ( $P_q$ ) 0.39 (inches w.c.)  
 Inside diameter: Port A \_\_\_\_\_ Port B \_\_\_\_\_  
 Tunnel cross sectional area: .1963Ft<sup>2</sup>  
 Pitot tube type: Standard

Traverse Point	Position (inches)			Velocity Head $\Delta_p$ (inches H <sub>2</sub> O)	Tunnel Temperature (°F)
	6 po	7 po	8 po		
A- Centroid	3.00	3.50	4	0058	7020
B - Centroid	3.00	3.50	4	0057	7065
A-1	0.40	0.50	0.50	0048	7017
A-2	1.50	1.75	2	0061	7034
A-3	4.50	5.25	6	0049	7042
A-4	5.60	6.5	7.5	0050	7056
B-1	0.40	0.50	0.50	0049	7060
B-2	1.50	1.75	2	0053	7069
B-3	4.50	5.25	6	0052	7071
B-4	5.60	6.5	7.5	0048	7059
AVERAGE					

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{(T_s)_{avg}}{P_s M_s}}$$

Where,

 $C_p$  = pitot tube coefficient, dimension less = 0.99 for standard pitot.

 $\Delta_p$  = manometer reading (inches H<sub>2</sub>O)

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

 $P_s$  = absolute dilution tunnel gas pressure or  $P_{bar} + P_{qg}$ 
 $P_q$  = static pressure in. H<sub>2</sub>O  
                                   { 13.6 }

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

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

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



Date: 2018-01-17 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 3 Tech: MM Reviewer: DP

Pre-Test (Adjust and Record)

	ZERO		SPAN		CAL. (Record Only)	
	Actual	Should Be	Actual	Should Be	Actual	Should Be
CO	0	0	3009	300	1009	100
Tolerance CO		+/- 0.02		+/- 0.15		+/- 0.05
CO <sub>2</sub>	0	0	1795	1800	973	1000
Tolerance CO <sub>2</sub>		+/- 0.02		+/- 0.5		+/- 0.5
O <sub>2</sub> informative CSA B415 calculated value	na	na	na	na	na	na
	Actual	Should Be	Actual	Should Be	Actual	Should Be

Post Test (Record Only)

	Zero	Span	Cal.	Zero Drift	Limit	Span Drift	Limit	Cal. Drift	Limit	OK?	Not OK*
CO	0005	3004	1006	0005	0.02	0005	0.15	0003	0.05	✓	
CO <sub>2</sub>	0	1789	980	0	0.02	006	0.5	007	0.5	✓	

**TEST DATA LOG**

Date: 2018-01-17 Manufacturer: Harshlab Model: GM 60  
 Project #: PI 20162 Run: 3 Tech: MM Reviewer: NP

**RAW DRY GAS METER READINGS**

	System 1	System 2	Blanck
Final (Liter)	621291, 83	547390, 70	717 87
Initial (Liter)	619983, 34	546064, 05	686 90

**AMBIENT CONDITIONS**

	Before	After
Barometer (kPa):	102,5	102,0
Dry Bulb (F):	70,34	72,83
Humidity (%):	19,1	20,1

**Flow Meter**

	Start	End
Flow meter reading	N.A	N.A

**Flow Meter Verification**

	Before	After
Flow meter Check (liters)	N.A	N.A
Scale Weight ( Kg)	N.A	N.A



**FUEL DATA**

Date: 2018-01-17 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 2062 Run: 3 Tech: mm Reviewer: DP

**FUEL DESCRIPTION:**

Type of wood:

**PRE-TEST LOAD**

Piece Size	Weight	Meter Moisture Content (% dry)*				
2 x 4 x 8 in.	1232 lbs.	213	216	218	220	221
2 x 4 x 8 in.	1268 lbs.	223	224	219	218	219
2 x 4 x 8 in.	1188 lbs.	230	228	219	224	226
2 x 4 x 8 in.	1320 lbs.	230	223	219	216	214
2 x 4 x 8 in.	1280 lbs.	223	228	224	229	219
2 x 4 x 8 in.	1250 lbs.	230	234	233	229	230
2 x 4 x 8 in.	1044 lbs.	236	234	236	235	232
2 x 4 x 8 in.	1058 lbs.	196	193	201	206	209
2 x 4 x 8 in.	1142 lbs.	206	208	209	207	208
2 x 4 x 8 in.	1250 lbs.	213	216	219	214	218
2 x 4 x 8 in.	1134 lbs.	220	223	216	209	211
2 x 4 x 8 in.	1144 lbs.	208	209	204	208	207
2 x 4 x 8 in.	1120 lbs.	216	214	213	209	208
2 x 4 x 8 in.	1122 lbs.	196	199	193	198	196
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					

TEST LOAD WEIGHT: 1655 lbs



### FUEL DATA

Date: 2018-01-17 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 20162 Run: 3 Tech: MM Reviewer: DP

**FUEL DESCRIPTION:**

Type of wood :

**TEST LOAD**

Piece Size		Weight		Meter Moisture Content (% dry)*				
1 1/2	x 3 1/2 x 17 1/4 in.	1,936	lbs.	21	21.6	21.3	21.8	21.7
1 1/2	x 3 1/2 x 17 1/4 in.	1,860	lbs.	19.1	19.6	19.3	19.4	19.4
3 1/2	x 3 1/2 x 17 1/4 in.	4,080	lbs.	20.6	19.1	19.1	19.9	20.1
3 1/2	x 3 1/2 x 17 1/4 in.	4,090	lbs.	20.1	20.1	22.0	21.7	22.0
1 1/2	x 3/4 x 5 in.	0,094	lbs.			19.1		
1 1/2	x 3/4 x 5 in.	0,092	lbs.			19.3		
1 1/2	x 3/4 x 5 in.	0,090	lbs.			19.6		
1 1/2	x 3/4 x 5 in.	0,094	lbs.			19.2		
1 1/2	x 3/4 x 5 in.	0,094	lbs.			19.3		
1 1/2	x 3/4 x 5 in.	0,100	lbs.			19.2		
1 1/2	x 3/4 x 5 in.	0,094	lbs.			19.5		
1 1/2	x 3/4 x 5 in.	0,096	lbs.			19.1		
1 1/2	x 3/4 x 5 in.	0,092	lbs.			19.6		
1 1/2	x 3/4 x 5 in.	0,090	lbs.			19.4		
1 1/2	x 3/4 x 5 in.	0,094	lbs.			19.8		
1 1/2	x 3/4 x 5 in.	0,088	lbs.			19.6		
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					

TEST LOAD WEIGHT: 1309 lbs Min 20%: 2.62 Max 25%: 327



Date: 2018-01-16 Manufacturer: Hearthstone Model: GM 60  
 Project #: PJ 20162 Run: 3 Tech: MR Reviewer: DO

		SYSTEM 1 - 1 <sup>st</sup> hour						SYSTEM 1						
Pre-test Weight Record	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
		009	21	22	8	11	23	24	9					
	17:00	614481	01263	01262	357852	937241	01245	01241	357870					01285
	10:00	614481	01263	01261	357851	937242	01246	01241	357869					01286

		SYSTEM 1 - 1 <sup>st</sup> hour						SYSTEM 1						
Post-test Weight Record	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
		009	21	22	8	11	23	24	9					
	16:00	614487	01264	01262	357866	937257	01243	01236	357888					01288
	8:00	614481	01261	01261	357863	937243	01240	01234	357883					01286
	8:00	614481	01261	01261	357863	937243	01240	01234	357883					01286



# DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2018-01-16 Project #: PJ 20162 Run: 3 Manufacturer: Healthstone Model: GM 60  
 Tech: MM Reviewer: RP

SYSTEM 2					
Pre-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time	472	25	26	10
2018-01-16	17:00	110 3110	01246	01266	35, 3365
2018-01-17	10:00	110 3111	01245	01265	35, 3366

SYSTEM 2					
Post-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time	472	25	26	10
2018-01-17	16:00	110 3113	01246	01260	35, 3386
2018-01-29	8:00	110 3111	01244	01258	35, 3383
2018-02-05	8:00	110 3112	01244	01259	35, 3383

## Paramètres

Tous les facteurs de corrections et autres paramètres qui peuvent être modifiés par l'utilisateur du fichier sont regroupés ici.

Code verrouillage: 

HEA
-----

### Description du test

Test standard	EPA
Run #	4
Date	18-01-2018
Technicien	M.M
Project #	PI 20162

### Description de l'unité

Manufacturier	HEARTHSTONE	
Modèle	GM 60	
Combustion system	Cat	
Appliance type	WOOD STOVE	
Firebox volume	2,03	cu ft.
Appliance weight empty	N.A	lbs
Appliance weight full	N.A	lbs

### Paramètres du test

Logging time	1	min
Manufacturer's rated heat output		BTU/h Donnée fournie par le manufacturier
Targeted category	3	
Targeted output	N.A	BTU/h
Cp steel	N.A	BTU/lb-°F

### Échantillonnage

Blank sampling rate	0,20	cuft/min
Internal probe diameter	0,18	in.
Calibration Factor (DGM #1):	0,988	Dimensionless
Equipment number (DGM #1):	EM 178	
Calibration Factor (DGM #2):	0,988	Dimensionless
Equipment number (DGM #2):	EM 179	
Calibration Factor (DGM #3):	0,986	Dimensionless
Equipment number (DGM #3):	EM 070	Dimensionless

### Tunnel

Targeted tunnel flow rate	160	scfm
Tunnel diameter	6	in.
Molecular weight	29	
Pitot tube type	Standard	
Pitot tube coefficient	0,99	Dimensionless

Project nu.	PI 20162
Date	18-01-2018
Technicien	M.M

### Fuel data

Fuel type	Dimension
Fuel specie	D. Fir
HHV	19810,0 kJ/kg
%C	48,7
%H	6,9
%O	43,9
%Ash	0,5
HHV	8519,2 Btu/lb
LHV	7451,0 Btu/lb

Default Fuel Values		
	D. Fir	Oak/Maple
HHV	19 810	19 887
%C	48,73	50
%H	6,87	6,6
%O	43,9	42,9
%Ash	0,5	0,5
HHV (Btu/lb)	8519	8552
LHV (Btu/lb)	7451	7480









**Filter set weight**

	System 1 (g) 1st hour				System 1 (g)				System 2 (g)				Ambient blank (g)	Date	Heure
	probe	front	back	gasket	probe	front	back	gasket	probe	front	back	gasket	Filter		
Number	16	29	31	11	36	32	33	12	41	35	36	13	37		
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	108,7541	0,1230	0,1296	35,5039	107,7411	0,1290	0,1305	36,0060	110,3645	0,1310	0,1296	35,7031	0,1299	17/01/2018	17:00
Before (6)	108,7542	0,1229	0,1295	35,5040	107,7411	0,1289	0,1306	36,0061	110,3646	0,1311	0,1295	35,7032	0,1300	18/01/2018	09:00
After (1)	108,7549	0,1231	0,1292	35,5068	107,7418	0,1281	0,1299	36,0082	110,3652	0,1316	0,1285	35,7065	0,1302	18/01/2018	15:00
After (2)	108,7542	0,1230	0,1292	35,5067	107,7411	0,1281	0,1299	36,0080	110,3646	0,1316	0,1285	35,7063	0,1301	29/01/2018	08:00
After (3)	108,7542	0,1230	0,1292	35,5067	107,7411	0,1281	0,1299	36,0080	110,3646	0,1316	0,1285	35,7063	0,1301	05/02/2018	08:00
After (4)															
After (5)															
After (6)	108,7542	0,1230	0,1292	35,5067	107,7411	0,1281	0,1299	36,0080	110,3646	0,1316	0,1285	35,7063	0,1301	05/02/2018	08:00
Difference	0,0000	0,0001	-0,0003	0,0027	0,0000	-0,0008	-0,0007	0,0019	0,0000	0,0005	-0,0010	0,0031	0,0001		
Total (mg)		2,5				2,9				2,6			0,1		
Total ajusté (mg)		<b>2,40</b>				<b>2,80</b>				<b>2,50</b>					

<b>Project nu.</b>	PI 20162
<b>Date</b>	18-01-2018
<b>Technicien</b>	M.M

SFBA EPA EMISSION RESULTS

RESULTS

**Average emission rate:** 0,8 g/hr

Burn Rate : 1,604 Dry kg/hr

**Test Duration:** 187 min

PRESSURE FACTOR: DGM 1 0,97177  
 DGM 2 0,96941  
 DGM 3 0,99881

BAROMETRIC PRESSURE  
 Average: 29,884349 in Hg  
 Start: 29,913879 in Hg  
 End: 29,854819 in Hg

TEMPERATURE FACTORS DGM 1 0,98393  
 DGM 2 0,98259  
 DGM 3 0,98987

DGM CONTROLLER VALUES

DGM 1 Final: 21975,537 Cuft  
 Initial: 21940,783 Cuft

VOLUMES SAMPLED DGM 1 32,827 SCft  
 DGM 2 33,546 SCft  
 DGM 3 22,411 SCft

DGM 2 Final: 19366,735 Cuft  
 Initial: 19331,105 Cuft

DGM #3 Final: 740,860 Cuft  
 Initial: 717,880 Cuft

TOTAL TUNNEL VOLUME : 30883

TEMPERATURES

SAMPLE RATIOS  
 Sample Train 1: 940,805  
 Sample Train 2: 920,631

DGM 1 536,622 °R  
 DGM 2 537,358 °R

Paticulate concentration  
 Sample Train 1 **0,000088** g/dscf  
 Sample Train 2 **0,000078** g/dscf  
 Room **0,000004** g/dscf

CALIBRATION FACTORS

DGM 1 0,9879  
 DGM 2 0,9884  
 DGM #3 0,9864

TUNNEL FLOW RATE: 165,152 Dscfm

TOTAL EMISSIONS  
 Sample Train 1 **2,59** g  
 Sample Train 2 **2,26** g

PARTICULATE CATCH  
 Total Sample Train 1: 2,90 mg  
 Total Sample Train 2: 2,60 mg  
 Total Sample Train 1 1st hour: 2,50 mg

EMISSION RATES  
 Sample Train 1 **0,83** g/hr  
 Sample Train 2 **0,72** g/hr

1st hour emission rate **2,35** g/hr

DEVIATION: 6,91%

Cs Train 1 Train 2  
 8,834E-05 7,75058E-05

		Average	0,13	10,42	#DIV/0!	360,01	73,41	99,40	449,79	306,78	425,15	417,92	485,22
*	*	*	*	*	*	*1	*2	*3	*4	*5	*6	*7	*8
Elapsed	Weight	Flue	Room	Tunnel	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit	Unit
Time	Raw data row	Remaining	CO	CO <sub>2</sub>	O <sub>2</sub>	Gas	Temp	Dry Bulb	Top	Back	R.Side	L.Side	Bottom
min	lbs	%	%	%	%	%F	°F	°F	°F	°F	°F	°F	°F
0,00	169,00	13,3	0,0	5,7	0,0	339,8	72,2	131,4	390,0	316,8	427,4	414,8	655,7
1,0	170,0	13,1	0,1	4,0	0,0	365,1	72,4	111,6	386,1	316,5	426,0	413,6	653,2
2,0	171,0	12,9	0,1	9,3	0,0	396,7	72,0	112,1	392,8	314,8	424,7	412,6	648,1
3,0	172,0	12,7	0,1	11,3	0,0	416,2	71,4	113,5	407,9	314,3	423,3	411,7	642,8
4,0	173,0	12,5	0,9	13,8	0,0	433,4	71,5	114,7	426,9	311,9	422,1	410,3	635,9
5,0	174,0	12,4	0,9	15,2	0,0	423,6	72,7	108,5	443,8	310,5	420,9	409,7	630,6
6,0	175,0	12,2	0,3	14,2	0,0	418,0	72,5	107,2	455,4	308,8	419,8	408,6	624,7
7,0	176,0	12,0	0,3	14,5	0,0	416,6	72,4	106,7	466,9	306,3	418,7	407,9	618,9
8,0	177,0	11,8	0,3	14,3	0,0	417,8	72,7	107,1	475,3	305,9	417,3	407,0	613,9
9,0	178,0	11,6	0,3	14,7	0,0	419,0	72,2	107,5	484,0	304,3	416,6	405,7	609,2
10,0	179,0	11,5	0,3	14,7	0,0	420,1	73,0	107,9	491,6	302,9	415,8	405,3	602,2
11,0	180,0	11,3	0,4	14,7	0,0	421,3	73,0	108,1	498,4	300,6	415,2	404,8	596,2
12,0	181,0	11,2	0,4	14,6	0,0	422,1	72,8	108,1	504,8	299,6	414,9	404,4	591,5
13,0	182,0	11,0	0,3	14,5	0,0	422,6	72,6	107,8	511,6	298,6	414,8	404,9	584,8
14,0	183,0	10,9	0,3	14,4	0,0	422,6	72,3	107,6	516,2	298,2	414,6	405,0	579,2
15,0	184,0	10,7	0,3	14,5	0,0	423,7	72,6	108,1	519,9	297,5	414,9	404,9	574,7
16,0	185,0	10,5	0,3	14,6	0,0	425,3	72,8	108,0	524,2	295,7	415,8	405,1	569,5
17,0	186,0	10,4	0,4	14,7	0,0	426,1	72,6	108,2	528,0	295,5	416,5	405,5	563,9
18,0	187,0	10,2	0,4	14,7	0,0	427,8	72,9	108,3	531,9	295,7	417,4	405,9	558,7
19,0	188,0	10,0	0,4	14,8	0,0	429,1	73,3	108,2	536,2	296,0	418,1	406,0	555,5
20,0	189,0	9,9	0,5	14,8	0,0	429,7	73,1	108,6	540,4	295,5	419,6	406,3	549,5
21,0	190,0	9,7	0,4	14,8	0,0	430,2	73,4	109,1	544,0	295,0	420,8	407,1	545,1
22,0	191,0	9,5	0,4	14,8	0,0	429,9	73,5	109,0	547,5	296,0	422,1	407,6	540,1
23,0	192,0	9,4	0,5	14,8	0,0	430,7	73,4	109,0	550,6	296,5	423,2	408,4	536,2
24,0	193,0	9,2	0,5	14,9	0,0	432,2	73,3	109,2	553,4	295,1	425,0	409,2	531,6
25,0	194,0	9,1	0,7	15,1	0,0	433,8	73,6	110,1	558,3	297,1	426,3	410,0	527,1
26,0	195,0	8,9	0,8	15,2	0,0	436,1	73,8	110,1	562,8	297,0	428,1	411,0	523,3
27,0	196,0	8,7	0,9	15,3	0,0	437,2	73,2	110,1	567,2	297,7	429,6	412,1	519,4
28,0	197,0	8,6	1,0	15,3	0,0	437,0	74,0	109,9	571,4	298,7	431,3	413,2	514,7
29,0	198,0	8,4	1,0	15,4	0,0	437,7	74,0	110,0	574,4	298,4	433,2	414,3	511,0
30,0	199,0	8,2	1,0	15,3	0,0	438,1	73,7	109,5	577,6	298,4	434,8	415,6	507,4
31,0	200,0	8,1	0,9	15,3	0,0	439,2	73,2	109,4	579,9	298,6	436,4	416,5	504,8
32,0	201,0	7,9	0,9	15,2	0,0	439,3	74,0	109,9	582,1	299,7	438,5	418,1	501,3
33,0	202,0	7,7	0,7	15,4	0,0	439,8	74,1	110,2	582,3	301,4	440,1	418,7	498,2
34,0	203,0	7,6	0,6	15,5	0,0	440,1	74,2	110,2	584,4	301,9	441,8	420,4	495,1
35,0	204,0	7,5	0,5	15,5	0,0	440,9	73,5	110,1	585,6	302,0	443,5	421,6	492,2
36,0	205,0	7,3	0,5	15,6	0,0	441,5	74,2	110,1	586,2	302,5	444,9	422,8	488,8
37,0	206,0	7,2	0,4	15,7	0,0	442,1	74,1	109,9	587,4	304,0	446,6	424,5	486,4
38,0	207,0	7,1	0,3	15,6	0,0	441,9	73,7	109,9	588,1	304,3	448,4	425,4	483,5
39,0	208,0	6,9	0,3	15,5	0,0	442,1	73,8	109,8	589,5	306,1	450,0	426,9	480,3
40,0	209,0	6,8	0,3	15,5	0,0	442,5	73,3	109,8	589,3	306,2	451,8	428,2	478,7
41,0	210,0	6,6	0,3	15,5	0,0	443,0	74,0	109,8	590,5	308,0	453,6	429,9	475,4
42,0	211,0	6,5	0,3	15,5	0,0	441,9	73,6	109,6	589,9	308,7	455,6	431,2	473,3
43,0	212,0	6,3	0,3	15,5	0,0	441,8	73,7	109,7	589,5	309,9	457,3	432,5	470,9
44,0	213,0	6,2	0,2	15,5	0,0	440,1	74,8	109,9	590,1	310,3	459,3	433,9	468,6
45,0	214,0	6,1	0,1	15,4	0,0	438,5	74,4	109,8	588,7	311,5	460,7	435,4	466,7
46,0	215,0	5,9	0,1	15,4	0,0	437,5	74,2	109,9	587,9	312,1	462,6	437,0	464,5
47,0	216,0	5,8	0,1	15,3	0,0	436,7	74,6	109,4	587,4	313,4	464,2	438,6	462,1
48,0	217,0	5,7	0,1	15,4	0,0	436,7	74,4	109,6	587,0	315,0	465,8	439,9	460,5
49,0	218,0	5,5	0,2	15,4	0,0	436,0	74,4	109,2	585,9	315,9	467,1	441,2	458,4
50,0	219,0	5,4	0,1	15,4	0,0	435,7	73,9	108,9	585,9	316,8	468,6	442,8	456,6
51,0	220,0	5,3	0,1	15,1	0,0	434,1	74,0	108,3	586,1	318,7	469,9	444,4	454,9
52,0	221,0	5,2	0,0	14,8	0,0	431,6	74,5	108,1	585,4	320,3	471,0	446,0	453,4
53,0	222,0	5,0	0,0	14,5	0,0	428,8	73,8	107,8	583,4	321,8	472,2	447,3	451,4
54,0	223,0	4,9	0,0	14,1	0,0	425,3	74,4	107,3	581,9	322,9	473,3	448,7	450,7
55,0	224,0	4,8	0,0	13,7	0,0	421,1	75,1	106,8	578,9	324,7	474,0	449,8	448,3
56,0	225,0	4,8	0,0	13,5	0,0	417,6	75,3	107,0	575,7	325,3	474,8	450,7	447,2
57,0	226,0	4,6	0,0	13,2	0,0	414,4	75,1	106,6	573,1	327,2	475,4	451,3	445,7
58,0	227,0	4,5	0,0	13,2	0,0	412,1	74,8	106,3	570,1	329,5	475,9	452,4	444,3
59,0	228,0	4,4	0,0	13,2	0,0	410,5	74,1	106,1	566,9	330,6	476,3	453,2	443,7
60,0	229,0	4,3	0,0	13,2	0,0	408,9	74,5	105,6	565,0	331,3	476,5	454,0	442,2
61,0	230,0	4,2	0,0	13,0	0,0	406,4	75,0	105,5	562,0	332,4	476,4	454,6	441,4
62,0	231,0	4,1	0,0	12,8	0,0	405,0	74,4	105,1	559,7	333,9	476,3	455,1	440,3
63,0	232,0	4,1	0,0	12,8	0,0	402,9	74,4	104,6	556,4	334,4	475,8	455,9	439,5
64,0	233,0	4,0	0,0	12,7	0,0	400,8	74,8	104,4	554,4	335,8	475,3	456,4	438,7
65,0	234,0	3,9	0,0	12,6	0,0	399,0	74,7	104,1	552,0	336,6	474,8	457,1	437,9
66,0	235,0	3,8	0,0	12,6	0,0	397,2	74,8	103,4	548,5	337,9	473,9	457,3	437,1
67,0	236,0	3,7	0,0	12,4	0,0	394,3	74,8	103,6	546,7	337,9	473,1	457,8	436,4
68,0	237,0	3,6	0,0	12,3	0,0	392,0	74,6	103,9	543,6	338,3	472,2	458,7	436,5
69,0	238,0	3,6	0,0	12,2	0,0	389,5	75,0	103,5	541,5	338,6	471,0	459,1	435,5
70,0	239,0	3,5	0,0	12,0	0,0	387,1	74,0	103,2	538,5	338,8	470,0	459,5	434,8
71,0	240,0	3,4	0,0	11,8	0,0	384,9	75,1	102,9	535,0	339,5	468,6	459,9	434,2
72,0	241,0	3,3	0,0	11,7	0,0	382,5	74,3	102,3	530,4	340,5	467,5	460,4	433,5
73,0	242,0	3,3	0,0	11,6	0,0	379,9	74,0	102,0	527,6	340,9	466,5	460,5	433,7
74,0	243,0	3,2	0,0	11,5	0,0	378,2	73,8	101,8	523,5	341,2	465,2	460,7	433,7
75,0	244,0	3,1	0,0	11,3	0,0	376,3	74,7	101,7	520,2	341,7	464,0	460,5	433,0
76,0	245,0	3,0	0,0	11,4	0,0	374,5	74,4	101,4	516,2	341,0	462,9	460,8	432,3
77,0	246,0	3,0	0,0	11,4	0,0	372,8	74,9	101,1	512,0	341,7	462,0	460,4	432,5
78,0	247,0	2,9	0,0	11,5	0,0	371,3	74,8	100,8	510,1	341,8	461,2	460,4	431,8
79,0	248,0	2,9	0,0	11,7	0,0	369,7	74,5	100,9	508,4	343,0	460,3	460,2	432,2
80,0	249,0	2,8	0,0	11,8	0,0	367,9	75,0	101,1	506,5	343,5	459,5	460,0	431,3
81,0	250,0	2,7	0,0	11,7	0,0	365,7	74,4	100,4	503,5	343,8	458,8	459,8	431,5
82,0	251,0	2,6	0,0	11,3	0,0	363,7	74,4	99,8	500,3	345,2	458,1	459,4	431,2
83,0	252,0	2,6	0,0	10,8	0,0	361,9	73,9	99,6	496,9	345,2	457,6	459,1	430,7
84,0	253,0	2,5	0,0	10,7	0,0	359,8	74,4	99,3	494,0	345,7	456,9	458,6	430,4
85,0	254,0	2,5	0,0	10,6	0,0	358,0	73,9	98,9	490,2	346,2	456,1	458,2	430,2</



101,0	270,0	1,9	0,0	7,9	0,0	333,2	74,2	94,7	428,2	337,5	441,0	447,2	440,8
102,0	271,0	1,9	0,0	7,9	0,0	331,8	73,9	95,1	424,7	336,1	439,8	445,7	441,3
103,0	272,0	1,9	0,0	7,9	0,0	331,1	74,1	95,4	421,0	334,6	438,6	445,0	442,8
104,0	273,0	1,9	0,0	7,9	0,0	329,5	74,0	95,0	418,0	332,3	437,3	443,4	443,5
105,0	274,0	1,8	0,0	7,9	0,0	328,9	73,6	94,7	414,3	330,9	436,2	442,0	444,6
106,0	275,0	1,8	0,0	8,0	0,0	327,8	73,8	94,5	411,6	327,7	434,8	440,3	445,7
107,0	276,0	1,8	0,0	8,0	0,0	327,4	73,3	94,3	408,7	326,9	433,7	439,0	446,5
108,0	277,0	1,8	0,0	8,0	0,0	326,0	73,2	94,0	405,9	325,5	432,7	437,5	447,4
109,0	278,0	1,7	0,0	8,1	0,0	325,1	73,6	93,9	403,3	323,6	431,3	436,0	448,1
110,0	279,0	1,7	0,0	8,1	0,0	324,3	72,7	93,8	401,2	321,3	430,1	434,2	449,4
111,0	280,0	1,7	0,0	8,1	0,0	323,6	72,7	93,5	398,9	319,2	428,8	432,9	449,6
112,0	281,0	1,6	0,0	8,2	0,0	322,7	73,6	93,2	396,1	318,0	427,4	431,1	451,0
113,0	282,0	1,6	0,0	8,2	0,0	321,6	73,6	93,7	393,5	316,7	426,3	430,0	450,9
114,0	283,0	1,6	0,0	8,2	0,0	320,6	73,4	93,9	391,8	315,4	424,9	428,3	452,8
115,0	284,0	1,6	0,0	8,2	0,0	320,2	72,5	93,5	389,8	315,6	423,7	426,9	453,5
116,0	285,0	1,6	0,0	8,2	0,0	319,6	73,6	93,5	387,7	313,7	422,7	425,4	454,1
117,0	286,0	1,5	0,0	8,1	0,0	318,7	73,0	93,3	386,5	311,9	421,5	424,0	454,8
118,0	287,0	1,5	0,0	8,2	0,0	318,1	73,2	93,3	384,5	311,0	420,0	422,8	455,4
119,0	288,0	1,5	0,0	8,2	0,0	317,9	73,6	92,9	382,4	309,9	418,8	421,2	456,3
120,0	289,0	1,5	0,0	8,2	0,0	317,5	73,7	92,8	381,4	308,7	417,7	420,1	457,7
121,0	290,0	1,4	0,0	8,1	0,0	316,7	73,0	92,6	379,5	307,6	416,5	419,0	458,1
122,0	291,0	1,4	0,0	8,1	0,0	316,7	73,3	92,3	377,9	307,0	415,4	417,6	459,8
123,0	292,0	1,4	0,0	8,1	0,0	316,0	73,3	92,8	376,5	305,5	414,3	416,3	459,7
124,0	293,0	1,3	0,0	8,0	0,0	315,4	73,4	93,0	374,7	304,9	413,2	415,1	461,2
125,0	294,0	1,3	0,0	8,0	0,0	315,1	72,8	92,6	373,3	304,7	412,0	413,9	460,8
126,0	295,0	1,3	0,0	7,9	0,0	315,1	73,1	92,6	372,4	303,9	411,1	412,9	462,0
127,0	296,0	1,2	0,0	7,8	0,0	314,4	73,1	92,6	370,5	302,9	410,2	411,6	462,4
128,0	297,0	1,3	0,0	7,9	0,0	313,9	73,2	92,1	369,6	302,4	408,8	410,4	463,8
129,0	298,0	1,2	0,0	7,9	0,0	312,9	73,2	92,4	368,6	301,6	407,9	409,3	463,9
130,0	299,0	1,2	0,0	8,0	0,0	312,5	73,5	92,0	367,7	301,4	406,7	408,0	464,8
131,0	300,0	1,2	0,0	7,9	0,0	311,4	73,6	92,0	366,6	300,6	405,7	406,9	465,2
132,0	301,0	1,2	0,0	7,7	0,0	310,9	73,4	91,6	366,0	300,0	404,8	405,7	466,9
133,0	302,0	1,2	0,0	7,7	0,0	310,0	72,8	92,4	364,9	299,9	404,0	404,5	466,2
134,0	303,0	1,1	0,0	7,7	0,0	309,0	73,0	92,7	363,4	298,7	403,2	403,9	468,9
135,0	304,0	1,1	0,0	7,7	0,0	308,4	72,9	92,5	362,7	297,7	402,6	402,4	468,9
136,0	305,0	1,1	0,0	7,8	0,0	308,0	72,7	92,0	361,3	297,0	401,8	401,1	471,6
137,0	306,0	1,1	0,0	7,8	0,0	307,5	72,9	92,0	360,5	296,2	401,1	400,2	472,1
138,0	307,0	1,0	0,0	7,8	0,0	306,8	72,5	91,7	359,4	294,7	400,6	399,1	473,3
139,0	308,0	1,0	0,0	7,8	0,0	306,7	72,1	91,7	358,9	294,3	399,9	398,0	474,6
140,0	309,0	1,0	0,0	7,7	0,0	306,6	72,6	91,6	357,9	293,6	399,4	396,8	476,1
141,0	310,0	1,0	0,0	7,7	0,0	306,2	72,9	91,5	357,1	291,5	398,8	395,9	477,4
142,0	311,0	1,0	0,0	7,7	0,0	306,7	72,5	91,4	356,2	291,4	398,3	394,9	478,5
143,0	312,0	0,9	0,0	7,8	0,0	306,4	72,7	91,6	355,5	290,4	397,7	393,9	480,5
144,0	313,0	0,9	0,0	7,7	0,0	305,9	73,2	91,7	354,6	288,2	397,1	393,1	480,8
145,0	314,0	0,9	0,0	7,8	0,0	305,5	73,3	91,8	354,0	288,3	396,4	392,0	482,1
146,0	315,0	0,8	0,0	7,8	0,0	305,2	73,0	91,6	353,5	287,3	396,1	391,3	483,9
147,0	316,0	0,8	0,0	7,7	0,0	305,6	72,6	91,8	352,8	286,2	395,3	390,5	485,1
148,0	317,0	0,8	0,0	7,8	0,0	305,6	72,6	91,7	352,2	285,1	394,9	389,7	486,4
149,0	318,0	0,8	0,0	7,6	0,0	306,3	72,2	91,2	352,0	283,9	394,4	389,0	486,8
150,0	319,0	0,8	0,0	7,6	0,0	306,1	72,5	91,4	351,0	282,9	393,8	388,0	488,0
151,0	320,0	0,7	0,0	7,5	0,0	306,4	72,0	91,2	350,7	282,1	393,2	387,3	488,4
152,0	321,0	0,7	0,0	7,5	0,0	306,3	72,5	91,1	349,3	282,0	392,5	386,6	489,6
153,0	322,0	0,7	0,0	7,5	0,0	306,4	72,9	91,2	348,9	280,5	391,7	385,9	492,0
154,0	323,0	0,7	0,0	7,5	0,0	306,8	72,7	91,6	348,3	280,2	390,9	385,1	491,3
155,0	324,0	0,7	0,0	7,4	0,0	306,3	73,1	91,9	347,1	279,1	390,1	384,5	492,9
156,0	325,0	0,6	0,0	7,4	0,0	306,7	73,2	91,8	346,3	277,5	389,3	383,7	493,5
157,0	326,0	0,6	0,0	7,2	0,0	306,7	72,7	91,6	345,5	278,0	388,7	383,1	494,3
158,0	327,0	0,6	0,0	7,1	0,0	306,0	72,9	91,5	345,2	276,4	387,8	382,3	494,6
159,0	328,0	0,6	0,0	7,0	0,0	306,2	72,7	91,3	343,9	275,6	386,9	381,3	495,4
160,0	329,0	0,5	0,0	7,0	0,0	305,7	73,7	91,2	343,0	275,0	385,9	380,4	496,2
161,0	330,0	0,5	0,0	7,0	0,0	306,0	72,8	91,2	342,4	275,0	385,4	379,9	497,4
162,0	331,0	0,5	0,0	7,0	0,0	305,8	72,9	91,0	341,8	273,6	384,5	378,9	497,9
163,0	332,0	0,5	0,0	7,0	0,0	305,7	73,0	91,1	340,9	272,7	383,6	378,3	498,7
164,0	333,0	0,5	0,0	7,0	0,0	305,5	72,9	90,9	340,1	271,6	382,5	377,0	499,8
165,0	334,0	0,4	0,0	7,0	0,0	305,7	72,7	91,7	339,2	270,9	381,7	376,4	500,0
166,0	335,0	0,4	0,0	7,1	0,0	305,2	72,8	92,1	338,7	270,5	380,8	375,4	502,0
167,0	336,0	0,4	0,0	7,1	0,0	305,0	72,9	91,8	337,7	269,1	380,0	374,7	502,0
168,0	337,0	0,4	0,0	6,9	0,0	304,6	72,8	91,4	337,1	268,8	379,1	373,9	503,1
169,0	338,0	0,4	0,0	6,8	0,0	304,4	72,9	91,3	336,2	267,5	378,2	373,1	504,3
170,0	339,0	0,4	0,0	6,8	0,0	304,6	72,5	91,2	335,6	266,5	377,3	372,2	504,9
171,0	340,0	0,3	0,0	6,8	0,0	304,5	72,3	91,2	335,1	265,7	376,3	371,4	506,6
172,0	341,0	0,3	0,0	6,8	0,0	304,1	72,5	91,0	334,3	265,4	375,2	370,6	508,2
173,0	342,0	0,3	0,0	6,8	0,0	304,5	72,6	91,0	333,7	264,0	374,4	369,6	508,8
174,0	343,0	0,3	0,0	7,1	0,0	303,0	72,1	90,7	332,8	262,9	373,4	368,9	510,1
175,0	344,0	0,2	0,0	7,1	0,0	301,0	72,7	90,5	332,0	262,6	372,3	367,7	512,2
176,0	345,0	0,2	0,0	6,7	0,0	298,7	72,5	91,3	330,9	262,9	371,0	367,1	513,2
177,0	346,0	0,2	0,0	6,6	0,0	296,4	72,8	91,3	330,2	261,4	369,9	366,3	515,6
178,0	347,0	0,2	0,0	6,6	0,0	294,5	72,5	91,0	328,8	261,0	369,0	365,5	516,9
179,0	348,0	0,2	0,0	6,5	0,0	293,6	72,3	90,7	328,1	260,7	368,2	364,5	518,8
180,0	349,0	0,1	0,0	6,5	0,0	292,8	72,4	90,6	326,7	258,6	367,0	363,6	520,4
181,0	350,0	0,1	0,0	6,4	0,0	291,4	72,4	90,3	325,7	258,9	365,9	362,7	522,0
182,0	351,0	0,1	0,0	6,5	0,0	291,1	72,6	90,2	324,4	257,9	364,6	361,7	524,8
183,0	352,0	0,1	0,0	6,4	0,0	291,1	72,2	90,1	323,2	257,5	363,8	360,7	527,1
184,0	353,0	0,1	0,0	6,4	0,0	290,6	72,4	90,0	322,0	256,3	362,9	360,0	528,5
185,0	354,0	0,1	0,0	6,4	0,0	290,3	72,6	89,6	320,6	256,6	362,1	359,1	529,7
186,0	355,0	0,1	0,0	6,3	0,0	290,3	72,4	90,1	319,9	254,8	360,9	358,0	532,6
187,0	356,0	0,0	0,0	6,3	0,0	289,5	72,5	90,3	318,7	255,3	360,0	357,5	533,6

Manufacturer: HEARTHSTONE  
 Model: GM 60

Run: 4  
 Project #: PI 20162  
 Test Duration: 187 min

	HHV	LHV
Eff	77,81%	84,10%
Comb Eff	98,69%	98,69%
HT Eff	78,85%	85,22%
Output	24 740	kJ/h
Burn Rate	1,61	kg/h
Grams CO	102	g
Input	31 795	kJ/h
MC wet	16,98	

Note: In the "Input data", "Calc. % O<sub>2</sub>", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a], [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3

Ultimate CO<sub>2</sub>  
 CO<sub>2-ut</sub> 19,64  
 F<sub>o</sub>  
 1,062

	Air Fuel Ratio (A/F)	
Overall Heating Efficiency:	77,81%	Dry Molecular Weight (M <sub>d</sub> ) 30,06
Combustion Efficiency:	98,69%	Dry Moles Exhaust Gas (N <sub>r</sub> ): 371,81
Heat Transfer Efficiency:	78,85%	Air Fuel Ratio (A/F) 10,67

Heat Output:	23 468 Btu/h	24 740 kJ/h
Heat Input:	30 161 Btu/h	31 795 kJ/h
Burn Duration:	3,12 h	
Burn Rate:	3,54 lb/h	1,605 kg/h
Stack Temp:	360,1 Deg. F	182,3 Deg. C

Date: 2018-02-18 Manufacturer: Hearthstone Model: GM 60  
 Project #: PJ 20162 Run: 84 mm Tech: MN Reviewer: SP

- At 33 LBS start fine kindling
- At 28 LBS close door
- At 100 LBS insert preload
- At 100 LBS close door
- Fan on low
- Bypass open
- At 10,00 LBS close bypass
- At 9,3 LBS close air inlet (Drill bit 7/16 0.438 in)
- At 29 LBS ~~test load~~
- Open bypass
- Open door
- crunch the bed
- close door
- close Bypass
- after 2 min

TEST LOAD CONFIGURATION

- open bypass
- open air inlet
- open door
- insert load
- close door
- close bypass
- after 5 min close air inlet (Drill bit 7/16 0.438 in)

## PRE / POST CHECKS

 Date: 2018-01-18

 Manufacturer: Hearthstone

 Model: GM 60

 Project #: PT 2062

 Run: 4

 Tech: MM

 Reviewer: DP

Moisture Meter Calibration Check:

Equipment #	Time	12%	22%
EM-191	7:00	ok	ok

Pre-Test

Post-Test

### Facility Conditions:

Air Velocity from less than 2 feet .....

	Pre-Test	Post-Test
	4 (max50 Fpm)	8 (max50 Fpm)
Smoke Capture Check.....	ok	ok
Picture.....	4 sides ok	ok

Smoke Capture Check.....

Picture.....

### Wood Heater Conditions:

Date Wood Heater Stack Cleaned.....

2018-01-15
2018-01-15
ok
ok

Date Dilution Tunnel Cleaned.....

 Induced Draft Check (max 0.005 H<sub>2</sub>O).....

Traverse before ignition.....

Flow Rate 140 cfm ±10%.....

ok

### Temperature System:

Ambient (65°-90°F).....

ok	°F
ok	°F

Wood Heater Surface (±125°F).....

### Proportional Checks:

Thermocouple check.....

Pitot Clean.....

Pitot verification.....

ok
ok
ok

### Sampling Train ID Numbers:

Probe.....

Filter Front.....

Filter Back.....

Filter Thermocouple.....

Filter (&lt;90°F).....

	Train 1 <sup>st</sup> hour	Train 1	Train 2
Probe	16	36	41
Filter Front	29	32	35
Filter Back	31	33	36
Filter Thermocouple	11	11	12
Filter (<90°F)	ok	ok	ok



## SAMPLING EQUIPMENT CHECK OUT

Date: 2018-01-18      Manufacturer: Hearthstone      Model: GM60  
 Project #: PT-20162      Run: 4      Tech: MR      Reviewer: DP

### Leakage Checks Tunnel Samplers

	System 1 <sup>st</sup> hour		System 1		System 2	
	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)
Unplugged Flow Rate = .25cfm						
Vacuum (inches Hg.)	- 15	- 15	- 15	- 15	- 15	- 15
Final 1minute DGM (Liter)	62293,09	62278,84	62293,32	62279,08	547393,45	548405,99
Initial 1minute DGM (Liter)	62293,08	62278,84	62293,20	62278,98	547393,31	548405,89
Change © (Liter)	0,01	0	0,12	0,10	0,14	0,10
Allowable leakage .04 x Sample rate or 0.28Lpm CSA B415 (0.56)						
Check OK	ok	ok	ok	ok	ok	ok

### Leakage Checks Flue Gas Sampler

Plugged Probe	Pre Test	Post Test
Vacuum (inches Hg.)	- 5	- 5
Rotometer Reading (mml/min.)	0	0
Flow Rate (lpm)	1.5	1.5
Allowable (.02 x Sample Rate)	30	30
Check OK	ok	ok

### Leakage Checks Pitot

Plugged Probe	Pre Test 3 H <sub>2</sub> O static	Pre Test 0.4-0.5 H <sub>2</sub> O velocity	Post Test 3 H <sub>2</sub> O Static	Post Test 0.4-0.5 H <sub>2</sub> O velocity
Vacuum (inches Hg.)	3	.4	3	.5
Check OK (no change after 15 sec.)	ok	ok	ok	ok

### PRE-TEST SCALE AUDIT

Date: 2018-02-18      Manufacturer: Hearthstone      Model: GM 60  
 Project #: PI 20182      Run: 4      Tech: MR      Reviewer: DL

Scale Type	Audit		Measured Weight
	Equipment #	Weight	
Platform	EM-090	44 lbs, Class F	44 lbs
Wood	EM-090	44 lbs, Class F	44 lbs
Analytical	EM-128	100 mg, Class S	100 mg
Analytical	EM-129	200 g, Class S	200 g

#### LIMITS OF WEIGHT RANGES

**ANALYTICAL SCALE:** ..... 50%-150% of dry filter weight, ± 0.1 mg  
**PLATFORM SCALE:** ..... 20%-80% of ideal test load weight, ± 0.1 lbs or 1%  
**WOOD SCALE:** ..... 20%-80% of ideal test load weight, ± 0.01 lbs or 1%



Date: 2018-07-18 Manufacturer: Hearthstone Model: GM 60  
 Project #: PL 20162 Run: 4 Tech: mn Reviewer: DP

FOR TUNNELS < 12 in

Barometric pressure ( $P_{bar}$ ) 101.3 (KPa.) Static pressure ( $P_q$ ) 0.39 (inches w.c.)  
 Inside diameter: Port A \_\_\_\_\_ Port B \_\_\_\_\_  
 Tunnel cross sectional area: .1963Ft<sup>2</sup>  
 Pitot tube type: Standard

Traverse Point	Position (inches)			Velocity Head $\Delta_p$ (inches H <sub>2</sub> O)	Tunnel Temperature (°F)
	6 po	7 po	8 po		
A- Centroid	3.00	3.50	4	0.058	78.67
B - Centroid	3.00	3.50	4	0.057	78.78
A-1	0.40	0.50	0.50	0.047	78.90
A-2	1.50	1.75	2	0.061	78.99
A-3	4.50	5.25	6	0.048	79.31
A-4	5.60	6.5	7.5	0.047	79.26
B-1	0.40	0.50	0.50	0.047	79.00
B-2	1.50	1.75	2	0.053	78.90
B-3	4.50	5.25	6	0.050	78.51
B-4	5.60	6.5	7.5	0.049	78.80
AVERAGE					

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{(T_s)_{avg}}{P_s M_s}}$$

Where,

$C_p$  = pitot tube coefficient, dimension less = 0.99 for standard pitot.

$\Delta_p$  = manometer reading (inches H<sub>2</sub>O)

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

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

$P_q$  = static pressure in. H<sub>2</sub>O  
 { 13.6 }

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

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

$\Delta_{p,avg}$  = average of the square roots of the velocity heads ( $\Delta_p$ ) measured at each traverse point.

Date: 2018-01-18 Manufacturer: Hearthstone Model: GM 60  
 Project #: p7 20162 Run: 4 Tech: MM Reviewer: DP

**Pre-Test (Adjust and Record)**

	ZERO		SPAN		CAL. (Record Only)	
	Actual	Should Be	Actual	Should Be	Actual	Should Be
CO	0	0	3009	300	1010	100
Tolerance CO		+/- 0.02		+/- 0.15		+/- 0.05
CO <sub>2</sub>	0	0	1801	1800	9.75	10.00
Tolerance CO <sub>2</sub>		+/- 0.02		+/- 0.5		+/- 0.5
O <sub>2</sub> informative CSA B415 calculated value	na	na	na	na	na	na
	Actual	Should Be	Actual	Should Be	Actual	Should Be

**Post Test (Record Only)**

	Zero	Span	Cal.	Zero Drift	Limit	Span Drift	Limit	Cal. Drift	Limit	OK?	Not OK*
CO	0003	3009	1015	0003	0.02	0	0.15	0005	0.05	✓	
CO <sub>2</sub>	0	1799	9.75	0	0.02	0.02	0.5	φ	0.5	✓	



**TEST DATA LOG**

Date: 2018-01-18 Manufacturer: Hearthstone Model: GM 60  
 Project #: pI 20162 Run: 4 Tech: MM Reviewer: DP

**RAW DRY GAS METER READINGS**

	System 1	System 2	Blank
Final (Liter)	622277, 89	54849, 85	740, 86
Initial (Liter)	621293, 78	547395, 92	717, 88

**AMBIENT CONDITIONS**

	Before	After
Barometer (kPa):	101,3	101,1
Dry Bulb (F):	69,80	72,01
Humidity (%):	18,7	19,0

**Flow Meter**

	Start	End
Flow meter reading	N.A	N.A

**Flow Meter Verification**

	Before	After
Flow meter Check (liters)	N.A	N.A
Scale Weight ( Kg)	N.A	N.A

### FUEL DATA

Date: 2018-01-18      Manufacturer: Headhunker      Model: GM 60  
 Project #: PI 20162      Run: 4      Tech: M M      Reviewer: DL

#### FUEL DESCRIPTION:

Type of wood:

#### PRE-TEST LOAD

Piece Size	Weight	Meter Moisture Content (% dry)*				
2 x 4 x 8 in.	1164 lbs.	20.9	21.3	21.6	21.4	20.8
2 x 4 x 8 in.	1230 lbs.	20.8	22.3	21.6	22.1	22.6
2 x 4 x 8 in.	1130 lbs.	20.8	20.4	20.3	20.2	20.2
2 x 4 x 8 in.	1170 lbs.	20.7	20.7	20.9	21.3	21.5
2 x 4 x 8 in.	1102 lbs.	22.1	22.3	22.4	22.4	22.5
2 x 4 x 8 in.	1104 lbs.	23.0	22.6	22.3	22.1	22.0
2 x 4 x 8 in.	1222 lbs.	23.4	23.4	23.0	22.9	22.6
2 x 4 x 8 in.	1164 lbs.	21.3	20.7	20.6	20.6	20.4
2 x 4 x 8 in.	1230 lbs.	20.3	19.9	19.9	20.0	20.3
2 x 4 x 8 in.	1432 lbs.	20.6	20.4	20.6	20.8	21.0
2 x 4 x 8 in.	1284 lbs.	20.9	20.4	20.6	20.3	20.2
2 x 4 x 8 in.	1174 lbs.	22.0	21.4	21.6	21.8	21.3
2 x 4 x 8 in.	1240 lbs.	22.0	22.4	22.5	22.3	22.0
2 x 4 x 8 in.	1226 lbs.	23.0	22.9	22.8	23.0	23.0
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					

TEST LOAD WEIGHT: 1688 lbs



### FUEL DATA

Date: 2018-01-18 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 2012 Run: 4 Tech: MM Reviewer: NP

#### FUEL DESCRIPTION:

Type of wood :

#### TEST LOAD

Piece Size		Weight		Meter Moisture Content (% dry)*				
1 1/2	x 3 1/2 x 17 1/4 in.	1 922	lbs.	196	193	191	193	198
1 1/2	x 3 1/2 x 17 1/4 in.	1 922	lbs.	193	192	192	195	195
3 1/2	x 3 1/2 x 17 1/4 in.	4 092	lbs.	212	209	216	218	220
3 1/2	x 3 1/2 x 17 1/4 in.	4 082	lbs.	206	200	208	203	208
1 1/2	x 3 1/2 x 5 in.	0 098	lbs.			191		
1 1/2	x 3 1/2 x 5 in.	0 108	lbs.			193		
1 1/2	x 3 1/2 x 5 in.	0 114	lbs.			203		
1 1/2	x 3 1/2 x 5 in.	0 098	lbs.			206		
1 1/2	x 3 1/2 x 5 in.	0 102	lbs.			211		
1 1/2	x 3 1/2 x 5 in.	6 116	lbs.			213		
1 1/2	x 3 1/2 x 5 in.	0 114	lbs.			206		
1 1/2	x 3 1/2 x 5 in.	0 094	lbs.			195		
1 1/2	x 3 1/2 x 5 in.	0 106	lbs.			193		
1 1/2	x 3 1/2 x 5 in.	0 106	lbs.			214		
1 1/2	x 3 1/2 x 5 in.	0 108	lbs.			198		
1 1/2	x 3 1/2 x 5 in.	0 094	lbs.			196		
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					

TEST LOAD WEIGHT: 13 28 lbs Min 20%: 266 Max 25%: 3 32



Date: 2018-01-17 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 20162 Run: 4 Tech: mm Reviewer: DR

		SYSTEM 1 - 1 <sup>st</sup> hour					SYSTEM 1				
Pre-test Weight Record	Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
			10	29	31	11	36	32	33	12	37
	2018-01-17	17:00	1087541	01230	01296	355039	1077411	01290	01305	360060	01299
	2018-01-17	19:00	1087542	01229	01295	355040	1077411	01289	01306	360061	01300

		SYSTEM 1 - 1 <sup>st</sup> hour					SYSTEM 1				
Post-test Weight Record	Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
			10	29	31	11	36	32	33	12	37
	2018-01-18	15:00	1087549	01231	01292	355068	1077418	01281	01299	360082	01302
	2018-01-29	8:00	1087542	01230	01292	355067	1077411	01281	01299	360080	01301
	2018-02-05	8:00	1087542	01230	01292	355067	1077411	01281	01299	360080	01301



Date: 2018-01-17 Manufacturer: Health Safety Model: GM 60  
 Project #: PI 20162 Run: 4 Tech: MM Reviewer: R

SYSTEM 2					
Pre-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time	41	35	36	13
2018-01-17	17:00	110 3645	01310	01296	35 7031
2018-01-18	9:30	110 3646	01311	01295	35 7032

SYSTEM 2					
Post-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time	41	35	36	13
2018-01-18	15:00	110 3652	01316	01285	35 7065
2018-01-29	8:00	110 3646	01316	01285	35 7063
2018-02-05	8:00	110 3646	01316	01285	35 7063

## Paramètres

Tous les facteurs de corrections et autres paramètres qui peuvent être modifiés par l'utilisateur du fichier sont regroupés ici.

Code verrouillage: 

HEA
-----

### Description du test

Test standard	EPA
Run #	5
Date	22-01-2018
Technicien	M.M
Project #	PI 20162

### Description de l'unité

Manufacturier	HEARTHSTONE	
Modèle	GM 60	
Combustion system	Cat	
Appliance type	WOOD STOVE	
Firebox volume	2,03	cu ft.
Appliance weight empty	N.A	lbs
Appliance weight full	N.A	lbs

### Paramètres du test

Logging time	1	min
Manufacturer's rated heat output		BTU/h Donnée fournie par le manufacturier
Targeted category	4	
Targeted output	N.A	BTU/h
Cp steel	N.A	BTU/lb-°F

### Échantillonnage

Blank sampling rate	0,20	cuft/min
Internal probe diameter	0,18	in.
Calibration Factor (DGM #1):	0,988	Dimensionless
Equipment number (DGM #1):	EM 178	
Calibration Factor (DGM #2):	0,988	Dimensionless
Equipment number (DGM #2):	EM 179	
Calibration Factor (DGM #3):	0,986	Dimensionless
Equipment number (DGM #3):	EM 070	Dimensionless

### Tunnel

Targeted tunnel flow rate	150	scfm
Tunnel diameter	6	in.
Molecular weight	29	
Pitot tube type	Standard	
Pitot tube coefficient	0,99	Dimensionless

Project nu.	PI 20162
Date	22-01-2018
Technicien	M.M

### Fuel data

Fuel type	Dimension
Fuel specie	D. Fir
HHV	19810,0 kJ/kg
%C	48,7
%H	6,9
%O	43,9
%Ash	0,5
HHV	8519,2 Btu/lb
LHV	7451,0 Btu/lb

Default Fuel Values		
	D. Fir	Oak/Maple
HHV	19 810	19 887
%C	48,73	50
%H	6,87	6,6
%O	43,9	42,9
%Ash	0,5	0,5
HHV (Btu/lb)	8519	8552
LHV (Btu/lb)	7451	7480





**FUEL LOAD DATA SHEET, CSA B415**

Test Load Weight:

Lower	Ideal	Upper
12,8	14,2	15,6

\* For boilers, a loading density factor of 10 lb/ft3 is applic

Load Volume:  cu. ft          Loading Density:          6,7 lbs./ft3

Number of Spaces:           Load Density (wet):          32,2 lbs./ft3

Spacer weight:  lbs          Dry Wood Density:          26,8 lbs./ft3

Piece Size (in):			Weight lbs	Meter Moisture Content					Ave. MC x Weight	Volume Cubic Inches	Ave. MC %
Thick	Wide	Length		Dry Uncorrected %							
1,5	3,5	17	1,77	20,70	20,50	20,20	20,10	20,90	36,2496	89,25	20,5
1,5	3,5	17	1,74	20,10	20,60	20,30	20,20	20,10	35,21188	89,25	20,3
3,5	3,5	17	4,70	19,60	19,90	20,10	19,50	19,50	92,64456	208,25	19,7
3,5	3,5	17	4,03	19,90	20,00	19,80	19,60	20,10	80,1164	208,25	19,9
1,5	0,75	5	0,12					20,40	2,4072	5,63	20,4
1,5	0,75	5	0,11					20,60	2,3072	5,63	20,6
1,5	0,75	5	0,11					20,80	2,2048	5,63	20,8
1,5	0,75	5	0,12					20,90	2,5498	5,63	20,9
1,5	0,75	5	0,12					20,40	2,4888	5,63	20,4
1,5	0,75	5	0,12					20,30	2,3548	5,63	20,3
1,5	0,75	5	0,11					20,90	2,299	5,63	20,9
1,5	0,75	5	0,10					21,00	2,184	5,63	21,0
1,5	0,75	5	0,11					21,10	2,2788	5,63	21,1
1,5	0,75	5	0,11					20,60	2,1836	5,63	20,6
1,5	0,75	5	0,11					20,80	2,2048	5,63	20,8
1,5	0,75	5	0,12					20,40	2,4888	5,63	20,4
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
										0,00	
SUM MCx									272,17404		20,5 %

Test Load Weight:  lbs.          Dry Weight:  kg.

Average Moisture Content: %

Dry:	<input type="text" value="20,03"/>	Dry(EPA)	20,03	<input type="text" value="20,03"/>	Wet:	<input type="text" value="16,69"/>
		Dry(B415)	20,03			

*Must be 19-25*                                  *must be 15,2-22*

Coal Bed Range:  lbs. to  lbs.

TEST CHARGE:          Coal bed weight:  lbs.

Project nu.	PI 20162
Date	22-01-2018
Technicien	M.M

**Filter set weight**

	System 1 (g) 1st hour				System 1 (g)				System 2 (g)				Ambient blank (g)	Date	Heure
	probe	front	back	gasket	probe	front	back	gasket	probe	front	back	gasket	Filter		
Number	13	3016	34	14	32	38	39	15	33	40	41	27	42		
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	95,1503	0,1281	0,1294	35,2240	110,1770	0,1280	0,1261	35,4866	109,3623	0,1280	0,1241	35,1025	0,1252	18/01/2018	18:00
Before (6)	95,1504	0,1282	0,1293	35,2239	110,1771	0,1279	0,1260	35,4867	109,3623	0,1280	0,1242	35,1026	0,1253	22/01/2018	09:00
After (1)	95,1532	0,1301	0,1293	35,2257	110,1783	0,1276	0,1255	35,4885	109,3638	0,1304	0,1239	35,1046	0,1253	22/01/2018	14:00
After (2)	95,1521	0,1299	0,1293	35,2254	110,1775	0,1275	0,1255	35,4881	109,3631	0,1304	0,1239	35,1042	0,1253	29/01/2018	08:00
After (3)	95,1520	0,1298	0,1293	35,2254	110,1774	0,1275	0,1254	35,4880	109,3631	0,1305	0,1240	35,1043	0,1253	01/02/2018	08:00
After (4)															
After (5)															
After (6)	95,1520	0,1298	0,1293	35,2254	110,1774	0,1275	0,1254	35,4880	109,3631	0,1305	0,1240	35,1043	0,1253	01/02/2018	08:00
Difference	0,0016	0,0016	0,0000	0,0015	0,0003	-0,0004	-0,0006	0,0013	0,0008	0,0025	-0,0002	0,0017	0,0000		
Total (mg)		4,7				5,3				4,8			0		
Total ajusté (mg)		<b>4,70</b>				<b>5,30</b>				<b>4,80</b>					

<b>Project nu.</b>	PI 20162
<b>Date</b>	22-01-2018
<b>Technicien</b>	mm

SFBA EPA EMISSION RESULTS

RESULTS

**Average emission rate:** 2,2 g/hr

Burn Rate : 2,370 Dry kg/hr

**Test Duration:** 130 min

PRESSURE FACTOR: DGM 1 0,98022  
 DGM 2 0,97511  
 DGM 3 1,01016

BAROMETRIC PRESSURE  
 Average: 30,223944 in Hg  
 Start: 30,268239 in Hg  
 End: 30,179649 in Hg

TEMPERATURE FACTORS DGM 1 0,98391  
 DGM 2 0,98236  
 DGM 3 0,99105

DGM CONTROLLER VALUES

DGM 1 Final: 21999,115 Cuft  
 Initial: 21975,620 Cuft

VOLUMES SAMPLED DGM 1 22,384 SCft  
 DGM 2 22,838 SCft  
 DGM 3 15,790 SCft

DGM 2 Final: 19390,979 Cuft  
 Initial: 19366,859 Cuft

DGM #3 Final: 756,840 Cuft  
 Initial: 740,850 Cuft

TOTAL TUNNEL VOLUME : 20878

TEMPERATURES

SAMPLE RATIOS  
 Sample Train 1: 932,686  
 Sample Train 2: 914,141

DGM 1 536,636 °R  
 DGM 2 537,480 °R

Paticulate concentration  
 Sample Train 1 **0,000237** g/dscf  
 Sample Train 2 **0,000210** g/dscf  
 Room **0,000000** g/dscf

CALIBRATION FACTORS

DGM 1 0,9879  
 DGM 2 0,9884  
 DGM #3 0,9864

TUNNEL FLOW RATE: 160,597 Dscfm

TOTAL EMISSIONS  
 Sample Train 1 **4,94** g  
 Sample Train 2 **4,39** g

PARTICULATE CATCH  
 Total Sample Train 1: 5,30 mg  
 Total Sample Train 2: 4,80 mg  
 Total Sample Train 1 1st hour: 4,70 mg

EMISSION RATES  
 Sample Train 1 **2,28** g/hr  
 Sample Train 2 **2,03** g/hr

1st hour emission rate **4,38** g/hr

DEVIATION: 5,95%

Cs Train 1 Train 2  
 0,0002368 0,000210171





101,0	258,0	0,9	0,0	8,0	0,0	396,2	72,0	106,5	449,7	367,0	487,2	464,3	461,3
102,0	259,0	0,9	0,0	8,0	0,0	394,8	72,8	106,2	446,8	365,7	486,0	462,3	461,0
103,0	260,0	0,9	0,0	8,3	0,0	393,5	73,1	106,2	444,0	366,1	484,0	460,2	461,7
104,0	261,0	0,8	0,0	8,3	0,0	391,4	73,2	106,2	440,8	366,3	482,8	458,8	462,0
105,0	262,0	0,8	0,0	8,3	0,0	389,7	72,1	106,3	439,0	365,1	481,0	456,9	462,7
106,0	263,0	0,8	0,0	8,3	0,0	389,1	72,5	106,2	437,0	363,2	479,8	455,6	463,1
107,0	264,0	0,7	0,0	8,3	0,0	388,6	72,5	105,9	435,5	363,7	478,3	454,2	464,8
108,0	265,0	0,7	0,0	8,3	0,0	387,9	72,4	105,5	433,5	361,4	476,9	452,8	465,6
109,0	266,0	0,6	0,0	8,3	0,0	386,6	72,7	105,7	431,1	362,2	475,8	451,4	466,7
110,0	267,0	0,7	0,0	7,7	0,0	383,8	72,2	105,1	429,3	358,5	474,9	450,2	468,2
111,0	268,0	0,6	0,0	7,4	0,0	382,2	72,2	104,8	428,1	355,9	473,0	449,0	470,5
112,0	269,0	0,6	0,0	7,5	0,0	380,7	72,7	104,5	427,0	355,7	471,7	447,9	473,3
113,0	270,0	0,5	0,0	7,4	0,0	379,5	72,8	104,6	425,8	358,2	470,0	446,3	476,3
114,0	271,0	0,5	0,0	7,5	0,0	378,8	73,2	104,6	423,5	354,9	468,9	445,8	479,8
115,0	272,0	0,4	0,0	7,5	0,0	378,6	72,3	104,6	422,1	355,7	467,7	444,3	484,0
116,0	273,0	0,4	0,0	7,5	0,0	378,1	72,3	104,6	420,9	353,5	466,7	443,6	487,4
117,0	274,0	0,4	0,0	7,5	0,0	378,0	72,1	104,4	419,3	353,3	465,2	442,7	491,7
118,0	275,0	0,4	0,0	7,4	0,0	377,0	72,0	104,1	417,5	349,9	463,6	442,0	495,4
119,0	276,0	0,3	0,0	7,4	0,0	377,1	72,1	104,1	416,6	346,2	462,3	441,2	499,9
120,0	277,0	0,3	0,0	7,4	0,0	377,3	72,0	104,0	415,4	344,4	461,0	440,6	503,0
121,0	278,0	0,2	0,0	7,4	0,0	376,8	72,0	103,6	414,1	342,8	459,2	440,0	507,4
122,0	279,0	0,2	0,0	7,3	0,0	376,4	72,0	103,7	412,0	340,0	458,0	439,4	510,4
123,0	280,0	0,2	0,0	6,3	0,0	375,2	72,6	103,7	410,6	338,7	456,4	438,1	514,2
124,0	281,0	0,2	0,0	6,1	0,0	374,1	72,9	103,8	408,7	337,0	455,2	437,8	516,2
125,0	282,0	0,1	0,0	6,1	0,0	374,2	72,3	103,8	406,7	336,6	453,6	436,7	518,6
126,0	283,0	0,1	0,0	6,2	0,0	373,8	73,1	103,9	405,0	334,5	452,2	436,1	520,3
127,0	284,0	0,1	0,0	6,2	0,0	374,1	71,8	103,6	403,8	333,0	450,9	435,3	520,9
128,0	285,0	0,1	0,0	6,2	0,0	374,3	72,7	103,4	401,9	330,4	448,9	434,6	522,4
129,0	286,0	0,1	0,0	6,2	0,0	374,3	72,0	103,4	400,2	328,0	447,6	433,5	524,0
130,0	287,0	0,0	0,0	6,2	0,0	374,8	72,2	103,1	398,6	326,6	446,3	432,7	525,3

Manufacturer: HEARTHSTONE  
 Model: GM 60

Run: 5  
 Project #: PI 20162  
 Test Duration: 130 min

	HHV	LHV
Eff	75,37%	81,46%
Comb Eff	98,56%	98,56%
HT Eff	76,47%	82,65%
Output	35 395	kJ/h
Burn Rate	2,37	kg/h
Grams CO	111	g
Input	46 962	kJ/h
MC wet	16,69	

Note: In the "Input data", "Calc. % O<sub>2</sub>", "Fuel Properties", and "Mass Balance" columns, [e], [d], [g], [a], [b], [c], [h], [u], [w], [j], and [k] refer to their respective variables in Clauses 13.7.3

Ultimate CO<sub>2</sub>  
 CO<sub>2-ut</sub> 19,64  
 F<sub>o</sub>  
 1,063

Overall Heating Efficiency: 75,37%  
 Combustion Efficiency: 98,56%  
 Heat Transfer Efficiency: 76,47%

Air Fuel Ratio (A/F)	
Dry Molecular Weight (M <sub>d</sub> )	30,17
Dry Moles Exhaust Gas (N <sub>r</sub> ):	342,07
Air Fuel Ratio (A/F)	9,81

Heat Output:	33 576 Btu/h	35 395 kJ/h
Heat Input:	44 548 Btu/h	46 962 kJ/h
Burn Duration:	2,17 h	
Burn Rate:	5,22 lb/h	2,371 kg/h
Stack Temp:	455,7 Deg. F	235,4 Deg. C

Date: 2018-01-22 Manufacturer: Hearthstone Model: GM 60  
 Project #: PI 2012 Run: YS Tech: MM Reviewer: DP  
mm

- holding 35 LBS STAIN FINE
- Fan low
- Bypass open
- At 28 LBS close Door
- At 100 LBS install prebar
- At 144 LBS close Door
- At 1000 LBS close bypass
- At 27 LBS
- Open bypass
- Open Door
- crunch the bed
- close Door
- close bypass
- After 2 min
- Open bypass
- open Door
- install load
- close Door
- close bypass

TEST LOAD CONFIGURATION



## PRE / POST CHECKS

 Date: 2018-01-22

 Manufacturer: Hearshstonk

 Model: GM 60

 Project #: pI 20162

 Run: 5

 Tech: MM

 Reviewer: NO

Moisture Meter Calibration Check:

Equipment #	Time	12%	22%
Em 192	7:00	ok	ok

Pre-Test

Post-Test

### Facility Conditions:

Air Velocity from less than 2 feet .....

4 (max 50 Fpm)	5 (max 50 Fpm)
ok	ok
4 sides ok	ok

Smoke Capture Check.....

Picture.....

### Wood Heater Conditions:

Date Wood Heater Stack Cleaned.....

2018-01-15

Date Dilution Tunnel Cleaned.....

2018-01-15

Induced Draft Check (max 0.005 H2O).....

ok

Traverse before ignition.....

ok

Flow Rate 140 cfm ±10%.....

ok

### Temperature System:

Ambient (65°-90°F).....

ok °F

Wood Heater Surface (±125°F).....

ok °F

### Proportional Checks:

Thermocouple check.....

ok

Pitot Clean.....

ok

Pitot verification.....

ok

### Sampling Train ID Numbers:

Probe.....

Train 1 <sup>st</sup> hour	Train 1	Train 2
13	32	33
3016	38	40
39	39	41
11	11	12
ok	ok	ok

Filter Front.....

Filter Back.....

Filter Thermocouple.....

Filter (&lt;90°F).....

**SAMPLING EQUIPMENT CHECK OUT**

 Date: 2018-01-22 Manufacturer: Heath Slopelt Model: Gm 60  
 Project #: pI 20162 Run: 5 Tech: mm Reviewer: BP
**Leakage Checks Tunnel Samplers**

Unplugged Flow Rate = .25cfm	System 1 <sup>st</sup> hour		System 1		System 2	
	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)	Pre-Test ASTM (-15) CSA B415 (-5)	Post-Test (Max test)
Vacuum (inches Hg.)	-15	-15	-15	-15	-15	-15
Final 1minute DGM (Liter)	622279.46	622949.61	622279.88	549092.35	54846.80	549092.34
Initial 1minute DGM (Liter)	622279.36	622946.51	622279.70	549092.35	548406.79	549092.34
Change © (Liter)	0.10	0.10	0.15	∅	0.01	∅
Allowable leakage .04 x Sample rate or 0.28Lpm CSA B415 (0.56)						
Check OK	ok	ok	ok	ok	ok	ok

**Leakage Checks Flue Gas Sampler**

Plugged Probe	Pre Test	Post Test
Vacuum (inches Hg.)	-5	-5
Rotometer Reading (mml/min.)	0	0
Flow Rate (lpm)	1.5	1.5
Allowable (.02 x Sample Rate)	30	30
Check OK	ok	ok

**Leakage Checks Pitot**

Plugged Probe	Pre Test 3 H <sub>2</sub> O static	Pre Test 0.4-0.5 H <sub>2</sub> O velocity	Post Test 3 H <sub>2</sub> O Static	Post Test 0.4-0.5 H <sub>2</sub> O velocity
Vacuum (inches Hg.)	3	5	3	4
Check OK (no change after 15 sec.)	ok	ok	ok	ok



Date: 2-18-01-22      Manufacturer: Hearthstone      Model: GM 60  
 Project #: PI 2016Z      Run: 5      Tech: mm      Reviewer: JP

Scale Type	Audit		Measured Weight
	Equipment #	Weight	
Platform	EM 090	44 lbs, Class F	44 lbs
Wood	EM 090	44 lbs, Class F	44 lbs
Analytical	EM 128	100 mg, Class S	100 mg
Analytical	EM 129	200 g, Class S	200 g

**LIMITS OF WEIGHT RANGES**

**ANALYTICAL SCALE:** ..... 50%-150% of dry filter weight, ± 0.1 mg  
**PLATFORM SCALE:** ..... 20%-80% of ideal test load weight, ± 0.1 lbs or 1%  
**WOOD SCALE:** ..... 20%-80% of ideal test load weight, ± 0.01 lbs or 1%

Date: 2018-01-22 Manufacturer: Hearthstone Model: GM 60  
 Project #: pJ 20162 Run: 5 Tech: MM Reviewer: RP

FOR TUNNELS &lt; 12 in

 Barometric pressure ( $P_{bar}$ ) 107.5 (KPa.) Static pressure ( $P_q$ ) 0.37 (inches w.c.)  
 Inside diameter: Port A \_\_\_\_\_ Port B \_\_\_\_\_  
 Tunnel cross sectional area: .1963Ft<sup>2</sup>  
 Pitot tube type: Standard

Traverse Point	Position (inches)			Velocity Head $\Delta_p$ (inches H <sub>2</sub> O)	Tunnel Temperature (°F)
	6 po	7 po	8 po		
A- Centroid	3.00	3.50	4	0059	7681
B - Centroid	3.00	3.50	4	0060	7644
A-1	0.40	0.50	0.50	0049	7699
A-2	1.50	1.75	2	0062	7704
A-3	4.50	5.25	6	0048	7681
A-4	5.60	6.5	7.5	0049	7678
B-1	0.40	0.50	0.50	0048	7636
B-2	1.50	1.75	2	0054	7639
B-3	4.50	5.25	6	0051	7649
B-4	5.60	6.5	7.5	0050	7632
AVERAGE					

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{(T_s)_{avg}}{P_s M_s}}$$

Where,

 $C_p$  = pitot tube coefficient, dimension less = 0.99 for standard pitot.

 $\Delta_p$  = manometer reading (inches H<sub>2</sub>O)

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

 $P_s$  = absolute dilution tunnel gas pressure or  $P_{bar} + P_{qg}$ 
 $P_q$  = static pressure in H<sub>2</sub>O  
 { 13.6 }

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

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

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



Date: 2018-01-22 Manufacturer: Heathstone Model: GM 60  
 Project #: PT 20162 Run: 5 Tech: MM Reviewer: [Signature]

**Pre-Test (Adjust and Record)**

	ZERO		SPAN		CAL. (Record Only)	
	Actual	Should Be	Actual	Should Be	Actual	Should Be
CO	0	0	2,999	300	1007	100
Tolerance CO		+/- 0.02		+/- 0.15		+/- 0.05
CO <sub>2</sub>	0	0	1790	1800	973	1800
Tolerance CO <sub>2</sub>		+/- 0.02		+/- 0.5		+/- 0.5
O <sub>2</sub> informative CSA B415 calculated value	na	na	na	na	na	na

**Post Test (Record Only)**

	Zero	Span	Cal.	Zero Drift	Limit	Span Drift	Limit	Cal. Drift	Limit	OK?	Not OK*
CO	0006	3006	1014	0006	0.02	0007	0.15	0007	0.05	✓	
CO <sub>2</sub>	0	1798	972	0	0.02	002	0.5	001	0.5	✓	

Date: 2018-01-22 Manufacturer: Acanthstone Model: GM 60  
 Project #: PI 20162 Run: 5 Tech: MM Reviewer: DP

**RAW DRY GAS METER READINGS**

	System 1	System 2	Blank
Final (Liter)	622945,55	549091,38	756,84
Initial (Liter)	622280,26	548408,35	740,85

**AMBIENT CONDITIONS**

	Before	After
Barometer (kPa):	102,5	102,2
Dry Bulb (F):	69,98	73,40
Humidity (%):	27,1	22,4

**Flow Meter**

	Start	End
Flow meter reading	N.A	N.A

**Flow Meter Verification**

	Before	After
Flow meter Check (liters)	N.A	N.A
Scale Weight ( Kg)	N.A	N.A



### FUEL DATA

Date: 2018-01-22 Manufacturer: Health Stone Model: GM 60  
 Project #: PI 20162 Run: 5 Tech: mn Reviewer: DP

#### FUEL DESCRIPTION:

Type of wood:

#### PRE-TEST LOAD

Piece Size	Weight	Meter Moisture Content (% dry)*				
2 x 4 x 8 in.	1038 lbs.	223	226	230	231	234
2 x 4 x 8 in.	1008 lbs.	219	216	218	219	213
2 x 4 x 8 in.	1046 lbs.	230	233	229	226	228
2 x 4 x 8 in.	1210 lbs.	231	234	236	231	236
2 x 4 x 8 in.	1074 lbs.	229	225	223	228	224
2 x 4 x 8 in.	1050 lbs.	226	229	218	213	219
2 x 4 x 8 in.	1096 lbs.	223	224	223	219	215
2 x 4 x 8 in.	1008 lbs.	228	225	223	220	224
2 x 4 x 8 in.	1016 lbs.	216	218	219	215	214
2 x 4 x 8 in.	1130 lbs.	230	226	228	224	223
2 x 4 x 8 in.	1046 lbs.	213	212	216	219	214
2 x 4 x 8 in.	1178 lbs.	228	223	229	228	229
2 x 4 x 8 in.	<del>1058</del> 1068 lbs.	230	234	226	229	230
2 x 4 x 8 in.	1096 lbs.	214	206	208	209	208
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					
x x in.	lbs.					

TEST LOAD WEIGHT: 15054 lbs  
15980 mn



### FUEL DATA

Date: 2018-01-22 Manufacturer: Hearthstone Model: GM 60  
 Project #: PT 20162 Run: 5 Tech: MM Reviewer: DP

#### FUEL DESCRIPTION:

Type of wood :

#### TEST LOAD

Piece Size		Weight		Meter Moisture Content (% dry)*				
1 1/2	x 3 1/2 x 17 in.	1,777	lbs.	207	205	202	201	209
1 1/2	x 3 1/2 x 17 in.	1,738	lbs.	201	206	203	202	201
3 1/2	x 3 1/2 x 17 in.	4,698	lbs.	196	199	201	195	195
3 1/2	x 3 1/2 x 17 in.	4,030	lbs.	199	200	198	196	201
1 1/2	x 3/4 x 5 in.	0,118	lbs.			204		
1 1/2	x 3/4 x 5 in.	0,112	lbs.			206		
1 1/2	x 3/4 x 5 in.	0,106	lbs.			208		
1 1/2	x 3/4 x 5 in.	0,122	lbs.			209		
1 1/2	x 3/4 x 5 in.	0,122	lbs.			204		
1 1/2	x 3/4 x 5 in.	0,116	lbs.			203		
1 1/2	x 3/4 x 5 in.	0,110	lbs.			209		
1 1/2	x 3/4 x 5 in.	0,109	lbs.			200		
1 1/2	x 3/4 x 5 in.	0,108	lbs.			211		
1 1/2	x 3/4 x 5 in.	0,106	lbs.			206		
1 1/2	x 3/4 x 5 in.	0,106	lbs.			208		
1 1/2	x 3/4 x 5 in.	0,112	lbs.			204		
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					
x	x in.		lbs.					

TEST LOAD WEIGHT: 13,59 lbs Min 20%: 270 Max 25%: 340  
272





DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2018-01-18 Project #: PI 20162 Run: 5 Manufacturer: Healthstone Model: GM 60  
 Tech: MM Reviewer: DP

		SYSTEM 1 - 1 <sup>st</sup> hour					SYSTEM 1				
Pre-test Weight Record	Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
			13	3016	34	14	32	38	39	15	42
	2018-01-18	18:00	951503	01281	01294	352240	1101770	01280	01261	354866	01252
	2018-01-22	9:00	951504	01282	01293	352239	1101771	01279	01260	354867	01253

		SYSTEM 1 - 1 <sup>st</sup> hour					SYSTEM 1				
Post-test Weight Record	Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank
			13	3016	34	14	32	38	39	15	42
	2018-01-22	14:00	951532	01301	01293	352257	1101783	01276	01255	354885	01253
	2018-01-28	9:00	951521	01299	01293	352254	1101775	01275	01255	354881	01253
	2018-02-01	8:00	951520	01298	01293	352254	1101774	01275	01254	354880	01253



# DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2018-01-18      Project #: PI 20162      Run: 5      Manufacturer: Heathston      Model: GM 60  
 Tech: MM      Reviewer: DP

SYSTEM 2					
Pre-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time	33	40	41	27
2018-01-18	18:00	109 3623	0,1280	0,1271	35,1025
2018-01-22	9:00	109 3623	0,1280	0,1242	35,1026 <del>109,3623</del> M

SYSTEM 2					
Post-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time	33	40	41	27
2018-01-22	14:00	109 3638	0,1304	0,1239	35,1046
2018-01-29	8:00	109 3631	0,1304	<del>0,1239</del>	35,1042
2018-02-01	8:00	109 3631	0,1305	0,1239 M	35,1043
				0,1240	



## APPENDIX 2: Proportionality results

Average	Average	Average						Average
15,47	Inlet +	Inlet +						0,245
	Outlet	Outlet	Average	Average	#1	#2		
Tunnel	Temp.	Temp.	100,48	100,96	System 1	System 2		SQRT
Velocity	Meter 1	Meter 2	<b>Proportional Rates</b>		Vol.Std.	Vol.Std.		Delta-P
			<b>PR1</b>	<b>PR2</b>			Time	
Ft/Sec	Deg. R	Deg. R	%	%	(ft3)	(ft3)	min	(in H2O)2
15,802	534,4	534,3			0,166	0,174	0	0,23928
15,519	534,2	534,3	100,13	104,00	0,166	0,174	1	0,2413909
15,581	534,0	534,3	99,34	102,54	0,166	0,174	2	0,2428571
15,336	534,0	534,3	105,20	104,63	0,170	0,173	3	0,2388564
15,479	533,9	534,4	105,96	103,45	0,174	0,173	4	0,2407595
15,512	533,9	534,3	103,44	101,86	0,175	0,173	5	0,2432747
15,456	533,8	534,3	101,33	102,25	0,173	0,174	6	0,243274
15,488	533,8	534,3	100,99	101,74	0,172	0,175	7	0,2438998
15,509	533,7	534,3	101,81	101,51	0,172	0,174	8	0,2438994
15,583	533,8	534,3	100,86	100,90	0,173	0,174	9	0,2453508
15,499	533,8	534,4	100,91	101,26	0,172	0,174	10	0,2443143
15,425	533,7	534,3	102,20	101,45	0,173	0,174	11	0,2432739
15,555	533,7	534,3	99,73	101,26	0,172	0,174	12	0,245351
15,465	533,6	534,3	100,66	101,42	0,171	0,174	13	0,2438992
15,524	533,6	534,3	100,52	101,91	0,171	0,174	14	0,244315
15,574	533,7	534,3	100,62	101,07	0,171	0,174	15	0,2449365
15,523	533,8	534,4	102,61	100,99	0,173	0,173	16	0,244307
15,557	533,8	534,4	102,35	100,61	0,175	0,173	17	0,2449371
15,481	533,8	534,4	102,65	101,01	0,175	0,173	18	0,2438996
15,634	533,7	534,4	99,32	100,87	0,173	0,174	19	0,2463829
15,526	533,7	534,4	99,98	101,77	0,170	0,175	20	0,2443144
15,554	533,8	534,4	102,53	101,22	0,172	0,174	21	0,244413
15,530	533,8	534,4	100,17	101,92	0,172	0,174	22	0,2443159
15,590	533,9	534,5	100,74	101,11	0,171	0,174	23	0,2453517
15,583	533,8	534,5	99,67	100,98	0,171	0,174	24	0,2453512
15,198	533,8	534,5	102,20	103,77	0,170	0,174	25	0,2392686
15,578	533,8	534,4	101,22	101,10	0,171	0,174	26	0,2449368
15,566	533,8	534,4	102,80	101,13	0,173	0,173	27	0,244323
15,614	533,9	534,5	99,49	101,51	0,172	0,174	28	0,245351
15,609	533,9	534,5	101,83	100,84	0,172	0,174	29	0,2453508
15,530	533,9	534,5	100,38	101,64	0,172	0,174	30	0,2443148
15,579	533,9	534,5	99,76	101,39	0,171	0,175	31	0,245351
15,485	533,9	534,6	102,45	101,35	0,172	0,174	32	0,2438989
15,374	534,0	534,6	101,03	102,71	0,172	0,174	33	0,2418102
15,618	534,1	534,7	99,64	101,09	0,170	0,174	34	0,2457639
15,549	534,2	534,7	100,08	101,20	0,171	0,174	35	0,2449366
15,481	534,2	534,8	101,14	101,54	0,171	0,174	36	0,2438986
15,561	534,2	534,8	101,28	100,59	0,173	0,174	37	0,2453511
15,465	534,2	534,8	99,75	101,76	0,171	0,174	38	0,2438998
15,430	534,2	534,8	102,69	101,51	0,172	0,174	39	0,2428576
15,583	534,2	534,8	99,75	101,65	0,172	0,174	40	0,2449365
15,559	534,3	534,9	101,83	100,83	0,172	0,174	41	0,2449365
15,553	534,3	534,9	100,80	101,20	0,173	0,174	42	0,2449365
15,571	534,3	534,9	101,79	100,82	0,173	0,174	43	0,2453514
15,537	534,3	534,9	101,66	100,93	0,174	0,174	44	0,2449369
15,597	534,3	534,9	99,96	100,71	0,172	0,174	45	0,2457637
15,469	534,3	534,9	100,51	102,77	0,171	0,175	46	0,2432749
15,618	534,4	534,9	101,51	100,50	0,172	0,174	47	0,2457638
15,515	534,4	535,0	100,27	101,35	0,172	0,174	48	0,2443144
15,507	534,5	535,0	102,12	101,21	0,172	0,174	49	0,2443155
15,407	534,4	535,0	100,03	102,14	0,172	0,174	50	0,242858
15,426	534,4	534,9	100,15	101,84	0,170	0,174	51	0,2432748
15,329	534,3	534,9	102,93	102,37	0,172	0,174	52	0,2414634
15,530	534,4	535,0	99,57	101,72	0,171	0,174	53	0,2443145

15,546	534,4	535,0	99,29	101,44	0,169	0,175	54	0,2449374
15,566	534,5	535,0	101,32	100,23	0,171	0,174	55	0,2453512
15,500	534,5	535,1	99,51	101,28	0,171	0,173	56	0,2443151
15,577	534,5	535,1	101,59	100,38	0,172	0,174	57	0,2457636
15,466	534,4	535,0	99,83	101,91	0,172	0,174	58	0,2439
15,523	534,4	535,0	101,73	101,61	0,171	0,175	59	0,2443149
15,597	534,4	535,0	101,24	101,15	0,173	0,174	60	0,2453513
15,448	534,5	535,1	100,20	102,03	0,171	0,174	61	0,2432747
15,572	534,5	535,1	101,29	100,92	0,171	0,174	62	0,2453517
15,536	534,5	535,1	99,23	101,31	0,171	0,174	63	0,2449362
15,557	534,4	535,0	101,47	100,66	0,172	0,174	64	0,245352
15,488	534,4	535,0	99,84	101,94	0,172	0,174	65	0,2438998
15,513	534,4	535,0	102,13	101,44	0,171	0,174	66	0,2439002
15,579	534,5	535,0	101,43	100,87	0,173	0,174	67	0,2453518
15,595	534,5	535,1	99,78	100,54	0,172	0,174	68	0,2457602
15,535	534,5	535,1	101,28	100,83	0,172	0,174	69	0,2449379
15,420	534,5	535,1	101,79	101,72	0,173	0,174	70	0,2432749
15,420	534,5	535,0	102,35	101,44	0,173	0,174	71	0,2432751
15,456	534,4	535,0	102,38	101,52	0,174	0,174	72	0,2432756
15,457	534,4	535,1	102,38	101,54	0,173	0,173	73	0,2432767
15,652	534,5	535,1	98,86	100,58	0,171	0,174	74	0,2463721
15,554	534,5	535,1	101,80	101,06	0,172	0,174	75	0,2449372
15,500	534,5	535,1	99,59	101,41	0,172	0,174	76	0,2443153
15,339	534,5	535,1	100,41	102,47	0,169	0,174	77	0,2418113
15,416	534,4	535,1	102,52	101,75	0,171	0,174	78	0,2428583
15,511	534,5	535,1	102,36	101,71	0,174	0,174	79	0,2438995
15,640	534,6	535,1	100,95	100,21	0,173	0,174	80	0,2463833
15,318	534,6	535,2	102,53	102,72	0,173	0,174	81	0,2413926
15,474	534,6	535,2	101,62	101,33	0,173	0,174	82	0,2439992
15,527	534,6	535,2	101,00	101,57	0,173	0,175	83	0,2449375
15,415	534,5	535,1	100,04	101,45	0,171	0,174	84	0,2432757
15,415	534,5	535,1	100,34	101,82	0,170	0,174	85	0,242858
15,555	534,5	535,1	99,34	100,94	0,170	0,174	86	0,2449378
15,498	534,6	535,2	99,72	101,61	0,170	0,174	87	0,2443154
15,533	534,6	535,2	99,46	101,27	0,170	0,175	88	0,2449373
15,522	534,6	535,2	99,84	101,41	0,170	0,175	89	0,2449373
15,475	534,5	535,2	99,23	101,14	0,170	0,174	90	0,2443157
15,405	534,5	535,1	101,53	101,90	0,171	0,174	91	0,2432753
15,191	534,5	535,1	101,61	103,29	0,171	0,174	92	0,239315
15,276	534,6	535,1	101,26	102,59	0,170	0,174	93	0,2407597
15,423	534,6	535,2	100,43	101,15	0,170	0,173	94	0,2432751
15,400	534,7	535,2	100,06	101,37	0,170	0,173	95	0,2428578
15,539	534,6	535,2	99,70	100,04	0,170	0,173	96	0,2453515
15,404	534,6	535,2	102,07	101,23	0,172	0,173	97	0,2432749
15,451	534,6	535,2	99,87	101,16	0,172	0,174	98	0,2438999
15,355	534,6	535,2	100,34	102,45	0,170	0,174	99	0,2418101
15,582	534,6	535,2	101,09	100,36	0,171	0,174	100	0,2457646
15,524	534,7	535,3	99,62	100,42	0,172	0,173	101	0,2449374
15,605	534,7	535,3	101,15	100,16	0,172	0,174	102	0,2463834
15,508	534,6	535,2	100,06	101,25	0,173	0,174	103	0,2449379
15,554	534,6	535,2	101,26	100,56	0,173	0,175	104	0,2457648
15,300	534,6	535,2	101,15	101,73	0,172	0,174	105	0,2414186
15,515	534,6	535,2	100,18	100,75	0,170	0,173	106	0,2443161
15,583	534,6	535,2	101,09	100,52	0,172	0,173	107	0,245765
15,544	534,7	535,2	100,66	101,51	0,173	0,174	108	0,2449376
15,488	534,7	535,2	101,86	101,39	0,173	0,175	109	0,2443155
15,390	534,7	535,2	101,56	102,14	0,173	0,175	110	0,2428583
15,381	534,6	535,2	102,16	101,55	0,173	0,174	111	0,2428583
15,428	534,6	535,2	101,99	101,96	0,173	0,174	112	0,243275
15,577	534,6	535,2	101,28	101,39	0,173	0,175	113	0,2453517
15,525	534,7	535,3	99,51	100,37	0,172	0,174	114	0,2449374



15,474	534,7	535,3	101,78	101,34	0,172	0,174	115	0,2441628
15,513	534,8	535,4	99,68	100,26	0,172	0,174	116	0,2449376
15,559	534,8	535,3	99,94	100,12	0,171	0,173	117	0,2457646
15,524	534,7	535,3	101,14	100,63	0,173	0,174	118	0,2453521
15,424	534,7	535,3	100,40	100,98	0,172	0,174	119	0,2432742
15,620	534,8	535,3	100,13	100,54	0,171	0,174	120	0,2463833
15,671	534,8	535,4	99,62	100,08	0,172	0,174	121	0,2474104
15,598	534,8	535,4	98,62	100,14	0,171	0,174	122	0,246384
15,465	534,8	535,4	99,73	100,90	0,170	0,174	123	0,2443157
15,452	534,8	535,3	99,82	101,08	0,170	0,174	124	0,2443153
15,450	534,7	535,3	98,98	100,98	0,170	0,174	125	0,244315
15,395	534,7	535,3	102,33	101,99	0,171	0,174	126	0,2428579
15,537	534,8	535,4	99,28	100,20	0,172	0,174	127	0,245352
15,508	534,8	535,4	101,26	100,73	0,172	0,174	128	0,2449378
15,502	534,8	535,4	99,21	100,58	0,172	0,174	129	0,2449405
15,584	534,8	535,4	98,68	100,28	0,170	0,174	130	0,2463839
15,359	534,8	535,4	102,43	101,60	0,172	0,174	131	0,242882
15,540	534,8	535,4	98,49	100,20	0,172	0,174	132	0,2457648
15,549	534,8	535,4	99,20	100,13	0,170	0,173	133	0,2453518
15,467	534,8	535,4	101,26	101,42	0,171	0,174	134	0,2443153
15,501	534,9	535,5	101,41	100,91	0,173	0,174	135	0,2449382
15,554	534,9	535,4	100,72	101,21	0,173	0,175	136	0,245765
15,578	534,9	535,4	98,30	99,83	0,171	0,174	137	0,2463841
15,415	534,8	535,4	99,53	100,48	0,170	0,173	138	0,2439006
15,414	534,8	535,4	101,14	101,67	0,171	0,174	139	0,2438995
15,449	534,8	535,4	99,92	100,97	0,171	0,174	140	0,2439007
15,531	534,8	535,4	98,69	100,24	0,170	0,173	141	0,2453519
15,521	534,8	535,4	100,34	100,19	0,171	0,173	142	0,2453517
15,359	534,9	535,4	101,44	101,70	0,172	0,174	143	0,2428585
15,532	534,8	535,4	100,02	100,63	0,172	0,174	144	0,2457642
15,525	534,8	535,4	98,87	99,73	0,171	0,174	145	0,2457645
15,627	534,8	535,4	97,63	99,07	0,170	0,173	146	0,2474105
15,508	534,7	535,3	101,44	100,88	0,171	0,174	147	0,2449377
15,556	534,8	535,4	99,84	100,31	0,172	0,174	148	0,2457639
15,542	534,8	535,4	100,60	100,48	0,172	0,174	149	0,2457645
15,512	534,8	535,4	100,81	100,52	0,173	0,174	150	0,2453522
15,529	534,8	535,4	98,35	99,97	0,171	0,174	151	0,2457646
15,367	534,8	535,4	99,65	101,16	0,169	0,174	152	0,243275
15,402	534,7	535,4	99,49	100,88	0,170	0,174	153	0,2439004
15,504	534,7	535,3	99,21	100,19	0,170	0,173	154	0,2449379
15,558	534,7	535,4	101,04	100,63	0,172	0,174	155	0,2457647
15,541	534,8	535,4	99,07	100,43	0,172	0,174	156	0,2457647
15,422	534,8	535,4	101,58	101,33	0,172	0,174	157	0,2439004
15,278	534,7	535,3	102,13	102,13	0,173	0,174	158	0,2418107
15,519	534,7	535,3	100,38	100,43	0,173	0,174	159	0,2457643
15,554	534,7	535,3	98,67	99,74	0,172	0,174	160	0,246383
15,459	534,6	535,3	100,44	101,22	0,171	0,174	161	0,2443155
15,520	534,7	535,3	99,07	100,07	0,171	0,174	162	0,2453518
15,535	534,7	535,3	100,24	100,20	0,171	0,173	163	0,2457066
15,419	534,7	535,3	101,38	101,25	0,173	0,174	164	0,2439002
15,469	534,7	535,3	100,60	100,76	0,173	0,174	165	0,2449372
15,493	534,7	535,3	98,83	100,35	0,171	0,174	166	0,2453521
15,551	534,7	535,3	98,17	99,28	0,170	0,173	167	0,2463835
15,389	534,7	535,3	99,83	101,32	0,170	0,173	168	0,2432747
15,439	534,7	535,3	101,80	101,41	0,172	0,174	169	0,2438998
15,509	534,7	535,3	99,33	100,04	0,172	0,174	170	0,2453536
15,489	534,7	535,3	100,22	100,36	0,171	0,173	171	0,2449379
15,342	534,8	535,3	99,86	101,12	0,171	0,173	172	0,2428585
15,432	534,7	535,3	99,31	100,69	0,170	0,174	173	0,2443159
15,553	534,7	535,3	98,33	99,58	0,170	0,174	174	0,2463837
15,351	534,6	535,2	100,50	101,32	0,170	0,174	175	0,2428583

15,469	534,6	535,2	101,53	101,46	0,172	0,174	176	0,2443158
15,443	534,7	535,3	101,87	101,67	0,174	0,175	177	0,2443155
15,287	534,7	535,3	100,36	101,86	0,172	0,175	178	0,241811
15,469	534,7	535,3	99,00	100,39	0,170	0,174	179	0,244937
15,428	534,6	535,2	101,31	101,18	0,172	0,174	180	0,2443148
15,464	534,6	535,2	99,16	100,11	0,172	0,174	181	0,245084
15,497	534,6	535,2	98,90	100,52	0,170	0,174	182	0,2453523
15,373	534,5	535,2	101,00	101,70	0,171	0,174	183	0,2428581
15,479	534,6	535,2	101,27	100,93	0,172	0,174	184	0,2449374
15,531	534,6	535,2	99,15	100,05	0,172	0,174	185	0,2457644
15,245	534,7	535,2	100,36	101,62	0,170	0,173	186	0,2413928
15,417	534,6	535,2	99,03	100,20	0,170	0,173	187	0,2443157
15,481	534,6	535,1	98,79	100,19	0,170	0,173	188	0,2453521
15,466	534,6	535,1	98,75	100,21	0,170	0,174	189	0,244937
15,434	534,6	535,1	101,46	101,40	0,171	0,174	190	0,2439002
15,441	534,6	535,1	100,69	100,95	0,173	0,174	191	0,2443153
15,341	534,6	535,2	101,94	101,66	0,173	0,174	192	0,2428583
15,569	534,6	535,1	100,41	100,30	0,173	0,174	193	0,2463835
15,552	534,6	535,1	98,81	99,95	0,172	0,174	194	0,2463841
15,682	534,5	535,1	99,90	99,67	0,172	0,175	195	0,2484337
15,366	534,5	535,1	101,82	101,49	0,174	0,175	196	0,2432755
15,376	534,5	535,0	102,35	101,98	0,174	0,175	197	0,2429634
15,476	534,5	535,1	98,91	100,31	0,172	0,174	198	0,2449375
15,432	534,6	535,1	101,43	101,57	0,172	0,174	199	0,2443163
15,519	534,6	535,1	100,44	100,29	0,173	0,175	200	0,2457651
15,481	534,6	535,1	100,98	100,69	0,173	0,174	201	0,2453519
15,448	534,5	535,1	99,45	100,28	0,172	0,174	202	0,2449375
15,404	534,5	535,1	101,31	101,06	0,172	0,174	203	0,2443163
15,445	534,5	535,0	99,36	100,76	0,172	0,174	204	0,2443163
15,567	534,5	535,1	100,65	100,72	0,172	0,174	205	0,2463526
15,407	534,6	535,1	100,46	101,30	0,173	0,175	206	0,2439005
15,465	534,6	535,1	99,65	100,82	0,171	0,175	207	0,2449375
15,392	534,6	535,1	99,38	100,42	0,170	0,174	208	0,2439011
15,420	534,6	535,1	99,33	100,38	0,170	0,173	209	0,2443158
15,608	534,5	535,1	100,19	100,06	0,172	0,174	210	0,2474056
15,476	534,5	535,1	99,01	100,04	0,172	0,174	211	0,2449378
15,458	534,5	535,1	101,22	101,01	0,171	0,174	212	0,2443161
15,363	534,6	535,1	101,85	101,52	0,173	0,174	213	0,2432758
15,524	534,6	535,1	100,39	100,22	0,173	0,174	214	0,2457647
15,419	534,6	535,1	99,14	100,64	0,171	0,174	215	0,2443159
15,612	534,5	535,1	98,45	99,72	0,170	0,174	216	0,2474107
15,499	534,5	535,0	98,64	99,88	0,170	0,174	217	0,2457644
15,268	534,4	535,0	100,76	102,06	0,170	0,174	218	0,2418118
15,437	534,4	534,9	101,83	101,24	0,172	0,174	219	0,2440361
15,621	534,5	535,0	98,09	99,51	0,172	0,174	220	0,2474112
15,431	534,5	535,0	101,09	101,36	0,171	0,174	221	0,2443444
15,490	534,5	535,0	99,03	100,27	0,172	0,174	222	0,245352
15,505	534,5	535,0	100,74	100,35	0,172	0,174	223	0,2457651
15,499	534,4	535,0	100,55	100,06	0,173	0,174	224	0,2457654
15,459	534,4	535,0	100,59	101,07	0,173	0,175	225	0,2449378
15,386	534,4	534,9	99,75	101,26	0,171	0,174	226	0,2432761
15,627	534,4	534,9	100,52	99,92	0,172	0,174	227	0,2474105
15,518	534,5	535,0	101,23	100,36	0,174	0,174	228	0,2457652
15,358	534,5	535,0	101,49	101,24	0,174	0,174	229	0,2432752
15,410	534,5	535,0	101,49	100,85	0,173	0,174	230	0,2443155
15,499	534,4	535,0	99,01	100,29	0,172	0,174	231	0,2457645
15,446	534,4	534,9	101,29	100,58	0,172	0,174	232	0,2449379
15,418	534,4	534,9	99,47	100,76	0,172	0,174	233	0,2440864
15,541	534,4	534,9	98,56	100,37	0,170	0,174	234	0,2457649
15,513	534,4	534,9	98,75	100,10	0,170	0,174	235	0,2457646
15,557	534,4	534,9	98,58	100,13	0,170	0,174	236	0,2463838

15,454	534,4	534,9	99,70	100,81	0,171	0,174	237	0,2449376
15,448	534,4	534,9	99,60	100,06	0,171	0,174	238	0,2449377
15,468	534,4	534,9	98,86	99,89	0,171	0,173	239	0,2453521
15,418	534,3	534,9	101,64	101,09	0,172	0,174	240	0,2443159
15,484	534,3	534,9	101,74	100,76	0,174	0,174	241	0,2449373
15,557	534,4	534,9	100,20	99,63	0,174	0,174	242	0,2463836
15,463	534,4	535,0	99,04	100,66	0,171	0,174	243	0,2449375
15,507	534,4	534,9	98,54	100,11	0,170	0,174	244	0,2457648
15,383	534,4	534,9	99,93	101,28	0,170	0,174	245	0,2438997
15,472	534,3	534,9	100,72	100,26	0,172	0,174	246	0,2453511
15,469	534,3	534,9	98,60	100,17	0,172	0,174	247	0,2453514
15,410	534,3	534,9	99,44	101,15	0,170	0,174	248	0,2439
15,517	534,3	534,9	98,97	100,48	0,170	0,174	249	0,2457645
15,512	534,4	534,9	100,69	100,05	0,172	0,174	250	0,2457645
15,418	534,4	534,9	99,49	101,11	0,172	0,174	251	0,2443155
15,382	534,3	534,9	101,57	101,00	0,172	0,174	252	0,2438998
15,493	534,3	534,8	100,51	100,29	0,174	0,174	253	0,2457642
15,533	534,2	534,8	100,28	100,19	0,173	0,175	254	0,2463852
15,521	534,2	534,8	98,92	100,14	0,172	0,174	255	0,2457643
15,512	534,2	534,8	101,23	100,58	0,172	0,174	256	0,2453517
15,490	534,3	534,8	98,83	100,64	0,172	0,174	257	0,245352
15,269	534,3	534,8	100,94	102,66	0,170	0,175	258	0,2418104
15,414	534,3	534,8	99,64	100,97	0,171	0,175	259	0,2443149
15,536	534,2	534,8	100,48	100,12	0,172	0,175	260	0,2463828
15,379	534,1	534,7	100,19	101,41	0,173	0,175	261	0,2439003
15,337	534,1	534,7	102,54	101,72	0,173	0,175	262	0,2428577
15,488	534,1	534,7	101,41	101,04	0,174	0,175	263	0,2449373
15,463	534,2	534,7	98,73	100,78	0,172	0,175	264	0,2449369
15,466	534,2	534,7	100,81	100,83	0,171	0,174	265	0,2449374
15,456	534,2	534,7	100,93	100,23	0,173	0,174	266	0,2449373
15,322	534,1	534,7	100,21	101,90	0,172	0,174	267	0,2428579
15,496	534,1	534,7	100,26	100,36	0,172	0,175	268	0,2457643
15,357	534,1	534,7	102,08	101,35	0,173	0,174	269	0,2432752
15,510	534,1	534,6	99,30	100,90	0,172	0,175	270	0,2453512
15,645	534,1	534,6	100,06	99,58	0,172	0,175	271	0,2478206
15,144	534,1	534,6	103,37	102,90	0,174	0,174	272	0,2399154
15,504	534,1	534,7	100,38	99,73	0,173	0,174	273	0,2457646
15,540	534,1	534,6	100,89	100,18	0,174	0,174	274	0,2463829
15,469	534,1	534,6	100,78	100,62	0,174	0,175	275	0,2453507
15,408	534,0	534,6	100,62	100,59	0,173	0,174	276	0,244315
15,280	534,0	534,6	102,67	102,29	0,173	0,174	277	0,2418104
15,559	534,1	534,6	98,57	100,60	0,172	0,175	278	0,246383
15,396	534,1	534,6	101,66	100,61	0,172	0,174	279	0,2438995
15,460	534,1	534,6	101,73	100,58	0,174	0,174	280	0,2449375
15,250	534,1	534,6	100,07	102,01	0,172	0,174	281	0,2418105
15,342	534,0	534,6	100,26	101,68	0,170	0,175	282	0,2432747
15,375	534,0	534,5	99,03	101,04	0,170	0,175	283	0,2438996
15,420	534,0	534,5	101,24	100,43	0,171	0,174	284	0,2441318
15,507	533,9	534,5	100,60	100,75	0,173	0,174	285	0,2453506
15,395	534,0	534,5	101,77	101,25	0,173	0,175	286	0,2438992
15,423	534,0	534,5	101,44	100,57	0,174	0,174	287	0,2443145
15,543	534,0	534,5	100,53	99,70	0,174	0,174	288	0,2463826
15,448	533,9	534,5	98,93	100,89	0,172	0,174	289	0,2449365
15,463	533,9	534,4	99,05	100,05	0,170	0,174	290	0,2453512
15,338	533,9	534,4	102,00	100,89	0,172	0,173	291	0,2428574
15,531	533,9	534,4	99,10	100,57	0,172	0,174	292	0,2457637
15,396	533,9	534,5	102,04	100,94	0,172	0,174	293	0,2438995
15,421	533,9	534,5	101,29	100,36	0,174	0,174	294	0,244315
15,503	533,9	534,4	101,16	100,52	0,174	0,174	295	0,2457638
15,443	533,9	534,5	98,72	100,72	0,172	0,175	296	0,2449366
15,403	533,9	534,4	99,20	101,23	0,170	0,175	297	0,2443134



15,272	533,8	534,4	101,70	102,26	0,171	0,175	298	0,2418104
15,660	533,8	534,4	100,05	99,53	0,173	0,174	299	0,24782
15,514	533,9	534,4	101,15	100,18	0,174	0,174	300	0,2457634
15,393	533,9	534,4	99,96	101,40	0,172	0,174	301	0,2438891
15,416	533,9	534,4	99,58	101,21	0,171	0,175	302	0,2443145
15,602	533,8	534,4	98,13	99,97	0,170	0,175	303	0,2474097
15,465	533,8	534,3	99,01	100,34	0,170	0,175	304	0,2453508
15,425	533,8	534,3	101,73	100,73	0,172	0,174	305	0,2443146
15,481	533,8	534,3	99,61	101,15	0,172	0,174	306	0,2449367
15,617	533,9	534,3	100,36	99,64	0,172	0,175	307	0,2474097
15,355	533,8	534,3	101,56	101,60	0,174	0,175	308	0,2432736
15,322	533,8	534,3	101,98	100,98	0,173	0,174	309	0,2428573
15,535	533,8	534,3	98,74	100,61	0,172	0,174	310	0,2463829
15,466	533,7	534,3	101,17	100,05	0,172	0,175	311	0,2453507
15,422	533,7	534,2	99,74	101,16	0,172	0,174	312	0,2443139
15,382	533,7	534,2	100,27	101,72	0,171	0,175	313	0,2432736
15,643	533,7	534,3	97,90	100,01	0,170	0,175	314	0,2478193
15,617	533,7	534,2	99,82	99,88	0,172	0,175	315	0,2474088
15,545	533,7	534,3	99,29	100,01	0,172	0,174	316	0,2463826
15,249	533,7	534,3	102,34	102,15	0,173	0,175	317	0,2418105
15,492	533,7	534,2	101,25	99,87	0,174	0,174	318	0,2457634
15,422	533,7	534,2	99,33	101,65	0,172	0,175	319	0,2443144
15,442	533,7	534,2	99,35	101,62	0,170	0,175	320	0,2443142
15,510	533,7	534,2	99,11	100,49	0,170	0,175	321	0,2457624
15,327	533,8	534,3	100,41	101,63	0,171	0,175	322	0,2428569
15,452	533,8	534,3	99,97	100,98	0,171	0,175	323	0,2449362
15,537	533,8	534,3	98,46	100,20	0,171	0,175	324	0,2463823
15,310	533,7	534,2	102,26	101,41	0,172	0,174	325	0,2428562
15,474	533,7	534,2	98,95	100,87	0,172	0,175	326	0,2453506
15,412	533,6	534,2	99,95	101,43	0,170	0,175	327	0,2438989
15,458	533,7	534,2	101,40	100,69	0,172	0,175	328	0,2449359
15,350	533,7	534,2	102,20	101,07	0,174	0,174	329	0,2432736
15,478	533,7	534,2	98,86	100,96	0,172	0,175	330	0,2453505
15,445	533,7	534,2	101,12	100,47	0,172	0,175	331	0,2449361
15,591	533,6	534,1	99,56	99,41	0,173	0,174	332	0,2474094
15,404	533,6	534,1	99,48	101,14	0,172	0,175	333	0,2443141
15,260	533,6	534,1	101,85	102,18	0,171	0,175	334	0,2415323
15,398	533,6	534,1	101,40	101,12	0,173	0,174	335	0,2438989
15,323	533,6	534,1	102,05	101,32	0,173	0,174	336	0,2428569
15,413	533,7	534,1	101,58	100,84	0,174	0,174	337	0,2443146
15,339	533,7	534,1	102,15	101,13	0,174	0,174	338	0,2432734
15,400	533,6	534,1	99,70	101,14	0,173	0,175	339	0,244314
15,250	533,6	534,1	102,54	101,45	0,172	0,174	340	0,2418093
15,433	533,5	534,0	101,18	101,01	0,173	0,174	341	0,2443139
15,488	533,5	534,0	101,47	100,42	0,174	0,174	342	0,245351
15,321	533,6	534,1	99,64	102,22	0,172	0,175	343	0,2428571
15,452	533,6	534,1	100,36	100,69	0,171	0,175	344	0,2449362
15,535	533,6	534,1	98,37	100,16	0,171	0,175	345	0,2463832
15,439	533,6	534,0	100,97	100,33	0,172	0,174	346	0,2449363
15,445	533,5	534,0	101,44	100,37	0,174	0,174	347	0,2449366
15,433	533,5	534,0	101,74	100,98	0,174	0,174	348	0,2443141
15,684	533,5	534,0	99,99	98,97	0,174	0,174	349	0,2484316
15,324	533,6	534,0	102,05	101,46	0,174	0,174	350	0,2428563
15,388	533,6	534,0	101,89	100,69	0,174	0,174	351	0,2438983
15,598	533,5	534,0	98,40	99,76	0,172	0,174	352	0,2474084
15,457	533,5	534,0	99,17	100,64	0,171	0,175	353	0,2453502
15,428	533,4	534,0	100,12	100,62	0,171	0,175	354	0,2446668

Average	Average	Average						Average
15,63	Inlet +	Inlet +						0,243
	Outlet	Outlet	Average	Average	#1	#2		
Tunnel	Temp.	Temp.	100,85	100,83	System 1	System 2		SQRT
Velocity	Meter 1	Meter 2	<b>Proportional Rates</b>		Vol.Std.	Vol.Std.		Delta-P
			<b>PR1</b>	<b>PR2</b>			Time	
Ft/Sec	Deg. R	Deg. R	%	%	(ft3)	(ft3)	min	(in H2O)2
15,920	535,5	535,9			0,165	0,190	0	0,2392788
15,876	535,4	535,9	96,26	101,58	0,165	0,183	1	0,2443135
15,649	535,4	536,0	97,71	102,81	0,165	0,176	2	0,2407643
15,654	535,4	535,9	102,64	103,26	0,169	0,176	3	0,2403373
15,757	535,3	535,9	104,66	102,74	0,174	0,176	4	0,24139
15,631	535,3	535,9	104,09	101,89	0,176	0,176	5	0,2413905
15,774	535,3	535,9	101,07	100,79	0,175	0,176	6	0,2443137
15,671	535,3	535,9	101,32	101,28	0,174	0,176	7	0,2428569
15,788	535,3	536,0	100,53	100,25	0,174	0,176	8	0,2447754
15,594	535,4	536,0	101,48	101,52	0,173	0,176	9	0,2418091
15,523	535,4	536,0	103,44	101,65	0,175	0,176	10	0,2407581
15,592	535,4	536,0	101,22	101,92	0,174	0,176	11	0,2418094
15,522	535,4	536,0	102,08	102,04	0,173	0,176	12	0,2407584
15,519	535,4	536,0	102,45	101,90	0,174	0,176	13	0,2407584
15,593	535,4	536,0	100,96	101,94	0,173	0,176	14	0,2418097
15,607	535,4	536,0	101,29	101,89	0,173	0,176	15	0,2418106
15,679	535,4	536,0	101,01	101,56	0,173	0,176	16	0,2428565
15,589	535,5	536,1	103,40	101,49	0,174	0,176	17	0,2413906
15,552	535,5	536,1	101,61	102,36	0,174	0,176	18	0,2407589
15,552	535,5	536,1	103,72	101,52	0,174	0,176	19	0,2407587
15,782	535,5	536,1	102,19	100,17	0,176	0,175	20	0,2443144
15,591	535,5	536,1	101,31	102,13	0,174	0,176	21	0,2413905
15,622	535,4	536,1	101,45	101,76	0,173	0,176	22	0,2418096
15,617	535,4	536,1	102,87	101,55	0,174	0,176	23	0,2418096
15,698	535,4	536,1	102,90	101,05	0,176	0,176	24	0,2428567
15,697	535,4	536,1	100,23	101,58	0,174	0,176	25	0,2428572
15,633	535,5	536,1	100,73	101,79	0,171	0,176	26	0,24181
15,603	535,5	536,1	101,06	102,26	0,172	0,176	27	0,2413904
15,605	535,5	536,2	101,91	101,97	0,173	0,176	28	0,2413901
15,567	535,6	536,2	101,62	102,22	0,173	0,176	29	0,2407586
15,567	535,6	536,2	102,34	102,16	0,173	0,176	30	0,2408328
15,563	535,6	536,2	101,03	102,36	0,172	0,176	31	0,2407589
15,727	535,6	536,2	102,26	101,02	0,173	0,176	32	0,2432742
15,518	535,6	536,3	101,93	102,50	0,174	0,176	33	0,239915
15,799	535,7	536,3	102,33	100,40	0,174	0,175	34	0,2443146
15,611	535,7	536,4	103,45	101,67	0,176	0,175	35	0,241391
15,541	535,8	536,4	103,80	101,98	0,176	0,175	36	0,2403381
15,571	535,8	536,4	101,67	102,01	0,174	0,175	37	0,2407586
15,571	535,8	536,4	103,27	101,64	0,174	0,175	38	0,2407585
15,570	535,8	536,4	101,22	102,27	0,173	0,175	39	0,240759
15,568	535,8	536,5	103,03	102,29	0,173	0,176	40	0,2407589
15,643	535,8	536,5	100,65	102,18	0,173	0,176	41	0,2418102
15,521	535,9	536,5	101,17	102,89	0,171	0,176	42	0,239917
15,643	535,9	536,5	100,60	102,22	0,171	0,176	43	0,2418103
15,616	536,0	536,6	100,60	102,20	0,171	0,176	44	0,2413799
15,578	536,0	536,6	102,02	102,62	0,172	0,176	45	0,2407593
15,616	536,0	536,6	103,05	101,59	0,174	0,176	46	0,2413902
15,706	536,0	536,6	100,65	101,03	0,174	0,175	47	0,2428569
15,730	536,0	536,6	101,51	100,70	0,173	0,175	48	0,2432737
15,607	536,0	536,6	101,76	101,59	0,173	0,175	49	0,241391
15,610	536,0	536,6	102,24	101,40	0,173	0,175	50	0,2413904
15,638	536,0	536,6	102,76	101,40	0,174	0,175	51	0,2418099
15,570	536,1	536,7	101,05	102,03	0,173	0,175	52	0,2407591
15,514	536,1	536,7	103,40	102,91	0,173	0,176	53	0,2399147

15,468	536,1	536,7	101,62	102,78	0,173	0,176	54	0,2392794
15,561	536,1	536,7	101,82	101,98	0,172	0,176	55	0,2407617
15,605	536,1	536,7	102,96	101,66	0,174	0,175	56	0,2413909
15,559	536,1	536,7	100,97	102,23	0,173	0,176	57	0,2407587
15,553	536,0	536,7	103,24	101,70	0,173	0,176	58	0,2407588
15,606	536,1	536,7	103,05	101,80	0,175	0,175	59	0,2413907
15,728	536,0	536,7	101,68	101,04	0,175	0,176	60	0,2432738
15,607	536,1	536,8	101,31	102,54	0,173	0,176	61	0,2413831
15,562	536,1	536,8	101,40	101,91	0,172	0,176	62	0,2407589
15,698	536,2	536,8	102,04	100,78	0,173	0,175	63	0,2428577
15,791	536,2	536,9	99,78	100,06	0,173	0,175	64	0,2443139
15,531	536,2	536,8	103,25	102,00	0,173	0,175	65	0,2403625
15,594	536,2	536,9	102,45	101,96	0,175	0,176	66	0,2413903
15,553	536,2	536,9	100,89	102,16	0,173	0,176	67	0,2407778
15,597	536,2	536,9	102,82	101,66	0,173	0,176	68	0,241391
15,427	536,2	536,9	102,07	102,50	0,173	0,175	69	0,2387501
15,556	536,3	536,9	100,91	102,60	0,171	0,176	70	0,2407594
15,595	536,3	536,9	100,12	101,67	0,171	0,176	71	0,2413907
15,554	536,3	537,0	102,82	102,18	0,172	0,176	72	0,2407595
15,687	536,3	537,0	100,07	100,89	0,173	0,176	73	0,2428572
15,550	536,3	536,9	101,36	101,65	0,172	0,175	74	0,2407591
15,587	536,3	537,0	102,21	101,91	0,173	0,176	75	0,2413911
15,679	536,3	537,0	99,99	100,89	0,173	0,176	76	0,2428574
15,675	536,3	536,9	101,26	101,61	0,172	0,176	77	0,2428575
15,708	536,3	536,9	99,98	101,34	0,172	0,177	78	0,2432746
15,681	536,3	536,9	100,08	100,79	0,171	0,176	79	0,2428573
15,585	536,3	537,0	102,50	101,60	0,173	0,175	80	0,2413906
15,537	536,3	537,0	100,75	101,98	0,173	0,176	81	0,2407596
15,577	536,3	537,0	100,52	102,03	0,171	0,176	82	0,2413901
15,531	536,3	537,0	101,34	102,45	0,172	0,176	83	0,2407597
15,595	536,3	537,0	100,41	101,80	0,172	0,177	84	0,2418106
15,566	536,3	536,9	100,87	100,95	0,172	0,175	85	0,2413915
15,521	536,2	536,9	103,02	102,24	0,174	0,176	86	0,2407592
15,660	536,3	536,9	100,77	100,73	0,174	0,176	87	0,2428581
15,592	536,2	536,9	102,27	101,68	0,174	0,176	88	0,2418522
15,563	536,2	536,9	101,06	101,25	0,173	0,176	89	0,241391
15,521	536,3	536,9	103,31	102,06	0,174	0,176	90	0,2407593
15,518	536,3	537,0	100,92	101,37	0,174	0,176	91	0,2407595
15,679	536,3	537,0	99,82	101,03	0,172	0,176	92	0,2432751
15,579	536,3	537,0	101,95	101,32	0,173	0,176	93	0,2418109
15,872	536,3	537,0	99,20	99,32	0,173	0,176	94	0,2463835
15,803	536,3	536,9	98,50	99,75	0,172	0,176	95	0,2453514
15,573	536,2	536,9	102,19	102,09	0,173	0,176	96	0,2418108
15,505	536,2	536,9	101,65	101,63	0,174	0,176	97	0,2407602
15,548	536,3	536,9	101,19	101,13	0,173	0,175	98	0,2413911
15,569	536,3	536,9	101,48	101,71	0,173	0,176	99	0,2418103
15,540	536,3	536,9	101,10	101,59	0,173	0,176	100	0,2413917
15,632	536,3	537,0	101,97	100,66	0,174	0,176	101	0,242857
15,558	536,3	536,9	101,97	101,58	0,175	0,176	102	0,2418107
15,487	536,2	536,9	102,80	101,51	0,175	0,176	103	0,2407599
15,614	536,2	536,9	101,71	100,71	0,175	0,176	104	0,2428579
15,548	536,2	536,9	99,82	100,94	0,173	0,176	105	0,2418099
15,549	536,2	536,9	100,59	101,01	0,172	0,175	106	0,2418109
15,611	536,1	536,8	101,52	100,69	0,173	0,176	107	0,2428568
15,519	536,1	536,8	101,86	101,72	0,174	0,176	108	0,2413917
15,608	536,1	536,8	99,99	100,24	0,173	0,176	109	0,2428575
15,703	536,1	536,8	101,61	100,31	0,174	0,176	110	0,2443151
15,604	536,1	536,8	100,09	100,33	0,174	0,176	111	0,2428576
15,507	536,1	536,8	99,91	100,99	0,172	0,175	112	0,2413906
15,628	536,1	536,8	99,34	100,15	0,171	0,175	113	0,2432747
15,626	536,1	536,8	101,05	100,46	0,173	0,176	114	0,2432748



15,785	536,0	536,8	100,28	99,42	0,174	0,176	115	0,2457639
15,626	536,0	536,7	99,62	100,52	0,173	0,176	116	0,2432745
15,734	536,0	536,7	100,80	99,86	0,173	0,176	117	0,2449369
15,597	536,0	536,7	101,86	100,91	0,175	0,176	118	0,2428574
15,729	536,0	536,7	98,55	99,22	0,173	0,176	119	0,2449371
15,726	536,0	536,7	100,71	100,25	0,173	0,176	120	0,2449236
15,493	536,0	536,7	101,08	101,47	0,174	0,177	121	0,2413911
15,615	535,9	536,7	101,41	100,57	0,174	0,176	122	0,2432744
15,614	535,9	536,6	101,61	100,41	0,175	0,176	123	0,2432744
15,772	535,9	536,6	100,43	99,25	0,175	0,176	124	0,245805
15,621	535,9	536,6	99,75	100,61	0,174	0,176	125	0,2432744
15,683	535,8	536,6	99,04	99,94	0,172	0,176	126	0,2443145
15,613	535,9	536,6	99,55	99,92	0,172	0,175	127	0,2432745
15,611	535,9	536,6	101,04	100,65	0,173	0,176	128	0,2432742
15,514	535,9	536,6	99,60	100,93	0,173	0,176	129	0,2418104
15,674	535,8	536,5	100,91	100,10	0,173	0,176	130	0,2443146
15,673	535,8	536,5	101,05	100,50	0,175	0,176	131	0,2443151
15,578	535,8	536,5	99,38	100,39	0,173	0,176	132	0,242858
15,600	535,8	536,5	99,23	100,10	0,171	0,176	133	0,2432746
15,607	535,8	536,5	101,95	100,74	0,174	0,176	134	0,2432744
15,712	535,7	536,4	100,80	99,83	0,176	0,176	135	0,2449371
15,715	535,8	536,4	100,52	99,95	0,175	0,176	136	0,2449366
15,716	535,8	536,4	98,76	99,54	0,173	0,176	137	0,2450567
15,707	535,8	536,4	99,41	99,62	0,172	0,176	138	0,2449371
15,761	535,8	536,4	100,14	99,49	0,174	0,176	139	0,2457644
15,600	535,8	536,4	98,94	100,19	0,173	0,176	140	0,2432741
15,437	535,7	536,4	102,65	101,95	0,173	0,176	141	0,2407593
15,730	535,7	536,4	98,45	99,39	0,174	0,176	142	0,2453511
15,662	535,6	536,3	99,85	99,83	0,172	0,176	143	0,2443151
15,581	535,6	536,3	101,24	100,83	0,174	0,176	144	0,2428579
15,509	535,6	536,3	102,16	101,21	0,175	0,176	145	0,2418097
15,440	535,7	536,3	100,26	100,75	0,173	0,176	146	0,2407592
15,600	535,7	536,3	101,31	100,55	0,173	0,175	147	0,243274
15,666	535,7	536,3	101,06	100,14	0,175	0,176	148	0,2443151
15,597	535,7	536,3	99,12	99,81	0,173	0,176	149	0,243274
15,593	535,6	536,3	101,81	100,72	0,174	0,176	150	0,2432737
15,431	535,6	536,3	102,03	101,68	0,175	0,177	151	0,2407659
15,699	535,6	536,3	100,90	99,75	0,175	0,176	152	0,2449369
15,436	535,6	536,3	100,96	101,43	0,174	0,176	153	0,240759
15,477	535,6	536,3	102,38	101,34	0,174	0,176	154	0,2413911
15,601	535,6	536,3	99,28	100,29	0,173	0,176	155	0,2432741
15,503	535,6	536,3	101,44	101,12	0,173	0,176	156	0,2418104
15,580	535,6	536,3	100,90	100,62	0,174	0,176	157	0,2430075
15,793	535,6	536,3	97,85	98,60	0,173	0,176	158	0,2463826
15,750	535,6	536,3	98,74	99,30	0,172	0,176	159	0,2457634
15,694	535,6	536,3	100,68	100,15	0,174	0,176	160	0,2449361
15,721	535,5	536,2	100,65	100,05	0,175	0,177	161	0,2453507
15,492	535,5	536,2	101,93	101,14	0,175	0,177	162	0,2418098
15,507	535,5	536,2	101,44	101,06	0,175	0,176	163	0,2418099
15,757	535,4	536,1	99,78	99,51	0,174	0,176	164	0,2457632
15,594	535,4	536,1	101,71	100,58	0,175	0,176	165	0,2432739
15,698	535,5	536,1	98,65	99,61	0,174	0,176	166	0,2449363
15,656	535,5	536,1	98,94	99,76	0,172	0,176	167	0,2443143
15,655	535,4	536,1	100,82	100,17	0,173	0,176	168	0,2443157
15,691	535,4	536,1	100,60	100,04	0,175	0,177	169	0,2449364
15,717	535,4	536,1	98,51	99,04	0,173	0,176	170	0,2453505
15,582	535,3	536,0	101,68	100,70	0,174	0,176	171	0,2432739
15,472	535,3	536,0	100,03	101,12	0,174	0,176	172	0,2413904
15,750	535,3	536,0	98,21	99,06	0,171	0,176	173	0,245762
15,701	535,4	536,0	100,98	100,00	0,174	0,176	174	0,2449363
15,700	535,4	536,0	101,00	100,09	0,176	0,177	175	0,2449362

15,372	535,4	536,0	102,50	102,00	0,175	0,177	176	0,2399146
15,561	535,4	536,0	99,86	100,23	0,174	0,176	177	0,2428569
15,650	535,4	536,0	100,29	99,70	0,173	0,176	178	0,2443136
15,715	535,3	536,0	100,75	100,00	0,175	0,176	179	0,2453506
15,710	535,3	535,9	100,69	99,53	0,176	0,177	180	0,2453509
15,555	535,2	535,9	99,30	100,13	0,174	0,176	181	0,2428576
15,709	535,2	535,9	100,87	99,89	0,173	0,176	182	0,2449362
15,566	535,2	535,9	101,75	100,80	0,175	0,176	183	0,2428566
15,589	535,2	535,9	99,30	99,85	0,174	0,176	184	0,2432738
15,695	535,2	535,9	98,68	99,52	0,172	0,175	185	0,2449369
15,692	535,2	535,9	99,08	99,69	0,172	0,176	186	0,2449358
15,688	535,2	535,9	101,01	99,97	0,174	0,176	187	0,2449053
15,687	535,2	535,8	98,54	99,63	0,174	0,176	188	0,244936
15,686	535,2	535,8	100,59	100,02	0,173	0,176	189	0,2449361
15,578	535,2	535,8	99,61	100,48	0,174	0,177	190	0,2432735
15,568	535,2	535,8	99,68	100,48	0,172	0,176	191	0,2428565
15,499	535,2	535,8	99,99	100,87	0,172	0,176	192	0,2418096
15,741	535,2	535,8	99,76	99,60	0,173	0,176	193	0,2456173
15,724	535,2	535,8	98,39	99,41	0,173	0,176	194	0,2453507
15,692	535,2	535,8	98,35	99,33	0,171	0,176	195	0,2449425
15,689	535,2	535,8	98,59	99,50	0,171	0,176	196	0,2449359
15,781	535,2	535,8	100,44	99,27	0,174	0,176	197	0,2463819
15,648	535,1	535,8	100,99	100,41	0,176	0,177	198	0,2443139
15,551	535,1	535,7	99,57	100,45	0,174	0,176	199	0,2428565
15,559	535,1	535,7	100,36	100,26	0,173	0,176	200	0,2428741
15,750	535,1	535,7	98,86	99,73	0,173	0,176	201	0,2457626
15,590	535,1	535,7	101,29	100,10	0,174	0,176	202	0,2432741
15,561	535,1	535,7	101,68	100,93	0,175	0,176	203	0,2428569
15,691	535,2	535,7	100,47	100,24	0,175	0,177	204	0,2449358
15,689	535,1	535,7	100,51	100,49	0,175	0,177	205	0,2449358
15,688	535,1	535,7	98,51	99,61	0,173	0,177	206	0,2449353
15,738	535,1	535,7	98,36	98,81	0,172	0,176	207	0,2457631
15,709	535,0	535,7	98,62	99,51	0,172	0,176	208	0,2453503
15,463	535,0	535,6	101,22	100,95	0,173	0,176	209	0,2413898
15,567	535,0	535,6	101,40	101,19	0,174	0,176	210	0,2428566
15,748	535,0	535,6	98,29	99,45	0,173	0,177	211	0,2457622
15,655	535,0	535,6	98,95	100,07	0,172	0,176	212	0,2443131
15,422	535,0	535,6	102,70	101,53	0,174	0,176	213	0,240758
15,740	535,1	535,7	98,83	99,37	0,174	0,176	214	0,2457199
15,685	535,0	535,6	100,85	100,22	0,174	0,177	215	0,244936
15,706	535,0	535,6	98,48	99,14	0,174	0,176	216	0,2453502
15,481	534,9	535,5	102,09	101,38	0,174	0,176	217	0,2418087
15,688	534,9	535,5	98,95	99,91	0,174	0,177	218	0,2449359
15,568	534,9	535,5	99,60	100,60	0,172	0,176	219	0,2428561
15,693	534,9	535,6	98,63	99,61	0,172	0,176	220	0,2449355
15,688	534,9	535,6	99,40	99,22	0,172	0,176	221	0,244936
15,646	535,0	535,6	101,52	100,19	0,175	0,176	222	0,2443143
15,576	534,9	535,5	101,55	100,42	0,176	0,176	223	0,2432734
15,734	534,9	535,5	98,88	99,85	0,174	0,177	224	0,2457634
15,733	534,9	535,5	100,55	99,55	0,174	0,177	225	0,2457627
15,477	534,9	535,5	102,31	101,12	0,176	0,177	226	0,241809
15,553	534,9	535,5	101,41	100,38	0,176	0,176	227	0,2429213
15,749	534,9	535,5	100,62	99,84	0,175	0,176	228	0,2457634
15,651	534,9	535,5	101,27	100,23	0,176	0,177	229	0,2443134
15,581	534,9	535,5	101,53	100,22	0,176	0,176	230	0,2432729
15,710	534,9	535,5	99,12	99,98	0,174	0,176	231	0,2453504
15,773	534,9	535,5	100,57	99,32	0,175	0,177	232	0,2463814
15,572	534,9	535,5	99,69	100,10	0,174	0,176	233	0,2432726
15,701	534,9	535,4	100,53	99,86	0,174	0,176	234	0,2453502
15,702	534,8	535,4	101,10	99,57	0,176	0,177	235	0,2453502
15,455	534,8	535,4	99,96	101,46	0,174	0,177	236	0,2413894

15,724	534,8	535,4	101,06	99,64	0,174	0,177	237	0,2454725
15,645	534,8	535,4	99,01	100,23	0,174	0,177	238	0,2443132
15,645	534,8	535,4	99,29	99,65	0,172	0,176	239	0,244313
15,798	534,9	535,4	100,29	99,00	0,174	0,176	240	0,246793
15,636	534,8	535,4	99,22	99,77	0,174	0,176	241	0,2443136
15,636	534,8	535,4	101,38	100,29	0,174	0,176	242	0,2443128



Average	Average	Average						Average
15,34	Inlet +	Inlet +						0,238
	Outlet	Outlet	Average	Average	#1	#2		
Tunnel	Temp.	Temp.	100,67	100,93	System 1	System 2		SQRT
Velocity	Meter 1	Meter 2	<b>Proportional Rates</b>		Vol.Std.	Vol.Std.		Delta-P
			<b>PR1</b>	<b>PR2</b>			Time	
Ft/Sec	Deg. R	Deg. R	%	%	(ft3)	(ft3)	min	(in H2O)2
15,722	534,9	535,6			0,168	0,180	0	0,2377912
15,614	535,0	535,6	101,75	100,77	0,172	0,178	1	0,2407583
15,430	535,0	535,6	99,04	101,90	0,172	0,175	2	0,2377914
15,454	535,1	535,7	103,21	101,98	0,172	0,175	3	0,2377908
15,372	535,2	535,7	103,38	101,55	0,176	0,175	4	0,2377908
15,417	535,2	535,7	100,75	100,93	0,175	0,176	5	0,239279
15,335	535,2	535,7	101,23	101,10	0,174	0,176	6	0,2382165
15,328	535,2	535,7	101,93	101,03	0,174	0,175	7	0,2382166
15,318	535,2	535,8	102,66	100,83	0,176	0,175	8	0,2382166
15,429	535,2	535,7	102,08	99,97	0,176	0,175	9	0,239914
15,326	535,1	535,7	100,65	101,38	0,175	0,176	10	0,2382168
15,347	535,2	535,8	102,77	100,84	0,175	0,176	11	0,2382168
15,390	535,2	535,8	100,09	101,19	0,174	0,175	12	0,238855
15,387	535,2	535,8	100,16	101,28	0,172	0,176	13	0,2388553
15,382	535,3	535,8	102,13	100,57	0,174	0,176	14	0,238855
15,385	535,3	535,9	100,99	100,91	0,175	0,175	15	0,2388553
15,314	535,3	535,9	100,66	101,41	0,173	0,176	16	0,2377916
15,325	535,3	535,9	101,68	101,59	0,173	0,176	17	0,2377914
15,332	535,3	535,9	102,61	100,83	0,175	0,175	18	0,2377909
15,336	535,3	535,9	100,64	101,34	0,174	0,175	19	0,2377911
15,566	535,3	535,9	101,27	99,50	0,174	0,175	20	0,2413901
15,365	535,3	535,9	100,23	101,91	0,174	0,176	21	0,2382166
15,485	535,4	535,9	99,75	100,85	0,172	0,176	22	0,2399141
15,415	535,4	536,0	102,11	100,83	0,174	0,175	23	0,2388552
15,378	535,5	536,0	100,79	101,31	0,174	0,175	24	0,2382408
15,449	535,5	536,0	101,95	100,88	0,174	0,175	25	0,2392792
15,371	535,5	536,0	102,14	101,15	0,175	0,175	26	0,2382168
15,376	535,4	536,1	102,58	100,78	0,175	0,175	27	0,2382166
15,353	535,4	536,0	100,60	101,97	0,174	0,175	28	0,2377915
15,357	535,4	536,0	100,50	102,22	0,172	0,176	29	0,237799
15,429	535,5	536,1	99,79	101,45	0,171	0,176	30	0,2388551
15,368	535,5	536,1	100,34	102,16	0,171	0,176	31	0,2377912
15,375	535,6	536,1	101,83	101,84	0,172	0,176	32	0,2377914
15,404	535,6	536,2	100,40	101,80	0,173	0,176	33	0,2382169
15,405	535,6	536,2	102,70	101,43	0,173	0,176	34	0,2382168
15,450	535,6	536,2	102,06	101,03	0,175	0,175	35	0,2388553
15,387	535,7	536,2	102,35	101,74	0,175	0,175	36	0,2377911
15,382	535,7	536,3	103,13	101,51	0,175	0,175	37	0,2377916
15,055	535,7	536,3	104,81	103,65	0,175	0,175	38	0,2326166
15,463	535,7	536,3	100,16	101,70	0,173	0,175	39	0,2388547
15,418	535,7	536,3	100,53	102,26	0,171	0,176	40	0,2382172
15,426	535,8	536,3	100,54	102,48	0,172	0,177	41	0,2382172
15,400	535,8	536,4	100,83	101,91	0,172	0,176	42	0,2377917
15,429	535,9	536,5	101,95	101,96	0,173	0,176	43	0,2382155
15,434	535,9	536,5	102,29	101,50	0,174	0,176	44	0,2382173
15,407	535,9	536,5	102,60	101,21	0,175	0,175	45	0,2377918
15,402	535,9	536,6	100,02	102,15	0,172	0,175	46	0,2377914
15,372	536,0	536,6	101,57	101,80	0,171	0,175	47	0,2373644
15,300	536,0	536,6	101,42	102,30	0,172	0,175	48	0,2362942
15,428	536,0	536,6	101,97	101,69	0,173	0,175	49	0,2382171
15,423	536,0	536,6	100,37	101,57	0,173	0,175	50	0,2382172
15,472	536,0	536,6	100,23	101,30	0,171	0,175	51	0,2388562
15,396	536,1	536,7	100,50	102,31	0,171	0,176	52	0,2377922

15,394	536,1	536,7	99,97	102,13	0,171	0,176	53	0,2377921
15,435	536,1	536,8	102,69	101,69	0,173	0,176	54	0,2382174
15,399	536,2	536,8	101,60	102,11	0,174	0,176	55	0,2377915
15,398	536,2	536,8	100,46	101,98	0,172	0,176	56	0,2377916
15,330	536,2	536,8	102,49	101,84	0,172	0,175	57	0,2367223
15,358	536,2	536,8	100,38	102,08	0,172	0,175	58	0,2373645
15,416	536,1	536,8	102,12	101,74	0,173	0,176	59	0,2382178
15,390	536,2	536,8	102,64	101,82	0,175	0,176	60	0,2377923
15,402	536,2	536,8	100,39	102,17	0,173	0,176	61	0,2377922
15,429	536,3	536,9	101,45	101,10	0,172	0,175	62	0,2382176
15,373	536,3	537,0	100,47	102,02	0,172	0,175	63	0,2373647
15,434	536,3	537,0	99,68	101,85	0,170	0,176	64	0,2382177
15,430	536,3	537,0	101,32	101,95	0,171	0,176	65	0,2382174
15,393	536,3	537,0	102,83	101,54	0,174	0,175	66	0,2377919
15,393	536,3	537,0	102,04	101,82	0,174	0,175	67	0,2378124
15,361	536,3	537,0	100,95	101,51	0,173	0,175	68	0,2373648
15,388	536,4	537,0	100,31	102,21	0,171	0,175	69	0,2377921
15,578	536,4	537,0	101,01	100,24	0,173	0,176	70	0,2407594
15,392	536,4	537,0	102,53	101,41	0,174	0,175	71	0,2377921
15,391	536,4	537,1	102,65	101,86	0,175	0,175	72	0,2377926
15,385	536,5	537,1	100,51	102,06	0,173	0,176	73	0,2377925
15,400	536,5	537,1	100,34	101,80	0,171	0,176	74	0,2378793
15,419	536,5	537,2	101,16	100,88	0,172	0,175	75	0,238218
15,413	536,5	537,2	99,92	101,56	0,172	0,175	76	0,2382176
15,114	536,5	537,2	103,82	103,29	0,172	0,175	77	0,2337044
15,381	536,5	537,2	100,73	101,17	0,173	0,175	78	0,2377924
15,399	536,5	537,2	102,36	101,14	0,173	0,175	79	0,2382173
15,506	536,5	537,1	99,58	100,25	0,173	0,175	80	0,239915
15,387	536,5	537,1	100,06	101,39	0,171	0,175	81	0,2382178
15,466	536,5	537,2	99,24	100,96	0,171	0,175	82	0,2392639
15,389	536,5	537,2	101,25	101,72	0,172	0,176	83	0,2382182
15,362	536,5	537,2	100,10	101,65	0,172	0,176	84	0,237793
15,366	536,5	537,2	101,55	101,24	0,172	0,175	85	0,237793
15,353	536,6	537,3	99,72	101,22	0,172	0,175	86	0,237793
15,345	536,6	537,3	100,23	101,06	0,171	0,175	87	0,2377929
15,344	536,5	537,2	101,49	101,76	0,172	0,175	88	0,2377929
15,364	536,5	537,2	99,86	101,38	0,172	0,176	89	0,2382188
15,364	536,5	537,2	99,70	101,12	0,171	0,175	90	0,2382187
15,475	536,5	537,2	98,72	100,27	0,171	0,175	91	0,2399162
15,435	536,4	537,1	100,91	100,52	0,172	0,175	92	0,2392805
15,333	536,5	537,1	99,93	101,29	0,172	0,175	93	0,2377929
15,334	536,5	537,2	100,01	101,35	0,171	0,175	94	0,2377931
15,360	536,5	537,2	101,84	101,14	0,173	0,175	95	0,2382182
15,356	536,5	537,2	101,68	101,07	0,174	0,175	96	0,2382182
15,251	536,4	537,1	100,39	101,14	0,173	0,175	97	0,2367229
15,318	536,3	537,1	100,00	100,76	0,171	0,174	98	0,2377929
15,342	536,3	537,0	101,36	100,55	0,173	0,174	99	0,2382185
15,312	536,3	537,0	100,04	101,36	0,173	0,175	100	0,2377924
15,450	536,2	537,0	100,87	100,96	0,173	0,176	101	0,2399152
15,316	536,2	537,0	101,95	101,26	0,174	0,176	102	0,2377926
15,411	536,2	536,9	101,36	100,40	0,175	0,175	103	0,2392803
15,316	536,2	537,0	99,49	101,21	0,172	0,175	104	0,2377929
15,312	536,2	537,0	99,57	101,12	0,170	0,175	105	0,2377923
15,315	536,2	536,9	101,84	101,53	0,173	0,176	106	0,2378887
15,306	536,2	536,9	102,15	101,45	0,175	0,176	107	0,2377926
15,273	536,2	536,9	102,02	101,28	0,175	0,176	108	0,237365
15,326	536,2	536,9	100,53	100,62	0,174	0,175	109	0,2382175
15,327	536,2	536,9	99,94	100,93	0,172	0,175	110	0,2382177
15,360	536,2	536,9	99,52	100,22	0,172	0,175	111	0,2388566
15,288	536,1	536,9	99,16	100,74	0,171	0,175	112	0,2377922
15,366	536,1	536,9	101,33	100,55	0,172	0,175	113	0,238859

15,320	536,1	536,9	101,59	100,87	0,174	0,175	114	0,2382179
15,319	536,1	536,9	99,43	100,80	0,173	0,175	115	0,2382181
15,295	536,1	536,9	99,52	100,79	0,171	0,175	116	0,2377929
15,294	536,1	536,9	101,69	101,13	0,172	0,175	117	0,2377923
15,295	536,1	536,9	100,89	101,18	0,174	0,175	118	0,2377924
15,314	536,1	536,9	101,83	101,08	0,174	0,176	119	0,238218
15,418	536,1	536,9	100,74	100,79	0,175	0,176	120	0,2399153
15,538	536,1	536,8	99,97	99,24	0,174	0,176	121	0,2418109
15,304	536,0	536,8	99,03	100,36	0,172	0,175	122	0,2382178
15,484	536,1	536,8	98,65	99,66	0,171	0,175	123	0,2407594
15,311	536,1	536,9	101,50	100,99	0,173	0,175	124	0,2382181
15,351	536,1	536,9	99,19	100,36	0,173	0,175	125	0,2388565
15,358	536,1	536,8	99,89	100,70	0,172	0,175	126	0,2388566
15,309	536,1	536,9	99,18	100,18	0,171	0,175	127	0,2382184
15,276	536,1	536,9	99,61	100,80	0,171	0,175	128	0,2377927
15,376	536,1	536,8	101,11	100,62	0,173	0,175	129	0,2392802
15,338	536,1	536,8	101,12	100,45	0,175	0,176	130	0,2388563
15,373	536,1	536,8	99,21	100,39	0,173	0,175	131	0,2392807
15,277	536,1	536,8	100,22	101,18	0,172	0,176	132	0,2377929
15,283	536,1	536,8	99,61	100,72	0,171	0,175	133	0,237792
15,302	536,1	536,8	101,83	101,41	0,173	0,176	134	0,2382184
15,311	536,1	536,9	100,89	100,76	0,174	0,176	135	0,238218
15,281	536,1	536,8	101,82	101,40	0,174	0,176	136	0,2377924
15,307	536,1	536,8	101,49	101,04	0,175	0,176	137	0,2382182
15,274	536,1	536,9	99,99	100,70	0,173	0,175	138	0,2377923
15,466	536,1	536,8	100,31	99,68	0,173	0,175	139	0,2407593
15,368	536,1	536,8	98,97	100,30	0,173	0,175	140	0,2392804
15,364	536,1	536,8	99,26	100,17	0,171	0,175	141	0,2392806
15,366	536,0	536,8	100,74	100,48	0,173	0,175	142	0,2392804
15,295	536,0	536,8	99,27	100,28	0,172	0,175	143	0,2382178
15,372	536,0	536,8	100,42	100,13	0,172	0,175	144	0,2392801
15,340	536,0	536,8	98,98	100,08	0,172	0,175	145	0,2388563
15,297	536,0	536,8	101,66	101,45	0,173	0,176	146	0,2382177
15,266	536,0	536,8	101,05	100,93	0,174	0,176	147	0,237793
15,233	536,0	536,8	101,63	101,68	0,174	0,176	148	0,2373649
15,262	536,0	536,8	101,63	101,00	0,174	0,176	149	0,2377929
15,294	535,9	536,7	101,63	101,10	0,175	0,176	150	0,2382178
15,287	535,9	536,7	101,53	100,83	0,175	0,176	151	0,2382186
15,398	535,9	536,7	98,54	99,85	0,173	0,175	152	0,2399155
15,356	535,8	536,6	98,56	99,89	0,171	0,175	153	0,239281
15,327	535,8	536,6	100,54	100,45	0,172	0,175	154	0,2388561
15,295	535,8	536,6	101,49	100,99	0,174	0,176	155	0,2382178
15,360	535,8	536,6	100,49	99,98	0,174	0,175	156	0,23928
15,327	535,8	536,6	100,99	100,48	0,174	0,175	157	0,2388566
15,253	535,7	536,6	99,81	101,03	0,173	0,176	158	0,2377921
15,256	535,7	536,6	101,19	101,10	0,173	0,176	159	0,2377921
15,277	535,7	536,5	100,47	100,60	0,173	0,176	160	0,2382176
15,281	535,7	536,5	101,23	101,00	0,174	0,176	161	0,2382509
15,264	535,7	536,5	101,28	100,75	0,174	0,176	162	0,2377922
15,513	535,7	536,5	99,29	99,27	0,174	0,175	163	0,2417846
15,396	535,7	536,4	98,60	99,83	0,172	0,175	164	0,2399152
15,399	535,7	536,4	100,94	100,85	0,173	0,176	165	0,239915
15,390	535,7	536,4	98,74	99,77	0,173	0,176	166	0,2399156
15,258	535,7	536,4	100,48	100,83	0,172	0,175	167	0,2377922
15,270	535,7	536,4	99,38	100,79	0,172	0,175	168	0,2377924
15,290	535,7	536,4	100,99	100,84	0,172	0,175	169	0,2382181
15,325	535,7	536,4	99,11	99,82	0,172	0,175	170	0,2388561
15,277	535,6	536,4	99,28	100,45	0,171	0,175	171	0,2382179
15,228	535,6	536,4	99,86	100,74	0,171	0,175	172	0,2373618
15,324	535,6	536,4	99,85	100,68	0,172	0,175	173	0,2388563
15,286	535,6	536,4	101,65	100,92	0,174	0,176	174	0,2382184

15,323	535,6	536,3	99,21	100,49	0,173	0,176	175	0,2388566
15,353	535,6	536,4	101,24	100,44	0,173	0,176	176	0,2392798
15,287	535,6	536,4	99,30	100,84	0,173	0,176	177	0,2382177
15,255	535,6	536,4	99,44	100,82	0,171	0,175	178	0,2377922
15,275	535,6	536,3	99,34	100,47	0,171	0,175	179	0,2382169
15,254	535,5	536,3	101,44	100,67	0,173	0,175	180	0,2377984
15,283	535,5	536,3	101,18	101,29	0,174	0,176	181	0,2382175
15,246	535,5	536,2	100,35	100,72	0,173	0,176	182	0,2377921
15,267	535,4	536,2	101,04	100,43	0,173	0,175	183	0,2382171
15,505	535,4	536,2	99,08	98,98	0,174	0,175	184	0,2418101
15,252	535,4	536,2	101,72	101,16	0,174	0,176	185	0,2377917
15,344	535,5	536,2	101,03	100,43	0,175	0,176	186	0,2392799
15,286	535,5	536,2	101,15	101,00	0,174	0,176	187	0,2382175
15,281	535,5	536,2	99,49	100,89	0,173	0,176	188	0,2382173
15,351	535,5	536,2	98,81	100,25	0,171	0,176	189	0,2392795
15,278	535,5	536,3	99,24	100,58	0,171	0,175	190	0,2382172
15,279	535,5	536,3	100,06	101,01	0,172	0,176	191	0,2382172
15,250	535,5	536,2	101,47	101,13	0,173	0,176	192	0,2377918
15,249	535,5	536,2	101,23	101,42	0,174	0,176	193	0,2377917
15,344	535,5	536,2	98,86	100,00	0,173	0,176	194	0,2392795
15,277	535,4	536,2	100,14	100,18	0,172	0,175	195	0,2382174
15,389	535,4	536,2	100,17	99,69	0,173	0,175	196	0,2399143
15,349	535,5	536,2	98,90	99,98	0,172	0,175	197	0,2392799
15,340	535,5	536,2	100,62	100,68	0,173	0,176	198	0,2392792
15,245	535,5	536,2	100,54	100,29	0,174	0,175	199	0,2377919
15,388	535,5	536,2	100,88	100,55	0,174	0,175	200	0,2398786
15,278	535,4	536,2	101,65	101,08	0,175	0,176	201	0,2382172
15,172	535,4	536,2	100,01	101,20	0,173	0,176	202	0,2367219
15,240	535,4	536,2	101,55	101,00	0,173	0,176	203	0,2377917
15,267	535,4	536,1	101,28	101,14	0,175	0,176	204	0,2382175
15,378	535,4	536,1	98,51	100,03	0,173	0,176	205	0,2399148
15,268	535,4	536,1	101,73	100,93	0,173	0,176	206	0,238217
15,270	535,4	536,1	99,15	100,38	0,173	0,175	207	0,2382174
15,236	535,4	536,1	99,81	101,12	0,171	0,176	208	0,2377916
15,240	535,4	536,1	101,58	100,89	0,173	0,176	209	0,2377917
15,271	535,4	536,1	101,84	100,79	0,175	0,176	210	0,2382171
15,212	535,4	536,1	99,74	100,89	0,173	0,176	211	0,2373642
15,241	535,4	536,1	99,59	100,80	0,171	0,175	212	0,237792
15,238	535,4	536,1	99,42	100,63	0,171	0,175	213	0,2377933
15,233	535,4	536,1	101,57	101,05	0,173	0,176	214	0,2377914
15,423	535,4	536,1	97,87	99,72	0,173	0,176	215	0,2407587
15,264	535,3	536,0	99,06	100,39	0,171	0,175	216	0,2382165
15,337	535,3	536,0	100,85	100,32	0,173	0,175	217	0,239279
15,232	535,4	536,1	101,76	100,90	0,175	0,176	218	0,237792
15,231	535,3	536,1	101,07	100,97	0,175	0,176	219	0,2377931
15,235	535,3	536,0	99,62	100,91	0,173	0,176	220	0,2377915
15,234	535,3	536,0	99,90	100,51	0,172	0,175	221	0,2377915
15,259	535,2	536,0	100,84	100,18	0,173	0,175	222	0,2382172
15,227	535,2	536,0	99,42	100,70	0,173	0,175	223	0,2377919
15,261	535,2	536,0	101,79	100,60	0,173	0,175	224	0,2382176
15,492	535,2	535,9	99,71	99,34	0,175	0,176	225	0,2418099
15,233	535,2	535,9	100,78	100,45	0,174	0,175	226	0,2377921
15,426	535,2	535,9	98,22	99,28	0,172	0,175	227	0,2407886
15,259	535,2	535,9	99,73	101,25	0,172	0,176	228	0,2382174
15,235	535,3	536,0	101,82	100,96	0,174	0,176	229	0,2377915
15,225	535,2	535,9	99,71	101,17	0,173	0,176	230	0,2377919
15,294	535,2	535,9	101,24	100,33	0,173	0,176	231	0,2388554
15,293	535,2	535,9	101,13	99,89	0,175	0,175	232	0,2388552
15,229	535,2	535,9	101,45	100,31	0,175	0,175	233	0,2377919
15,259	535,2	535,9	99,10	100,18	0,173	0,175	234	0,2382169
15,299	535,1	535,9	99,22	100,19	0,171	0,175	235	0,2388552



15,262	535,1	535,8	101,54	100,32	0,173	0,175	236	0,2382176
15,315	535,1	535,8	101,18	100,29	0,175	0,175	237	0,239035
15,325	535,2	535,9	99,51	99,95	0,174	0,175	238	0,2392792
15,255	535,2	535,9	99,39	100,34	0,172	0,175	239	0,2382171
15,365	535,2	535,9	100,22	100,07	0,173	0,175	240	0,2399143
15,258	535,2	535,9	99,55	100,94	0,173	0,176	241	0,238217
15,322	535,2	535,9	100,65	100,03	0,173	0,176	242	0,2392787
15,296	535,1	535,9	100,89	100,01	0,174	0,175	243	0,2388549
15,254	535,1	535,8	101,47	100,84	0,175	0,175	244	0,2382165
15,259	535,1	535,8	101,92	100,35	0,175	0,176	245	0,2382167
15,300	535,1	535,8	101,32	100,31	0,175	0,175	246	0,2388557
15,485	535,1	535,8	98,82	98,75	0,174	0,175	247	0,2418096
15,324	535,1	535,8	98,60	100,48	0,172	0,176	248	0,2392787
15,252	535,1	535,8	99,07	100,58	0,171	0,176	249	0,2382169
15,355	535,1	535,8	98,77	99,70	0,171	0,175	250	0,2399145
15,288	535,1	535,8	99,52	100,68	0,172	0,176	251	0,2388552
15,222	535,1	535,8	101,44	100,89	0,173	0,176	252	0,2377911
15,241	535,0	535,8	101,26	100,65	0,175	0,176	253	0,2382164

Average	Average	Average						Average
15,16	Inlet +	Inlet +						0,234
	Outlet	Outlet	Average	Average	#1	#2		
Tunnel	Temp.	Temp.	100,35	99,83	System 1	System 2		SQRT
Velocity	Meter 1	Meter 2	<b>Proportional Rates</b>		Vol.Std.	Vol.Std.		Delta-P
			<b>PR1</b>	<b>PR2</b>			Time	
Ft/Sec	Deg. R	Deg. R	%	%	(ft3)	(ft3)	min	(in H2O)2
15,743	536,5	537,0			0,170	0,174	0	0,2367208
15,576	536,5	537,0	100,15	99,61	0,171	0,174	1	0,2382169
15,526	536,4	537,0	96,33	99,70	0,168	0,174	2	0,2373633
15,574	536,4	537,0	99,50	99,95	0,167	0,174	3	0,2377907
15,450	536,4	537,0	101,53	100,88	0,171	0,174	4	0,2356473
15,309	536,3	537,0	103,30	100,26	0,173	0,174	5	0,2347853
15,418	536,3	537,0	100,04	99,71	0,173	0,174	6	0,2367213
15,412	536,3	537,0	102,03	99,17	0,173	0,173	7	0,2367217
15,493	536,3	537,0	99,69	99,06	0,173	0,173	8	0,237886
15,421	536,4	537,1	100,47	99,51	0,171	0,174	9	0,2367215
15,498	536,4	537,1	99,92	99,30	0,171	0,174	10	0,237803
15,360	536,4	537,1	100,27	100,70	0,171	0,174	11	0,235648
15,472	536,5	537,2	100,90	99,37	0,172	0,174	12	0,2373636
15,426	536,5	537,2	99,86	99,82	0,172	0,174	13	0,2367221
15,396	536,5	537,2	99,68	99,66	0,170	0,174	14	0,2362931
15,472	536,5	537,3	100,84	99,46	0,171	0,174	15	0,2373638
15,470	536,5	537,3	100,86	99,40	0,173	0,174	16	0,237364
15,431	536,5	537,3	100,70	99,51	0,172	0,174	17	0,2367222
15,503	536,5	537,3	99,69	98,98	0,171	0,173	18	0,2377914
15,473	536,5	537,3	99,25	99,73	0,170	0,174	19	0,2373635
15,534	536,6	537,4	99,23	98,91	0,170	0,174	20	0,2382173
15,486	536,7	537,4	99,43	99,41	0,170	0,173	21	0,2373638
15,414	536,7	537,4	99,27	99,74	0,170	0,173	22	0,2362938
15,415	536,8	537,5	101,25	99,79	0,171	0,173	23	0,2362963
15,376	536,8	537,5	101,94	99,48	0,173	0,173	24	0,2356488
15,146	536,9	537,6	102,05	101,75	0,172	0,173	25	0,2319607
15,146	536,8	537,6	103,15	102,03	0,171	0,174	26	0,2319609
15,189	536,8	537,6	103,41	101,23	0,173	0,174	27	0,2326161
15,187	536,9	537,6	100,80	101,43	0,171	0,173	28	0,2326163
15,116	536,9	537,6	102,74	102,01	0,170	0,174	29	0,2315226
15,081	536,9	537,6	103,75	101,98	0,172	0,173	30	0,2310849
15,180	537,0	537,7	102,99	101,27	0,173	0,173	31	0,2326161
15,144	537,0	537,7	102,03	101,60	0,171	0,173	32	0,2319608
14,918	537,1	537,8	102,92	103,77	0,170	0,174	33	0,2284367
15,090	537,2	537,9	104,15	101,96	0,171	0,174	34	0,2310852
15,117	537,3	537,9	103,42	101,46	0,173	0,173	35	0,2315213
14,873	537,3	538,0	103,37	103,37	0,171	0,173	36	0,2277701
15,087	537,3	537,9	103,77	101,44	0,171	0,173	37	0,2310852
15,087	537,2	538,0	101,34	102,16	0,171	0,173	38	0,2310854
15,013	537,2	537,9	104,35	102,18	0,171	0,173	39	0,2299849
15,114	537,2	538,0	101,17	102,04	0,171	0,173	40	0,2315231
15,085	537,2	538,0	101,63	102,42	0,169	0,174	41	0,2310847
15,111	537,2	538,0	101,33	102,24	0,169	0,174	42	0,2315227
15,255	537,3	538,0	99,96	101,35	0,169	0,174	43	0,2337037
15,015	537,4	538,1	104,41	102,37	0,171	0,174	44	0,2299867
15,142	537,5	538,1	101,86	101,45	0,171	0,173	45	0,2319614
15,215	537,5	538,2	102,44	101,17	0,171	0,173	46	0,2330514
15,108	537,5	538,2	100,94	101,75	0,170	0,173	47	0,2315231
15,111	537,5	538,2	103,96	101,82	0,171	0,173	48	0,2315231
15,177	537,5	538,2	102,98	101,19	0,173	0,173	49	0,2326163
15,173	537,5	538,2	101,92	101,80	0,172	0,174	50	0,2326166
14,893	537,5	538,2	103,98	103,57	0,171	0,174	51	0,2284374
15,120	537,4	538,2	101,39	101,34	0,170	0,174	52	0,2319615
15,079	537,4	538,2	103,29	101,61	0,171	0,173	53	0,2313853

15,009	537,4	538,2	103,31	102,28	0,172	0,173	54	0,2304257
15,216	537,4	538,2	102,10	100,51	0,172	0,173	55	0,2337039
15,105	537,5	538,2	101,17	101,87	0,171	0,174	56	0,231959
15,043	537,5	538,2	101,25	101,80	0,169	0,174	57	0,2310855
15,040	537,6	538,3	101,77	102,34	0,169	0,174	58	0,2310994
15,093	537,5	538,3	103,15	100,98	0,171	0,174	59	0,2319615
15,201	537,5	538,3	99,83	100,35	0,171	0,173	60	0,2337269
15,198	537,4	538,2	102,00	100,38	0,170	0,173	61	0,2337037
15,051	537,4	538,2	103,16	101,37	0,172	0,173	62	0,231523
15,116	537,4	538,2	102,03	100,61	0,172	0,173	63	0,2326164
15,014	537,3	538,1	101,31	101,45	0,171	0,173	64	0,2310851
15,137	537,3	538,1	100,08	101,09	0,169	0,174	65	0,2330512
15,199	537,3	538,1	102,00	100,27	0,171	0,174	66	0,2341372
15,003	537,3	538,1	102,54	101,20	0,172	0,173	67	0,231085
15,247	537,4	538,1	101,63	100,07	0,172	0,173	68	0,2347871
15,130	537,4	538,1	102,40	100,90	0,173	0,174	69	0,2330513
15,054	537,4	538,2	102,89	100,97	0,173	0,174	70	0,2319607
15,122	537,4	538,2	102,48	100,89	0,173	0,174	71	0,2330514
15,183	537,4	538,1	99,67	100,42	0,171	0,174	72	0,2341369
15,180	537,4	538,1	101,73	100,10	0,171	0,174	73	0,2341372
15,177	537,4	538,1	101,12	100,58	0,172	0,174	74	0,2341368
14,977	537,4	538,1	102,52	101,87	0,172	0,174	75	0,2310847
15,143	537,4	538,1	101,99	100,19	0,172	0,174	76	0,233704
15,167	537,3	538,1	101,37	99,99	0,173	0,173	77	0,2341363
15,164	537,3	538,1	101,65	99,86	0,172	0,173	78	0,2341371
15,094	537,4	538,1	101,57	101,01	0,172	0,174	79	0,2330509
15,068	537,4	538,2	100,01	100,36	0,170	0,174	80	0,2326163
14,989	537,5	538,2	100,50	101,03	0,169	0,173	81	0,2315229
15,150	537,5	538,2	99,26	99,62	0,169	0,173	82	0,2341367
15,077	537,4	538,2	99,78	100,45	0,169	0,173	83	0,233051
15,185	537,4	538,1	99,54	99,04	0,169	0,173	84	0,2347864
15,138	537,3	538,1	101,45	99,84	0,171	0,173	85	0,2341374
15,232	537,3	538,0	98,67	99,13	0,171	0,173	86	0,2356488
15,030	537,2	538,0	101,34	100,68	0,170	0,174	87	0,2326167
15,094	537,2	537,9	99,16	99,69	0,170	0,174	88	0,2337044
15,120	537,1	537,9	101,78	100,12	0,171	0,174	89	0,2341375
15,218	537,1	537,9	98,58	99,08	0,171	0,174	90	0,235649
15,159	537,1	537,8	99,73	99,65	0,170	0,174	91	0,2347859
15,018	537,1	537,9	99,61	100,09	0,170	0,173	92	0,2326173
14,978	537,2	537,9	100,16	100,77	0,169	0,173	93	0,2319996
15,015	537,2	537,9	102,20	100,48	0,171	0,174	94	0,232617
15,008	537,1	537,8	99,85	99,91	0,171	0,173	95	0,232617
15,002	537,0	537,7	100,18	99,92	0,170	0,173	96	0,2326062
15,196	536,9	537,7	98,13	98,71	0,169	0,173	97	0,2356482
15,187	536,9	537,7	98,07	99,03	0,169	0,173	98	0,2356488
15,088	536,8	537,6	98,98	99,49	0,169	0,174	99	0,2341372
15,085	536,8	537,6	100,88	100,17	0,171	0,174	100	0,2341376
15,220	536,7	537,5	98,57	98,80	0,171	0,174	101	0,2362936
15,184	536,7	537,5	100,49	99,33	0,171	0,174	102	0,2356485
15,089	536,7	537,5	99,77	100,02	0,172	0,174	103	0,2341369
15,251	536,7	537,5	100,23	98,83	0,172	0,174	104	0,236722
15,219	536,7	537,5	100,55	99,27	0,173	0,175	105	0,2362938
15,176	536,7	537,5	98,04	98,63	0,171	0,174	106	0,235648
15,214	536,7	537,5	97,81	98,30	0,169	0,173	107	0,236294
15,278	536,7	537,4	99,74	98,39	0,171	0,174	108	0,2373642
15,167	536,6	537,4	100,15	99,06	0,173	0,174	109	0,2356485
15,207	536,5	537,3	98,41	98,36	0,171	0,174	110	0,2362943
15,162	536,5	537,2	98,63	98,95	0,170	0,174	111	0,2356485
14,821	536,4	537,2	100,55	100,91	0,170	0,174	112	0,2304255
15,164	536,4	537,2	99,93	98,74	0,171	0,174	113	0,2356485
15,236	536,5	537,2	98,18	98,21	0,171	0,173	114	0,2367221

15,107	536,5	537,2	98,56	99,06	0,169	0,173	115	0,2347857
15,162	536,6	537,3	98,96	98,62	0,170	0,173	116	0,2356485
15,035	536,6	537,3	99,07	99,60	0,170	0,174	117	0,233726
14,964	536,5	537,2	101,61	100,58	0,171	0,174	118	0,2326167
15,194	536,4	537,2	99,74	98,61	0,172	0,174	119	0,2362936
15,096	536,3	537,1	100,77	99,33	0,173	0,174	120	0,234786
15,191	536,2	537,0	98,04	98,29	0,171	0,174	121	0,2362941
15,186	536,2	537,0	97,94	97,86	0,169	0,173	122	0,2362895
15,194	536,2	537,0	98,30	98,52	0,170	0,173	123	0,2362936
15,155	536,2	537,0	100,40	98,96	0,171	0,174	124	0,2356481
15,094	536,2	537,0	98,45	98,75	0,171	0,174	125	0,2347857
15,151	536,3	537,0	98,11	98,41	0,169	0,173	126	0,2356865
15,149	536,2	537,0	100,65	99,15	0,171	0,174	127	0,2356487
15,088	536,2	537,0	98,70	98,95	0,171	0,174	128	0,2347856
15,049	536,1	536,9	99,28	99,46	0,170	0,174	129	0,2341373
15,210	536,1	536,9	97,53	97,98	0,169	0,174	130	0,2367223
15,086	536,0	536,8	98,43	98,91	0,169	0,173	131	0,2347872
15,246	536,0	536,8	97,62	98,05	0,169	0,174	132	0,2373644
15,215	536,0	536,8	99,50	98,41	0,171	0,174	133	0,2367218
15,095	536,1	536,8	100,98	99,45	0,173	0,174	134	0,2347859
15,092	536,1	536,9	98,87	98,80	0,172	0,174	135	0,2347857
15,182	536,2	536,9	98,06	98,36	0,170	0,173	136	0,236294
15,210	536,2	536,9	99,57	98,60	0,171	0,174	137	0,2367219
15,178	536,2	536,9	100,40	98,92	0,173	0,174	138	0,2362935
15,136	536,1	536,9	100,33	98,93	0,173	0,174	139	0,235648
15,135	536,1	536,8	100,71	99,11	0,173	0,174	140	0,2356481
15,203	536,0	536,8	97,80	98,30	0,172	0,174	141	0,2367219
15,133	536,0	536,7	100,21	99,04	0,171	0,174	142	0,2356483
14,941	536,0	536,7	101,59	100,50	0,173	0,175	143	0,2326158
15,178	535,9	536,7	98,30	98,48	0,171	0,174	144	0,2362937
15,138	536,0	536,7	98,19	98,68	0,170	0,174	145	0,2356482
15,177	536,0	536,7	99,60	98,32	0,171	0,174	146	0,2362934
15,179	536,0	536,7	97,90	98,19	0,171	0,173	147	0,2362933
15,247	536,0	536,7	97,55	97,67	0,169	0,173	148	0,2373639
15,172	536,0	536,7	98,40	98,28	0,170	0,173	149	0,2362935
15,133	536,0	536,7	100,24	99,08	0,172	0,174	150	0,2356478
15,267	535,9	536,7	98,55	97,55	0,172	0,174	151	0,2377913
15,129	535,9	536,6	98,61	98,84	0,171	0,174	152	0,2356477
15,074	535,9	536,6	98,55	98,66	0,170	0,174	153	0,2347848
15,039	535,9	536,6	101,25	99,54	0,171	0,174	154	0,2341364
15,043	536,0	536,7	99,44	99,38	0,172	0,174	155	0,2341361
15,094	536,0	536,7	98,62	98,64	0,170	0,173	156	0,2349507
15,136	536,0	536,7	98,41	98,42	0,170	0,173	157	0,2356481
15,079	536,0	536,7	101,13	99,39	0,172	0,174	158	0,2347857
15,006	536,0	536,7	99,24	99,07	0,172	0,174	159	0,2337032
15,075	536,0	536,7	99,07	99,25	0,170	0,174	160	0,2347849
15,171	535,9	536,6	100,25	98,85	0,172	0,174	161	0,2362936
15,072	535,9	536,6	98,96	98,87	0,172	0,174	162	0,2347851
15,170	535,8	536,6	100,26	98,78	0,172	0,174	163	0,236293
14,978	535,8	536,6	100,83	99,47	0,173	0,174	164	0,2333434
15,179	535,9	536,6	97,64	98,48	0,171	0,174	165	0,2362932
15,142	535,9	536,6	100,63	99,14	0,171	0,174	166	0,2356479
15,013	536,0	536,6	99,65	99,36	0,172	0,174	167	0,2337033
14,966	536,0	536,7	99,20	99,69	0,170	0,174	168	0,2330509
15,034	536,0	536,7	98,53	99,27	0,169	0,174	169	0,2341372
15,053	536,0	536,7	100,93	99,43	0,171	0,174	170	0,2344433
15,200	536,0	536,7	99,67	98,85	0,173	0,175	171	0,236722
15,128	535,9	536,6	97,88	98,48	0,171	0,174	172	0,2356485
15,127	535,9	536,6	98,60	98,81	0,170	0,174	173	0,2356483
15,164	535,8	536,6	98,54	98,69	0,170	0,174	174	0,2362939
15,190	535,8	536,5	98,17	97,70	0,170	0,174	175	0,2367275



14,964	535,7	536,5	101,63	100,20	0,172	0,174	176	0,2330511
15,034	535,8	536,5	101,13	99,72	0,173	0,175	177	0,234137
15,127	535,8	536,5	98,07	98,70	0,171	0,174	178	0,2356481
15,192	535,8	536,5	98,33	98,53	0,170	0,174	179	0,2367218
15,164	535,8	536,5	100,34	98,64	0,172	0,174	180	0,236293
15,187	535,8	536,5	100,29	98,22	0,174	0,174	181	0,236722
15,019	535,7	536,4	101,18	99,45	0,174	0,174	182	0,2341368
14,948	535,7	536,4	100,57	100,41	0,173	0,175	183	0,2330511
15,183	535,7	536,4	97,97	97,99	0,171	0,174	184	0,2367217
15,009	535,6	536,4	98,72	99,32	0,170	0,174	185	0,234088
15,184	535,6	536,4	98,80	97,65	0,170	0,173	186	0,2367218
15,187	535,7	536,4	97,72	97,98	0,170	0,173	187	0,236722

Average	Average	Average						Average
15,04	Inlet +	Inlet +						0,231
	Outlet	Outlet	Average	Average	#1	#2		
Tunnel	Temp.	Temp.	101,45	100,99	System 1	System 2		SQRT
Velocity	Meter 1	Meter 2	<b>Proportional Rates</b>		Vol.Std.	Vol.Std.		Delta-P
			<b>PR1</b>	<b>PR2</b>			Time	
Ft/Sec	Deg. R	Deg. R	%	%	(ft3)	(ft3)	min	(in H2O)2
15,463	535,6	535,9			0,171	0,176	0	0,2284367
15,164	535,4	535,9	102,20	101,73	0,171	0,175	1	0,2315234
15,296	535,3	535,9	102,87	100,38	0,173	0,174	2	0,2341377
15,117	535,2	535,9	102,06	101,70	0,173	0,174	3	0,2312119
15,165	535,2	535,9	101,86	101,53	0,172	0,174	4	0,2319617
15,111	535,2	535,9	104,34	101,66	0,173	0,174	5	0,2310856
15,142	535,2	535,9	104,54	101,71	0,175	0,174	6	0,2315239
15,115	535,2	536,0	103,03	101,90	0,174	0,174	7	0,2310863
15,152	535,2	535,9	104,61	101,47	0,174	0,174	8	0,2315237
15,018	535,1	535,9	103,68	103,08	0,174	0,174	9	0,2293239
15,266	535,1	535,9	101,59	101,42	0,172	0,175	10	0,2330522
15,186	535,1	536,0	104,43	101,83	0,173	0,174	11	0,231524
14,916	535,2	536,0	104,82	103,91	0,174	0,174	12	0,2273246
15,122	535,3	536,1	104,50	102,31	0,173	0,174	13	0,2304264
15,167	535,4	536,2	103,44	102,28	0,174	0,174	14	0,2310865
15,097	535,4	536,2	102,88	103,23	0,172	0,175	15	0,2299868
15,001	535,4	536,3	105,64	103,13	0,173	0,174	16	0,2284382
15,131	535,4	536,3	104,60	102,25	0,174	0,174	17	0,2304267
15,102	535,3	536,3	105,09	102,51	0,175	0,174	18	0,229987
15,209	535,4	536,3	101,76	102,42	0,173	0,174	19	0,2315244
15,217	535,5	536,4	101,87	102,81	0,170	0,175	20	0,2315246
15,069	535,7	536,5	102,92	103,20	0,170	0,175	21	0,2293244
15,146	535,7	536,6	104,66	102,24	0,172	0,174	22	0,2304271
14,936	535,8	536,7	105,79	103,51	0,174	0,173	23	0,2273211
15,178	535,8	536,7	104,07	101,91	0,174	0,173	24	0,2310869
15,203	535,9	536,8	104,06	101,68	0,174	0,174	25	0,2315247
15,058	535,9	536,8	102,44	103,18	0,172	0,174	26	0,2293236
15,137	536,0	536,9	104,29	102,36	0,172	0,174	27	0,2304274
15,012	536,1	536,9	105,03	102,91	0,174	0,173	28	0,2284383
14,968	536,2	537,0	104,03	103,65	0,172	0,174	29	0,2277711
15,012	536,3	537,1	105,02	103,28	0,172	0,174	30	0,2284645
15,105	536,3	537,2	102,36	102,69	0,172	0,174	31	0,2299871
15,129	536,3	537,2	102,00	102,72	0,170	0,174	32	0,2304272
15,097	536,4	537,3	102,80	102,68	0,171	0,174	33	0,2299877
15,123	536,4	537,3	103,09	101,75	0,171	0,174	34	0,2304277
15,049	536,5	537,4	102,27	103,15	0,171	0,174	35	0,2293247
15,190	536,5	537,4	103,32	101,40	0,171	0,174	36	0,2315254
15,053	536,6	537,5	104,58	102,62	0,173	0,173	37	0,229402
15,084	536,7	537,6	104,29	102,33	0,174	0,174	38	0,2299889
15,110	536,8	537,6	101,69	102,80	0,172	0,174	39	0,230428
15,075	536,9	537,7	101,70	101,97	0,170	0,174	40	0,2299884
15,026	536,8	537,7	102,47	102,54	0,170	0,173	41	0,2293256
14,962	536,9	537,7	102,47	103,55	0,170	0,174	42	0,2284399
15,163	536,9	537,7	102,78	101,90	0,171	0,175	43	0,2315263
15,131	536,8	537,7	100,90	101,95	0,171	0,174	44	0,2310883
15,190	536,9	537,7	100,58	101,72	0,169	0,174	45	0,2319653
15,137	537,0	537,8	103,65	101,98	0,171	0,174	46	0,2310882
15,132	537,1	537,9	100,76	101,87	0,171	0,174	47	0,2310843
14,881	537,2	538,0	103,36	104,02	0,170	0,174	48	0,2273271
14,997	537,1	538,0	103,38	101,89	0,171	0,174	49	0,229326
15,132	537,2	538,0	101,55	101,82	0,172	0,174	50	0,2315266
15,029	537,2	538,0	101,06	102,29	0,170	0,174	51	0,2299887
15,120	537,1	538,0	102,93	101,05	0,171	0,174	52	0,2315269
15,015	537,1	538,0	103,50	101,79	0,173	0,174	53	0,2299884

15,140	537,1	538,0	102,45	101,22	0,173	0,174	54	0,2319647
15,185	537,2	538,0	100,12	101,16	0,171	0,174	55	0,23262
15,035	537,3	538,1	101,00	101,93	0,169	0,174	56	0,230429
15,130	537,3	538,1	102,39	100,59	0,171	0,174	57	0,2319652
15,019	537,3	538,1	103,19	101,49	0,173	0,173	58	0,2304291
15,083	537,3	538,2	99,89	101,27	0,171	0,174	59	0,2315274
14,726	537,3	538,2	102,22	103,23	0,169	0,174	60	0,2262095
15,039	537,3	538,1	100,62	100,74	0,169	0,173	61	0,231089
15,038	537,3	538,1	100,22	101,30	0,169	0,174	62	0,2311919
15,132	537,3	538,1	100,13	100,18	0,170	0,174	63	0,2326206
15,063	537,3	538,2	100,52	101,51	0,170	0,174	64	0,2315272
14,963	537,4	538,2	103,12	101,09	0,172	0,174	65	0,2300374
15,054	537,5	538,2	102,02	100,61	0,173	0,173	66	0,2315274
15,077	537,5	538,3	99,89	100,56	0,171	0,174	67	0,2319655
14,973	537,5	538,3	100,50	101,62	0,169	0,174	68	0,2304301
14,934	537,5	538,3	102,85	101,58	0,171	0,174	69	0,2299901
14,710	537,5	538,3	104,29	102,82	0,173	0,174	70	0,2266581
15,049	537,4	538,2	101,25	100,31	0,172	0,174	71	0,2319657
14,941	537,3	538,2	100,01	101,11	0,170	0,174	72	0,2304297
15,111	537,3	538,2	99,42	99,67	0,169	0,174	73	0,2330561
14,942	537,4	538,2	100,02	101,14	0,169	0,174	74	0,2304293
15,007	537,4	538,2	101,30	100,17	0,170	0,174	75	0,2315277
14,931	537,4	538,3	102,57	100,93	0,173	0,173	76	0,2304298
14,851	537,5	538,3	100,64	101,71	0,171	0,174	77	0,2293272
15,056	537,4	538,3	100,47	100,33	0,170	0,174	78	0,2325542
14,953	537,4	538,2	100,29	100,35	0,171	0,174	79	0,2310896
15,003	537,3	538,2	101,59	100,04	0,172	0,174	80	0,231966
15,109	537,3	538,2	98,97	99,58	0,171	0,174	81	0,2337083
14,892	537,3	538,1	101,99	101,34	0,171	0,175	82	0,2304302
15,101	537,3	538,1	98,64	98,97	0,171	0,174	83	0,2337088
14,964	537,3	538,1	102,02	100,54	0,172	0,174	84	0,2315268
15,097	537,3	538,1	98,53	99,23	0,171	0,174	85	0,2337084
14,955	537,3	538,2	99,26	100,22	0,169	0,174	86	0,2315284
14,978	537,3	538,2	101,49	100,32	0,171	0,174	87	0,2319657
14,703	537,3	538,2	101,01	101,68	0,171	0,174	88	0,2277732
15,039	537,3	538,1	99,43	98,97	0,170	0,173	89	0,2330561
14,696	537,2	538,1	103,36	101,96	0,172	0,174	90	0,2277982
15,033	537,2	538,0	98,79	99,27	0,171	0,174	91	0,2330561
15,030	537,1	538,0	100,88	99,26	0,171	0,174	92	0,2330562
15,198	537,1	537,9	98,06	97,99	0,172	0,173	93	0,2356534
15,034	537,1	537,9	98,64	99,51	0,170	0,174	94	0,2330558
14,962	537,1	537,9	101,50	99,80	0,171	0,174	95	0,2319667
14,928	537,1	537,9	100,66	100,13	0,173	0,174	96	0,2315271
15,067	537,1	537,9	98,66	98,97	0,171	0,174	97	0,233706
15,024	537,1	537,9	98,55	98,84	0,170	0,173	98	0,233056
15,020	537,0	537,9	98,85	99,69	0,170	0,174	99	0,2330548
15,017	537,0	537,9	99,24	99,29	0,170	0,174	100	0,2330557
15,055	536,9	537,8	98,90	98,93	0,170	0,174	101	0,2337057
14,981	536,9	537,8	99,49	99,68	0,171	0,174	102	0,2326209
15,079	536,9	537,8	98,05	98,96	0,170	0,174	103	0,2341429
15,052	536,9	537,7	100,87	99,60	0,172	0,175	104	0,2337083
15,122	536,9	537,7	97,79	98,44	0,172	0,174	105	0,2347909
14,911	536,9	537,7	101,11	100,32	0,171	0,174	106	0,2315278
14,936	536,9	537,7	98,88	99,84	0,171	0,174	107	0,2319655
14,930	536,8	537,7	101,21	100,15	0,171	0,174	108	0,2319657
14,975	536,8	537,7	101,05	99,85	0,173	0,175	109	0,2326206
14,994	536,7	537,6	99,45	99,09	0,172	0,174	110	0,2330556
15,033	536,7	537,6	98,32	99,00	0,170	0,174	111	0,2337081
14,986	536,6	537,6	100,63	99,51	0,171	0,174	112	0,2330553
15,030	536,6	537,5	99,69	98,75	0,173	0,174	113	0,2337081
15,099	536,6	537,5	98,08	98,37	0,171	0,174	114	0,2347902

14,820	536,7	537,5	100,84	100,27	0,171	0,174	115	0,23043
14,890	536,7	537,6	101,42	100,34	0,172	0,174	116	0,231527
14,985	536,7	537,6	98,92	99,32	0,172	0,175	117	0,233055
15,052	536,6	537,5	98,23	98,62	0,170	0,174	118	0,2341407
15,023	536,6	537,5	98,06	98,69	0,170	0,174	119	0,2337076
14,952	536,6	537,5	100,78	99,61	0,171	0,174	120	0,23262
14,807	536,5	537,4	99,65	100,08	0,171	0,174	121	0,2304294
15,018	536,5	537,4	97,93	98,46	0,169	0,174	122	0,2337076
14,976	536,5	537,4	99,88	99,47	0,171	0,174	123	0,233055
14,949	536,5	537,4	99,60	99,25	0,172	0,174	124	0,2326207
14,978	536,5	537,4	99,50	99,36	0,171	0,174	125	0,2330553
14,979	536,5	537,4	98,50	99,03	0,170	0,174	126	0,2330546
14,876	536,5	537,4	101,37	100,26	0,172	0,174	127	0,2315266
15,015	536,5	537,4	98,92	98,76	0,172	0,174	128	0,2337075
15,014	536,4	537,3	100,42	99,39	0,172	0,174	129	0,2337083
15,038	536,4	537,3	100,40	99,00	0,174	0,175	130	0,2341407



## APPENDIX 3: Calibration data



**Instrumentation  
Saint-Laurent** inc.  
Accrédité ISO 17025



80 rue de la montagne  
St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
Fax: (450) 473-5207  
Email: inst.st-laurent@videotron.ca

## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-001 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9101
Précision requise:	+/- 2.0°C
Fréquence d'étalonnage: (jours)	365

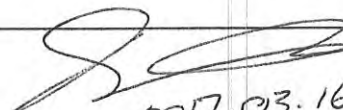
SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Fluke	Type de sortie:	Digitale
No. Model:	52-II	Type de mesure:	Température
No. Série:	90630037	Gamme:	Divers
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
0.0 °C	0.0 °C	-0.1 °C	-0.1 °C	-0.1 °C	1.0 °C	T1 typeJ
125.0 °C	125.0 °C	124.9 °C	-0.1 °C	124.9 °C	1.0 °C	T1 typeJ
250.0 °C	250.0 °C	250.0 °C	0.0 °C	250.0 °C	1.0 °C	T1 typeJ
375.0 °C	375.0 °C	374.9 °C	-0.1 °C	374.9 °C	1.0 °C	T1 typeJ
500.0 °C	500.0 °C	500.0 °C	0.0 °C	500.0 °C	1.0 °C	T1 typeJ
0.0 °C	0.0 °C	0.0 °C	0.0 °C	0.0 °C	1.0 °C	T2 typeJ
125.0 °C	125.0 °C	125.0 °C	0.0 °C	125.0 °C	1.0 °C	T2 typeJ
250.0 °C	250.0 °C	250.0 °C	0.0 °C	250.0 °C	1.0 °C	T2 typeJ
375.0 °C	375.0 °C	374.9 °C	-0.1 °C	374.9 °C	1.0 °C	T2 typeJ
500.0 °C	500.0 °C	500.0 °C	0.0 °C	500.0 °C	1.0 °C	T2 typeJ
0.0 °C	0.0 °C	0.0 °C	0.0 °C	0.0 °C	1.0 °C	T1 typeK
125.0 °C	125.0 °C	125.0 °C	0.0 °C	125.0 °C	1.0 °C	T1 typeK
250.0 °C	250.0 °C	250.0 °C	0.0 °C	250.0 °C	1.0 °C	T1 typeK
375.0 °C	375.0 °C	375.0 °C	0.0 °C	375.0 °C	1.0 °C	T1 typeK
500.0 °C	500.0 °C	500.0 °C	0.0 °C	500.0 °C	1.0 °C	T1 typeK
0.0 °C	0.0 °C	0.0 °C	0.0 °C	0.0 °C	1.0 °C	T2 typeK
125.0 °C	125.0 °C	125.0 °C	0.0 °C	125.0 °C	1.0 °C	T2 typeK
250.0 °C	250.0 °C	250.0 °C	0.0 °C	250.0 °C	1.0 °C	T2 typeK
375.0 °C	375.0 °C	375.0 °C	0.0 °C	375.0 °C	1.0 °C	T2 typeK
500.0 °C	500.0 °C	500.0 °C	0.0 °C	500.0 °C	1.0 °C	T2 typeK

Conditions Environnementales: Température: 18 °C Humidité: 33 %RH

Type d'Étalonnage:

  
2017.03.16

5F09101

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## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-001 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9101
Précision requise:	+/- 2.0°C
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Fluke	Type de sortie:	Digitale
No. Model:	52-II	Type de mesure:	Température
No. Série:	90630037	Gamme:	Divers
Emplacement:	N.A.	No. Machine:	N.A.

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabriquant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est traçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	27 Février 2017
Date du prochain Étalonnage:	27 Février 2018
Date d'émission du certificat:	27 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-006 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/-0.25"H2O
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Indicateur	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	MS-321-LCD	Type de mesure:	Pression
No. Série:	E47U020014	Gamme:	0-0.5"H2O
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Setra	No. du certificat d'étalonnage:	AC17021126
No. Série:	2784759	Dernière date d'étalonnage:	17-Feb-17
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	17-Feb-18
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
0.0000 "H2O	0.000 "H2O	-0.007 "H2O	-0.007 "H2O	-0.007 "H2O	0.25 "H2O	Vérification indicateur
0.2500 "H2O	0.250 "H2O	0.237 "H2O	-0.013 "H2O	0.237 "H2O	0.25 "H2O	Vérification indicateur
0.5000 "H2O	0.500 "H2O	0.493 "H2O	-0.007 "H2O	0.493 "H2O	0.25 "H2O	Vérification indicateur
0.7500 "H2O	0.750 "H2O	0.740 "H2O	-0.010 "H2O	0.740 "H2O	0.25 "H2O	Vérification indicateur
1.0000 "H2O	1.000 "H2O	0.989 "H2O	-0.011 "H2O	0.989 "H2O	0.25 "H2O	Vérification indicateur
0.0000 "H2O	0.0000 V.DC.	0.0003 V.DC.	+0.0003 V.DC.	0.0003 V.DC.	0.00 V.DC.	Vérification sortie analogique
0.2500 "H2O	2.5000 V.DC.	2.3571 V.DC.	-0.1429 V.DC.	2.3571 V.DC.	0.00 V.DC.	Vérification sortie analogique
0.5000 "H2O	5.0000 V.DC.	4.8491 V.DC.	-0.1509 V.DC.	4.8491 V.DC.	0.00 V.DC.	Vérification sortie analogique
0.7500 "H2O	7.5000 V.DC.	7.4099 V.DC.	-0.0901 V.DC.	7.4099 V.DC.	0.00 V.DC.	Vérification sortie analogique
1.0000 "H2O	10.0000 V.DC.	9.8836 V.DC.	-0.1164 V.DC.	9.8836 V.DC.	0.00 V.DC.	Vérification sortie analogique
Conditions Environnementales:			Température: 18 °C	Humidité: 33 %RH		
Type d'Étalonnage:						





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-006 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette
	St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/-0.25"H2O
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Indicateur	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	MS-321-LCD	Type de mesure:	Pression
No. Série:	E47U020014	Gamme:	0-0.5"H2O
Emplacement:	N.A.	No. Machine:	N.A.

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabricant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	27 Février 2017
Date du prochain Étalonnage:	27 Février 2018
Date d'émission du certificat:	27 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien

2017-03-16





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-007 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/- 0.25"H2O
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Indicateur	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	MS-321-LCD	Type de mesure:	Pression
No. Série:	E23S020111/12	Gamme:	0-0.5"H2O
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Setra	No. du certificat d'étalonnage:	AC17021126
No. Série:	2784759	Dernière date d'étalonnage:	17-Feb-17
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	17-Feb-18
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
0.0000 "H2O	0.0000 "H2O	0.0015 "H2O	+0.0015 "H2O	0.0015 "H2O	0.25 "H2O	Vérification indicateur
0.1500 "H2O	0.1500 "H2O	0.1484 "H2O	-0.0016 "H2O	0.1484 "H2O	0.25 "H2O	Vérification indicateur
0.2500 "H2O	0.2500 "H2O	0.2444 "H2O	-0.0056 "H2O	0.2444 "H2O	0.25 "H2O	Vérification indicateur
0.3500 "H2O	0.3500 "H2O	0.3528 "H2O	+0.0028 "H2O	0.3528 "H2O	0.25 "H2O	Vérification indicateur
0.5000 "H2O	0.5000 "H2O	0.5017 "H2O	+0.0017 "H2O	0.5017 "H2O	0.25 "H2O	Vérification indicateur
0.0000 "H2O	0.0000 V.DC.	0.0026 V.DC.	+0.0026 V.DC.	0.0026 V.DC.	0.01 V.DC.	Vérification sortie analogique
0.0250 "H2O	2.5000 V.DC.	2.8463 V.DC.	+0.3463 V.DC.	2.8463 V.DC.	0.01 V.DC.	Vérification sortie analogique
0.0500 "H2O	5.0000 V.DC.	5.2385 V.DC.	+0.2385 V.DC.	5.2385 V.DC.	0.01 V.DC.	Vérification sortie analogique
0.0750 "H2O	7.5000 V.DC.	7.5625 V.DC.	+0.0625 V.DC.	7.5625 V.DC.	0.01 V.DC.	Vérification sortie analogique
0.1000 "H2O	10.0000 V.DC.	9.9601 V.DC.	-0.0399 V.DC.	9.9601 V.DC.	0.01 V.DC.	Vérification sortie analogique
Conditions Environnementales:			Température: 18 °C	Humidité: 33 %RH		
Type d'Étalonnage:						





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-007 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette
	St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/- 0.25"H2O
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Indicateur	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	MS-321-LCD	Type de mesure:	Pression
No. Série:	E23S020111/12	Gamme:	0-0.5"H2O
Emplacement:	N.A.	No. Machine:	N.A.

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabriquant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraceable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	27 Février 2017
Date du prochain Étalonnage:	27 Février 2018
Date d'émission du certificat:	27 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-047 28/02/17

CLIENT		SPÉCIFICATION DE CALIBRATION	
Compagnie:	Services Polytests Inc	Procédure de service:	4IN9101
Adresse:	695 B rue Gaudette	Précision requise:	+/-2°C
	St-Jean-sur-Richelieu, Québec, J3B 7S7	Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Keithley	Type de sortie:	Digitale
No. Model:	2700	Type de mesure:	Température
No. Série:	1217093	Gamme:	Divers
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
Voir Commentaire						
Conditions Environnementales: Température: 18 °C Humidité: 32 %RH						
Type d'Étalonnage: Data Acquisition system Conforme Carte1: EM-154 Carte2: EM-015						

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabricant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	28 Février 2017
Date du prochain Étalonnage:	28 Février 2018
Date d'émission du certificat:	28 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien

*2017-03-16*



## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	152-4BB901-181
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	09-01-2018

**Technicien:**  
Simeonidis, Georgios



David Llorens, Responsable Qualité

## DESCRIPTION DU SERVICE:

<b>Description des masses :</b>	ASTM E617	<b>Date d'approbation :</b>	09-01-2018
<b>Classe de précision :</b>	ASTM 6	<b>Date prochain étalonnage :</b>	09-01-2023
<b>Densité :</b>	7.95g/cm <sup>3</sup>	<b>Accréditation CCN n. :</b>	668
<b>Identification (si unique) :</b>	EM-090	<b>Certification CLAS n. :</b>	2010-01

<b>Condition d'essai :</b>	<b>Temp °C:</b> 21.17	<b>Pression kPa:</b> 101.475	<b>Humidité:</b> 48.665
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## NOTES:

Pour l'étalonnage des masses, nous utilisons la procédure "Comparaison individuelle" PDL-09-MG-001 et la procédure "Détermination des incertitudes" PDL-09-MG-002. Le droit d'auteur du présent certificat appartient au laboratoire délivreur et doit être reproduit intégralement, à moins d'une autorisation écrite du laboratoire délivreur.

## REMARQUES:



11 JANV. 2018

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## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

### BALANCES UTILISÉES

Pour l'étalonnage manuel :

> 5 kg à 25 kg :	Mettler Toledo XP32003L, SNR 1123271214, max. 32100 g, d = 0.005 g
> 1 kg à 5 kg	Mettler Toledo PR5003, SNR 1115311634, max. 5100 g, d = 0.001 g
> 300 g à 2 kg :	Mettler Toledo XP2004S, SNR B131185222, max. 2100 g, d = 0.1 mg
> 100 g à 200 g :	Mettler Toledo AT201 SNR BA1115230146, max. 205 g, d = 0.01 mg
> 5 g à 100 g :	Mettler Toledo AX106 SNR 1127063924, max. 111 g, d = 1 µg
1 mg à 5 g :	Mettler UMX5, SNR 1121103055, max. 5.1 g, d = 0.1 µg

Pour l'étalonnage automatisé :

> 200 g à 1 kg :	Mettler Toledo AX1005 SNR 1127063210, max. 1109 g, d = 0.01 mg
> 5 g à 100 g :	Mettler Toledo AX106 SNR 1120143015, max. 111 g, d = 1 µg
1 mg à 5 g :	Mettler UMX5, SNR 1125140561, max. 5.1 g, d = 0.1 µg

Les balances sont vérifiées selon notre procédure de contrôle périodique PDL-11-MG-001.

### INCERTITUDES:

Les incertitudes que nous retrouvons comprennent :

1. L'incertitude associée à l'opération de pesage.
2. L'incertitude associée à la densité de l'air.
3. L'incertitude associée à l'étalon utilisé.
4. L'incertitude associée à la densité de la masse à être étalonnée.

L'incertitude de l'opération de pesage comprend la reproductibilité à long terme.

Les incertitudes précisées dans ce rapport sont des incertitudes élargies représentant un niveau de confiance d'approximativement 95 %, obtenu en multipliant ensemble l'incertitude-type composée par un facteur de couverture de  $k = 2$ . Pour de plus amples renseignements, veuillez consulter la publication GUM (Guide pour l'expression de l'incertitude de mesure, édition de 1995).

### TRAÇABILITÉ

Le Service d'évaluation de laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et a certifié des capacités d'étalonnage spécifiques de ce laboratoire et leur traçabilité à des étalons nationaux de mesure reconnus et au Système international d'unités (SI). Ce certificat d'étalonnage est émis conformément aux conditions de certification accordées par CLAS et aux conditions d'accréditation accordées par le Conseil canadien des normes (CCN). Le CLAS pas plus que le CCN ne peut garantir l'exactitude des étalonnages individuels effectués par des laboratoires accrédités.

D.P.



## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

### RÉFÉRENCES UTILISÉES

Poids	No de série	Fabricant	Date d'étalonnage	Date due
20kg	69976	Troemner	30-05-2017	30-05-2018
5kg	129099	Mettler Toledo	02-09-2017	02-09-2018
5kg	96-0888-50-3	Denver Instrument Company	02-09-2017	02-09-2018
2kg	129098	Mettler Toledo	02-09-2017	02-09-2018
2kg	96-0888-50-3	Denver Instrument Company	02-09-2017	02-09-2018
300g	96-0888-50-2	Denver Instrument Company	02-09-2017	02-09-2018
1kg - 1mg	MT-01	Mettler Toledo	02-09-2017	02-09-2018

### ÉTALONS CERTIFIÉS PAR LE CNRC( Référence NRC MS-2016-0021)

Poids	No de série	Fabricant	Date d'étalonnage	Date due
100g	95170	Mettler Toledo	17-10-2016	17-10-2018
10kg	129100	Mettler Toledo	17-10-2016	17-10-2018
1kg	95171	Mettler Toledo	17-10-2016	17-10-2018

### RÉFÉRENCES DE LA STATION ROBOTISÉE

Poids	No de série	Fabricant	Date d'étalonnage	Date due
1kg - 1mg	DK000A132	Laboratoire Dispersion	01-08-2017	01-08-2018

DP



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-126 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/- 1"Hg
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Manomètre	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	DPG200	Type de mesure:	Pression
No. Série:	N.A.	Gamme:	0-28"Hg
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Crystal XP2i 300	No. du certificat d'étalonnage:	AC16061306
No. Série:	866756	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
0.00 "Hg	0.00 "Hg	0.00 "Hg	0.00 "Hg	0.00 "Hg	1 "Hg	Vérification indicateur
-7.50 "Hg	-7.50 "Hg	-7.61 "Hg	-0.11 "Hg	-7.61 "Hg	1 "Hg	Vérification indicateur
-15.00 "Hg	-15.00 "Hg	-15.23 "Hg	-0.23 "Hg	-15.23 "Hg	1 "Hg	Vérification indicateur
-22.50 "Hg	-22.50 "Hg	-22.84 "Hg	-0.34 "Hg	-22.84 "Hg	1 "Hg	Vérification indicateur
-28.00 "Hg	-28.00 "Hg	-28.44 "Hg	-0.44 "Hg	-28.44 "Hg	1 "Hg	Vérification indicateur
0.00 "Hg	10.0000 V.DC.	10.0600 V.DC.	+0.0600 V.DC.	10.0600 V.DC.	0.01 V.DC.	Vérification sortie analogique
-7.50 "Hg	8.0000 V.DC.	8.0461 V.DC.	+0.0461 V.DC.	8.0461 V.DC.	0.01 V.DC.	Vérification sortie analogique
-15.00 "Hg	6.0000 V.DC.	6.0117 V.DC.	+0.0117 V.DC.	6.0117 V.DC.	0.01 V.DC.	Vérification sortie analogique
-22.50 "Hg	4.0000 V.DC.	3.9727 V.DC.	-0.0273 V.DC.	3.9727 V.DC.	0.01 V.DC.	Vérification sortie analogique
-28.00 "Hg	2.5333 V.DC.	2.4605 V.DC.	-0.0728 V.DC.	2.4605 V.DC.	0.01 V.DC.	Vérification sortie analogique
Conditions Environnementales:			Température: 18 °C	Humidité: 33 %RH		
Type d'Étalonnage:						

*[Signature]*  
2017-03-16





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-126 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/- 1"Hg
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Manomètre	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	DPG200	Type de mesure:	Pression
No. Série:	N.A.	Gamme:	0-28"Hg
Emplacement:	N.A.	No. Machine:	N.A.

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabriquant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	27 Février 2017
Date du prochain Étalonnage:	27 Février 2018
Date d'émission du certificat:	27 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-127 27/02/17

CLIENT		SPÉCIFICATION DE CALIBRATION	
Compagnie:	Services Polytests Inc	Procédure de service:	4IN9106
Adresse:	695 B rue Gaudette	Précision requise:	+/- 1"Hg
	St-Jean-sur-Richelieu, Québec, J3B 7S7	Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Manomètre	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	DPG200	Type de mesure:	Pression
No. Série:	N.A.	Gamme:	0-28"Hg
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Crystal XP2i 300	No. du certificat d'étalonnage:	AC16061306
No. Série:	866756	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
0.00 "Hg	0.00 "Hg	0.00 "Hg	0.00 "Hg	0.00 "Hg	1 "Hg	Vérification indicateur
-7.50 "Hg	-7.50 "Hg	-7.53 "Hg	-0.03 "Hg	-7.53 "Hg	1 "Hg	Vérification indicateur
-15.00 "Hg	-15.00 "Hg	-15.03 "Hg	-0.03 "Hg	-15.03 "Hg	1 "Hg	Vérification indicateur
-22.50 "Hg	-22.50 "Hg	-22.56 "Hg	-0.06 "Hg	-22.56 "Hg	1 "Hg	Vérification indicateur
-28.00 "Hg	-28.00 "Hg	-28.08 "Hg	-0.08 "Hg	-28.08 "Hg	1 "Hg	Vérification indicateur
0.00 "Hg	10.0000 V.DC.	10.0101 V.DC.	+0.0101 V.DC.	10.0101 V.DC.	0.01 V.DC.	Vérification sortie analogique
-7.50 "Hg	8.0000 V.DC.	8.0232 V.DC.	+0.0232 V.DC.	8.0232 V.DC.	0.01 V.DC.	Vérification sortie analogique
-15.00 "Hg	6.0000 V.DC.	6.0216 V.DC.	+0.0216 V.DC.	6.0216 V.DC.	0.01 V.DC.	Vérification sortie analogique
-22.50 "Hg	4.0000 V.DC.	4.0059 V.DC.	+0.0059 V.DC.	4.0059 V.DC.	0.01 V.DC.	Vérification sortie analogique
-28.00 "Hg	2.5333 V.DC.	2.5208 V.DC.	-0.0125 V.DC.	2.5208 V.DC.	0.01 V.DC.	Vérification sortie analogique
Conditions Environnementales:			Température: 18 °C	Humidité: 33 %RH		
Type d'Étalonnage:						

*[Signature]*  
2017-03-16





Instrumentation  
**Saint-Laurent** inc.  
Accrédité ISO 17025



80 rue de la montagne  
St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
Fax: (450) 473-5207  
Email: inst.st-laurent@videotron.ca

## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-127 27/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette
	St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9106
Précision requise:	+/- 1"Hg
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Manomètre	Type d'entrée:	Pression
Manufacturier:	Dwyer	Type de sortie:	Digitale
No. Model:	DPG200	Type de mesure:	Pression
No. Série:	N.A.	Gamme:	0-28"Hg
Emplacement:	N.A.	No. Machine:	N.A.

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabricant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	27 Février 2017
Date du prochain Étalonnage:	27 Février 2018
Date d'émission du certificat:	27 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien

## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	152-4BB901-182
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	09-01-2018

**Technicien:**  
Simeonidis, Georgios



David Llorens, Responsable Qualité


### DESCRIPTION DU SERVICE:

<b>Description des masses :</b>	ASTM E617	<b>Date d'approbation :</b>	09-01-2018
<b>Classe de précision :</b>	ASTM 1	<b>Date prochain étalonnage :</b>	09-01-2023
<b>Densité :</b>	7.95g/cm <sup>3</sup>	<b>Accréditation CCN n. :</b>	668
<b>Identification (si unique) :</b>	(items multiples)	<b>Certification CLAS n. :</b>	2010-01
<b>Condition d'essai :</b>	Temp °C: 21.265	Pression kPa: 101.565	Humidité: 49.58

### NOTES:

Pour l'étalonnage des masses, nous utilisons la procédure "Comparaison individuelle" PDL-09-MG-001 et la procédure "Détermination des incertitudes" PDL-09-MG-002. Le droit d'auteur du présent certificat appartient au laboratoire délivreur et doit être reproduit intégralement, à moins d'une autorisation écrite du laboratoire délivreur.

### REMARQUES:

  
11 JANV. 2018  
page 1 de 5









## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

### BALANCES UTILISÉES

Pour l'étalonnage manuel :

> 5 kg à 25 kg :	Mettler Toledo XP32003L, SNR 1123271214, max. 32100 g, d = 0.005 g
> 1 kg à 5 kg	Mettler Toledo PR5003, SNR 1115311634, max. 5100 g, d = 0.001 g
> 300 g à 2 kg :	Mettler Toledo XP2004S, SNR B131185222, max. 2100 g, d = 0.1 mg
> 100 g à 200 g :	Mettler Toledo AT201 SNR BA1115230146, max. 205 g, d = 0.01 mg
> 5 g à 100 g :	Mettler Toledo AX106 SNR 1127063924, max. 111 g, d = 1 µg
1 mg à 5 g :	Mettler UMX5, SNR 1121103055, max. 5.1 g, d = 0.1 µg

Pour l'étalonnage automatisé :

> 200 g à 1 kg :	Mettler Toledo AX1005 SNR 1127063210, max. 1109 g, d = 0.01 mg
> 5 g à 100 g :	Mettler Toledo AX106 SNR 1120143015, max. 111 g, d = 1 µg
1 mg à 5 g :	Mettler UMX5, SNR 1125140561, max. 5.1 g, d = 0.1 µg

Les balances sont vérifiées selon notre procédure de contrôle périodique PDL-11-MG-001.

### INCERTITUDES:

Les incertitudes que nous retrouvons comprennent :

1. L'incertitude associée à l'opération de pesage.
2. L'incertitude associée à la densité de l'air.
3. L'incertitude associée à l'étalon utilisé.
4. L'incertitude associée à la densité de la masse à être étalonnée.

L'incertitude de l'opération de pesage comprend la reproductibilité à long terme.

Les incertitudes précisées dans ce rapport sont des incertitudes élargies représentant un niveau de confiance d'approximativement 95 %, obtenu en multipliant ensemble l'incertitude-type composée par un facteur de couverture de  $k = 2$ . Pour de plus amples renseignements, veuillez consulter la publication GUM (Guide pour l'expression de l'incertitude de mesure, édition de 1995).

### TRAÇABILITÉ

Le Service d'évaluation de laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et a certifié des capacités d'étalonnage spécifiques de ce laboratoire et leur traçabilité à des étalons nationaux de mesure reconnus et au Système international d'unités (SI). Ce certificat d'étalonnage est émis conformément aux conditions de certification accordées par CLAS et aux conditions d'accréditation accordées par le Conseil canadien des normes (CCN). Le CLAS pas plus que le CCN ne peut garantir l'exactitude des étalonnages individuels effectués par des laboratoires accrédités.



## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

### RÉFÉRENCES UTILISÉES

Poids	No de série	Fabricant	Date d'étalonnage	Date due
20kg	69976	Troemner	30-05-2017	30-05-2018
5kg	129099	Mettler Toledo	02-09-2017	02-09-2018
5kg	96-0888-50-3	Denver Instrument Company	02-09-2017	02-09-2018
2kg	129098	Mettler Toledo	02-09-2017	02-09-2018
2kg	96-0888-50-3	Denver Instrument Company	02-09-2017	02-09-2018
300g	96-0888-50-2	Denver Instrument Company	02-09-2017	02-09-2018
1kg - 1mg	MT-01	Mettler Toledo	02-09-2017	02-09-2018

### ÉTALONS CERTIFIÉS PAR LE CNRC( Référence NRC MS-2016-0021)

Poids	No de série	Fabricant	Date d'étalonnage	Date due
100g	95170	Mettler Toledo	17-10-2016	17-10-2018
10kg	129100	Mettler Toledo	17-10-2016	17-10-2018
1kg	95171	Mettler Toledo	17-10-2016	17-10-2018

### RÉFÉRENCES DE LA STATION ROBOTISÉE

Poids	No de série	Fabricant	Date d'étalonnage	Date due
1kg - 1mg	DK000A132	Laboratoire Dispersion	01-08-2017	01-08-2018





## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	142-439505-171-2130
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	18-05-2017

**Technicien:**

Gatto, Angelo



David Llorens, Responsable Qualité

### DESCRIPTION DU SERVICE:

<b>Modèle de Balance :</b>	PA214	<b>Méthode :</b>	ISO 17025
<b>Manufacturier :</b>	Ohaus	<b>Date d'approbation :</b>	23-05-2017
<b>Numéro de Série :</b>	8331230529	<b>Date prochain étalonnage :</b>	23-05-2018
<b>Numéro d'identification :</b>		<b>accréditation CCN n. :</b>	668
<b>Capacité :</b>	210g	<b>Certification CLAS n. :</b>	2010-01
<b>Résolution:</b>	0.0001g		

<b>Condition d'essai :</b>	Temp °C:	15.6	Pression kPa:	101	Humidité %:	45.6
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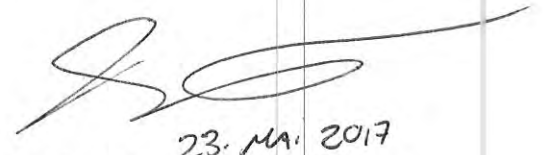
Note: Les conditions environnementales ne sont pas utilisées dans le calcul de l'incertitude.

### CETTE BALANCE RENCONTRE LES SPÉCIFICATIONS SUIVANTES:

Type de test :	Manufacturier
Excentricité:	<input checked="" type="checkbox"/> Oui <input type="checkbox"/> Non
Linéarité:	<input checked="" type="checkbox"/> Oui <input type="checkbox"/> Non
Sensibilité:	<input checked="" type="checkbox"/> Oui <input type="checkbox"/> Non
Répétabilité:	<input checked="" type="checkbox"/> Oui <input type="checkbox"/> Non

**NOTES:**

Cette balance a été certifiée selon la procédure de travail PDL-09-MG-010 (certification de balance analytique et à plateau) et la et la procédure PDL-09-MG-012 (détermination des incertitudes de pesées). Nos étalons sont certifiés à chaque année. Le droit d'auteur du présent certificat appartient au laboratoire délivreur et doit être reproduit intégralement, à moins d'une autorisation écrite du laboratoire délivreur.



23. MAI 2017

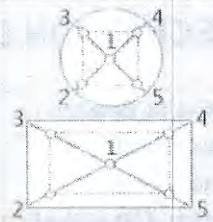
## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	142-439505-171-2130
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
		<b>Certification CLAS n. :</b>	2010-01
		<b>Modèle de Balance :</b>	PA214
<b>Méthode :</b>	ISO 17025	<b>Date d'étalonnage :</b>	18-05-2017
		<b>Date du prochain étalonnage :</b>	23-05-2018

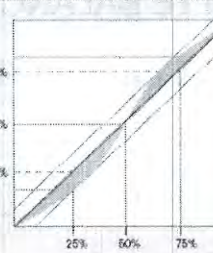
### TEST D'EXCENTRICITÉ:

Poids Test: 50 g Tolérance 0.0003 g  
(Note: Le Poids Test est taré au centre du plateau de pesée)

Position	Avant Ajustement	Après Ajustement	
1: Centre:	0.0000 g	---	
2: Avant Gauche:	0.0001 g	---	
3: Arrière Gauche:	-0.0001 g	---	
4: Arrière Droit:	0.0000 g	---	
5: Avant Droit:	-0.0003 g	---	
<b>Résultats</b>	<b>0.0003 g</b>	<b>---</b>	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	

### TEST DE LINÉARITÉ:

Méthode: Substitution Plage: 210 g Poids Test: 50 g Tolérance: 0.0002 g

Pré-Charge	Avant Ajustement	Après Ajustement	
0.0000 g	50.0000 g	---	
50.0000 g	50.0001 g	---	
100.0000 g	50.0002 g	---	
150.0000 g	50.0001 g	---	
---	---	---	
---	---	---	
---	---	---	
<b>Résultats</b>	<b>0.00010 g</b>	<b>---</b>	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	

### TEST DE SENSIBILITÉ:

Valeur de masse conventionnelle: 200.0001 g Tolérance: 0.0004 g

	Avant Ajustement	Après Ajustement	
Lecture:	199.9998 g	---	$S = \frac{\Delta W}{\Delta m}$
<b>Résultats:</b>	<b>0.0003 g</b>	<b>---</b>	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	



## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	142-439505-171-2130
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
		<b>Certification CLAS n. :</b>	2010-01
		<b>Modèle de Balance :</b>	PA214
<b>Méthode :</b>	ISO 17025	<b>Date d'étalonnage :</b>	18-05-2017
		<b>Date du prochain étalonnage :</b>	23-05-2018

### TEST DE RÉPÉTABILITÉ:

#### AVANT AJUSTEMENT:

Charge Utilisée:  
100.0000 g

Tolérance:  
0.00010 g

Résolution d'affichage:  
0.0001 g

Moyenne:  
100.00001 g

Écart-type:  
**0.00003 g**

#	Vide	Chargé	Différence
1	0.0000 g	100.0000 g	100.0000 g
2	0.0000 g	100.0000 g	100.0000 g
3	0.0000 g	100.0000 g	100.0000 g
4	0.0000 g	100.0000 g	100.0000 g
5	0.0000 g	100.0001 g	100.0001 g
6	0.0000 g	100.0000 g	100.0000 g
7	0.0000 g	100.0000 g	100.0000 g
8	0.0000 g	100.0000 g	100.0000 g
9	0.0000 g	100.0000 g	100.0000 g
10	0.0000 g	100.0000 g	100.0000 g

**Statut : CONFORME**

#### APRÈS AJUSTEMENT:

Charge Utilisée:  
---

Tolérance:  
0.00010 g

Résolution d'affichage:  
0.0001 g

Moyenne:  
---

Écart-type:  
---

#	Vide	Chargé	Différence
1	---	---	---
2	---	---	---
3	---	---	---
4	---	---	---
5	---	---	---
6	---	---	---
7	---	---	---
8	---	---	---
9	---	---	---
10	---	---	---

**Statut : N/A**



## CERTIFICAT D'ÉTALONNAGE

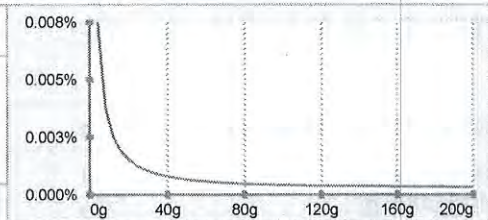
9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

### INCERTITUDE AVANT AJUSTEMENT :

$$U_c = \sqrt{(u_{(cr)})^2 + s_p^2 + u_{(l)}^2 + u_{(dr)}^2 + u_{(s)}^2}$$

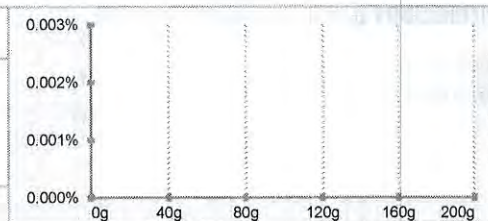
- $u_{(cr)}$  = Incertitude reliée à l'étalon utilisé
- $s_p$  = Incertitude de l'écart-type
- $u_{(l)}$  = Incertitude associée à la linéarité
- $u_{(dr)}$  = Incertitude associée à résolution si  $s_p = 0$
- $u_{(s)}$  = Incertitude liée à la sensibilité (span)

Valeur	Incetitude	Incetitude (%)
12.5000 g	0.00017 g	0.001329 %
25.0000 g	0.00018 g	0.000727 %
50.0000 g	0.00023 g	0.000468 %
100.0000 g	0.00038 g	0.000376 %
200.0000 g	0.00073 g	0.000364 %



### INCERTITUDE APRÈS AJUSTEMENT :

Valeur	Incetitude	Incetitude (%)
---	---	---
---	---	---
---	---	---
---	---	---



### NOTES :

De ces valeurs d'incertitudes, seule la valeur surlignée est calculée selon ISO17025:2005, les autres étant estimées jusqu'au résultat de l'incertitude minimale. Dans le calcul de cette l'incertitude, l'écart-type utilisé est de 0,577d (où d est la précision d'affichage de la balance) lorsque cet écart-type est plus inférieure à 0,577d.

## CERTIFICAT D'ÉTALONNAGE

9900 Chemin de la Côte-de-Liesse, Lachine, QC H8T 1A1  
www.dispersion.ca 1.866.390.5066

### RÉFÉRENCE

#### ENSEMBLE DE RÉFÉRENCE:

Référence	No de série	Fabricant	Date d'étalonnage
1mg-5kg	DK000A175	Dispersion	23-08-2016

### INCERTITUDES:

Les incertitudes que nous retrouvons comprennent :

1. *L'incertitude associée à l'opération de pesage.*
2. *L'incertitude associée à l'écart-type.*
3. *L'incertitude associée à l'étalon utilisé.*
4. *L'incertitude associée à la résolution de l'appareil.*

L'incertitude de l'opération de pesage comprend la reproductibilité à long terme.

Les incertitudes précisées dans ce rapport sont des incertitudes élargies représentant un niveau de confiance d'approximativement 95 %, obtenu en multipliant ensemble l'incertitude-type composée par un facteur de couverture de  $k = 2$ . Pour de plus amples renseignements, veuillez consulter la publication GUM (Guide pour l'expression de l'incertitude de mesure, édition de 1995).

### TRAÇABILITÉ

Le Service d'évaluation de laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et a certifié des capacités d'étalonnage spécifiques de ce laboratoire et leur traçabilité à des étalons nationaux de mesure reconnus et au Système international d'unités (SI). Ce certificat d'étalonnage est émis conformément aux conditions de certification accordées par CLAS et aux conditions d'accréditation accordées par le Conseil canadien des normes (CCN). Le CLAS pas plus que le CCN ne peut garantir l'exactitude des étalonnages individuels effectués par des laboratoires accrédités.

### REMARQUES:

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**Instrumentation  
Saint-Laurent** inc.  
Accrédité ISO 17025



80 rue de la montagne  
St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
Fax: (450) 473-5207  
Email: inst.st-laurent@videotron.ca

## CERTIFICAT D'ÉTALONNAGE

No. Certificat: CE-EM-015 28/02/17

CLIENT		SPÉCIFICATION DE CALIBRATION	
Compagnie:	Services Polytests Inc	Procédure de service:	4IN9101
Adresse:	695 B rue Gaudette	Précision requise:	+/- 2°C
	St-Jean-sur-Richelieu, Québec, J3B 7S7	Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Keithley	Type de sortie:	Digitale
No. Model:	7700	Type de mesure:	Température
No. Série:	1213648	Gamme:	Divers
Emplacement:	N/A	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
-190.0 °C	-190.0 °C	-190.7 °C	-0.7 °C	-190.7 °C	1.0 °C	Input#1TypeK
0.0 °C	0.0 °C	-0.3 °C	-0.3 °C	-0.3 °C	1.0 °C	Input#1TypeK
750.0 °C	750.0 °C	749.7 °C	-0.3 °C	749.7 °C	1.0 °C	Input#1TypeK
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#2 TypeK
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#3 TypeK
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#4 TypeK
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#5TypeK
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#6TypeK
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#7TypeK
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#8TypeK
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#9TypeK
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#10TypeJ
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#11TypeJ
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#12TypeJ
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#13 TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#14TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#15 TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#16TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#17TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#18TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#19TypeJ
100.0 °C	100.0 °C	99.9 °C	-0.1 °C	99.9 °C	1.0 °C	Input#20TypeJ
12.000 mA	12.000 mA	12.002 mA	+0.002 mA	12.002 mA	1.00 mA	Input#21
12.000 mA	12.000 mA	12.002 mA	+0.002 mA	12.002 mA	1.00 mA	Input#22
Conditions Environnementales:      Température: 18 °C      Humidité: 34 %RH						

5F09101





Instrumentation  
**Saint-Laurent**<sub>inc.</sub>  
Accrédité ISO 17025



80 rue de la montagne  
St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
Fax: (450) 473-5207  
Email: inst.st-laurent@videotron.ca

## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-015 28/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette
	St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9101
Précision requise:	+/- 2°C
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Keithley	Type de sortie:	Digitale
No. Model:	7700	Type de mesure:	Température
No. Série:	1213648	Gamme:	Divers
Emplacement:	N/A	No. Machine:	N.A.

Type d'Étalonnage: Test avec EM-047

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabricant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	28 Février 2017
Date du prochain Étalonnage:	28 Février 2018
Date d'émission du certificat:	28 Février 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien

*2017-03-16*

## CERTIFICAT D'ÉTALONNAGE # 7274

Date d'étalonnage : 2017-09-29  
Date d'émission du certificat : 2017-09-29

Services Polytests  
695 B Gaudette street  
St-Jean-sur-Richelieu, Québec, Canada  
J3B 7S7

Étalonnage d'un  
Débitmètre volumétrique American Meter Company DTM-200A S/N : 99A274209

### CONFORMITÉ AU PROGRAMME DE QUALITÉ

Tous les étalonnages sont effectués conformément au manuel d'assurance qualité de Polycontrols et sont conformes à la norme ISO/IEC 17025 – 2005, à la norme ISO 9001 – 2008 ainsi qu'à tout autre exigences de qualité définies dans la description d'achat des clients.

### TRAÇABILITÉ

La traçabilité des étalons de débit au National Institute of Standards and Technology, NIST, est maintenue par les laboratoires de Fluke Corporation de Phoenix, Arizona et est conforme aux normes ISO/IEC 17025, AINSI/NCSL Z540-1-1994, ISO-10012-1, MIL-STD 45662A.

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

### APTITUDE EN MATIÈRE DE MESURE ET D'ÉTALONNAGE - CMC

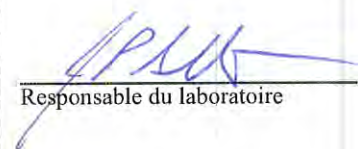
Les références utilisées pour l'étalonnage de débit ont une incertitude de  $\pm 0.2\%$  de la lecture pour les mesures entre 5 SCCM à 10 SLPM,  $\pm 0.3\%$  de la lecture pour les mesures entre 10 SLPM à 30 SLPM,  $\pm 0.2\%$  de la lecture pour les mesures entre 30 SLPM à 3000 SLPM,  $\pm 0.3\%$  de la lecture pour les mesures supérieures à 3000 SLPM jusqu'à 6000 SLPM et  $\pm 0.5\%$  pour les mesures inférieures à 5 SCCM jusqu'à concurrence de 1 SCCM, équivalent air ou azote. Les incertitudes exprimées sont élargies avec un facteur d'élargissement  $k = 2$ , et ce, pour un niveau de confiance d'environ 95 %, dans l'hypothèse d'une distribution normale incluant la résolution de l'instrument. Le rapport d'incertitude des essais (RIE) de cet étalonnage respecte un ratio de 4:1 à moins d'indication contraire.

### SOMMAIRE DES CONDITIONS DE L'INSTRUMENT EN TEST

Conditions initiales	En bon état
Travail Effectué	Étalonnage de l'instrument
	Lectures Initiales = Lectures finales, aucun ajustement
Résultats	Lectures finales dans les tolérances
Remarques	Fréquence d'étalonnage aux 12 mois



Métrologiste



Responsable du laboratoire



## Certificat d'étalonnage # 7274

Numero de série:	99A274209	Station de mesure:	3
Date d'étalonnage:	2017-09-29	Procédure:	POS-CAL-005
Identification de l'instrument:	EM-130		

## Instrument de mesure de référence utilisé pour l'étalonnage final

Description	Modèle	# Série	Traçabilité	Date dû
DHI molbloc (120 slpm)	2E2-S	237	1500210395	2017-12-28
DHI molbloc (30 slpm)	3E4-VCR-V-Q	3444	1500218603	2018-06-05
DHI molbox1	Molbox1	755	1500215634	2018-04-18
RTD Mist	M22	1871501	2017002165	2018-04-20
Module 44.5 PSI avec Baro 163671	Module 30	160659	2017002162	2018-04-26

## Spécifications finales de l'appareil

## Condition d'étalonnage

Spécifications finales de l'appareil		Condition d'étalonnage	
Gaz	Air	Gaz	Air
Température d'opération		Température ambiante	24 °C
Pression à l'entrée		Pression ambiante	1010.52 mbar
Pression à la sortie		Orientation	Verticale
Température de référence		Élastomère	Viton
Pression de référence		Valve	Viton
Étendue d'échelle	0-200 ACFH		
Signaux Entrée/Sortie	-		
Alimentation			
Tolérance	±1 %O.R.		

## Lectures finales

Débit du test ACFH	Instrument en test ft <sup>3</sup>	Valeurs mesurées			Référence calculée ft <sup>3</sup>	Erreur calculée ft <sup>3</sup>	Tolérance acceptable ft <sup>3</sup>	TUR
		Pression PSIA	Température °C	Référence ft <sup>3</sup>				
41.7507	6.920	14.671	23.16	6.879	6.939	-0.019	0.069	2.92
70.7794	11.810	14.765	22.18	11.805	11.793	0.017	0.118	3.99
160.2473	26.690	14.870	22.27	26.906	26.697	-0.007	0.267	>4

Fact. cor : 1,00274566

*[Signature]*  
3 oct 2017

*[Signature]*  
Signature

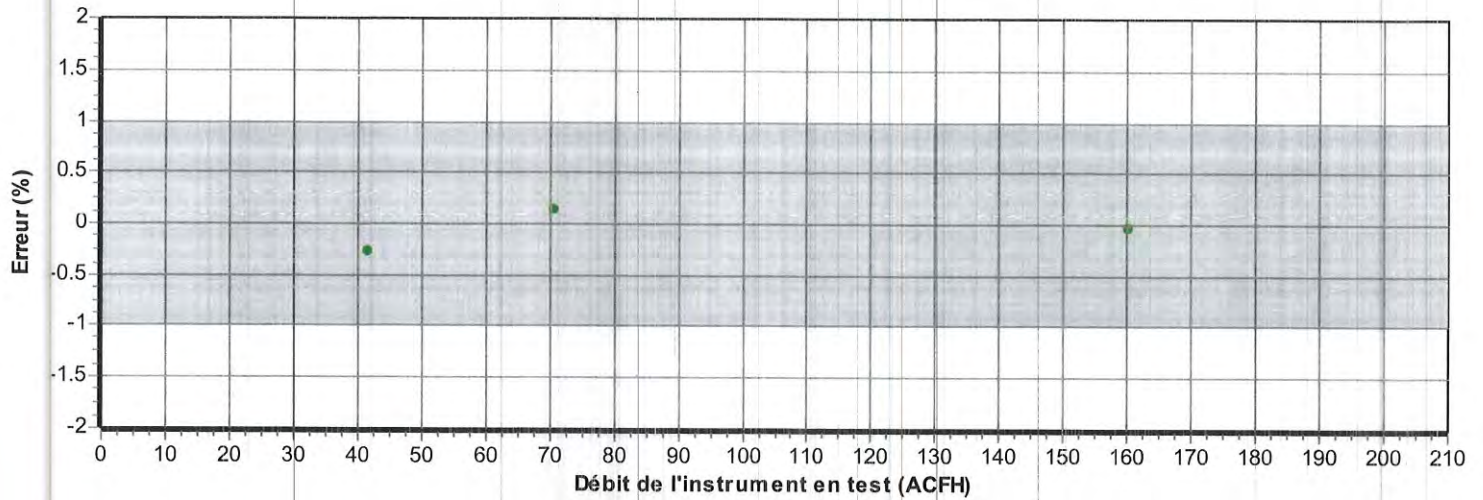
Bernard Poirier  
Métrologiste



## Certificat d'étalonnage # 7274

Numero de série:	99A274209	Station de mesure:	3
Date d'étalonnage:	2017-09-29	Procédure:	POS-CAL-005
Identification de l'instrument:	EM-130		

## Résultats finaux



- La mesure (et son incertitude) se situe dans les tolérances
- La mesure (et son incertitude) se situe hors tolérance
- La mesure (et son incertitude) ne rencontre pas la marge de sécurité tel que spécifié dans le document G-8 de l'ILAC

*[Handwritten signature]*  
3 oct 2017

*[Handwritten signature: B Poirier]*  
Signature

Bernard Poirier  
Métrologue



Instrumentation  
**Saint-Laurent** inc.  
Accrédité ISO 17025



80 rue de la montagne  
St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
Fax: (450) 473-5207  
Email: inst.st-laurent@videotron.ca

## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-136 01/03/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette
	St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	ISL-004
Précision requise:	+/-2°C +/-3%RH
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Hygromètre	Type d'entrée:	Temp/%RH
Manufacturier:	Fluke	Type de sortie:	Digitale
No. Model:	971	Type de mesure:	Temp/humidité
No. Série:	10610850	Gamme:	5-95%RH -20a60°C
Emplacement:	N.A.	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Vaisala Portable 1	No. du certificat d'étalonnage:	AC16071314
No. Série:	U4840010/U4920031	Dernière date d'étalonnage:	21-Jul-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	21-Jul-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
25.0 °C	25.0 °C	25.2 °C	+0.2 °C	25.2 °C	1.0 °C	
40.0 °C	40.0 °C	40.2 °C	+0.2 °C	40.2 °C	1.0 °C	
33.0 %RH	33.0 %RH	32.9 %RH	-0.1 %RH	32.9 %RH	3.0 %RH	
50.0 %RH	50.0 %RH	50.6 %RH	+0.6 %RH	50.6 %RH	3.0 %RH	
80.0 %RH	80.0 %RH	80.9 %RH	+0.9 %RH	80.9 %RH	3.0 %RH	
Conditions Environnementales: Température: 22 °C Humidité: 35 %RH						
Type d'Étalonnage:						

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabricant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT	
Date d'Étalonnage:	1 Mars 2017
Date du prochain Étalonnage:	1 Mars 2018
Date d'émission du certificat:	1 Mars 2017

CONFORMITÉ D'ÉTALONNAGE		
	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien

2017-03-16



# CERTIFICATE OF NIST TRACEABLE CALIBRATION

## Calibration Certificate No: 63484

### Customer Information

Customer: Services Polytests, Inc.

Address : 695-B Gaudette  
St-Jean-sur-richelieu  
J3B 7S7

Customer PO #: 100431



**LABORATORY ACCREDITATION BUREAU**  
a division of A-S-B  
**ACCREDITED** ISO/IEC 17025  
Certificate # L2115-1 Calibration

### Calibration Procedure Information

Procedure ID: GTP AIRVEL

Revision #: 6

Revision Date: 1/6/2013

### Calibration Standards Information

<u>Graffel ID</u>	<u>Manufacturer</u>	<u>Model #</u>	<u>Description</u>	<u>CAL Due</u>
10017	Hart Scientific/Burns	1502A/3925	Thermometer	2/18/2018
10086	Furness Controls	FC0332	DP Transmitter	6/6/2018
10100	Graffel	n/a	Temperature	10/29/2019
10155	HOBO	UX100-011	RH/Temp logger	11/15/2017
10171	Furness	FC0332-2W	0 - .4" H2O	11/10/2017
10187	Vaisala	PTB210	Barometric Pressure Gauge	12/6/2017

### Sensor Information

Manufacturer: Omega

Description: Anemometer

Method Used: Pitot Tube

Model #: HHF143

Rated Accuracy:  $\pm$  See Attachment

Accuracy Specified By: Omega

Instrument ID#: EM153

Range: 40 to 7800 fpm

Condition: Functional

Serial #: 1015949

Comments: Calibration Date: 08/22/2017 \*Limited calibration up to 5000 fpm  
Calibration Due: 08/22/2018

*The instruments(s) listed on this certificate have been calibrated against standards traceable to the National Institute of Standards & Technology (NIST) or compared to nationally or internationally recognized consensus standards. The reported calibration uncertainty has a confidence level of 95% ( $k=2$ ). A calibration uncertainty ratio of 4:1 was maintained unless required uncertainty is supported by analysis. Graffel, LLC. Quality Assurance System complies with applicable requirements of ISO/IEC-17025-2005, ANSI/NCCL Z540-1-1994 and ISO 9001: 2008. All results contained within this certificate relate only to item(s) calibrated. This certificate shall not be reproduced except in full and with the written consent of Graffel, LLC. Acceptance Criteria per Simple Acceptance Rule: Measurement Uncertainty is not applied to the measured value when in/out of tolerance statement is made.*

Performed By:

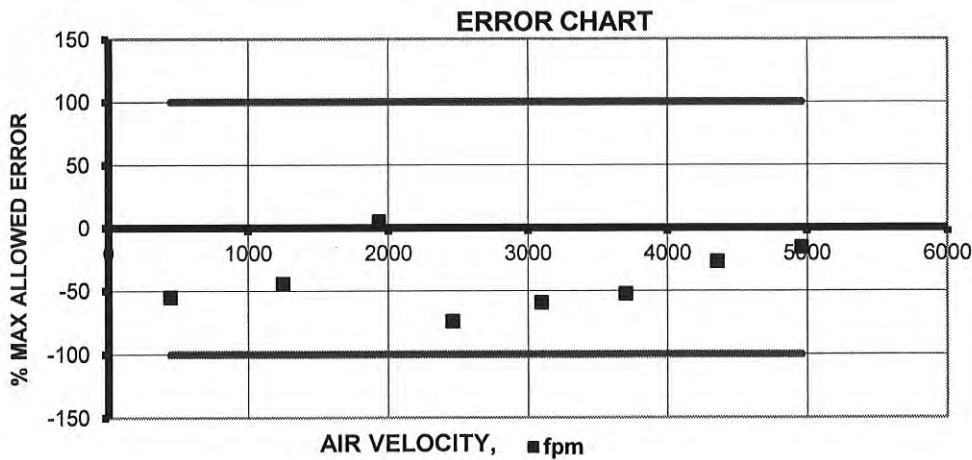
D. Paras  
Calibration Technician

Date: 8/22/2017



**ATTACHMENT TO CALIBRATION CERTIFICATE 63484  
AS FOUND/AS LEFT DATA  
Page 2 of 2**

Reading From Standard,	Lower Limit of Meter Reading,	Measured Reading From Meter,	Upper Limit of Meter Reading,	Error,	Measurement Uncertainty,	STATUS
<b>Actual Air Velocity</b>						
fpm	fpm	fpm	fpm	fpm	fpm	
446	441	443	451	-3	2.23	<b>Pass</b>
1249	1236	1243	1262	-6	6.25	<b>Pass</b>
1932	1912	1933	1952	1	9.66	<b>Pass</b>
2459	2433	2440	2485	-19	12.30	<b>Pass</b>
3096	3064	3077	3128	-19	15.48	<b>Pass</b>
3701	3663	3681	3739	-20	18.51	<b>Pass</b>
4361	4316	4349	4406	-12	21.81	<b>Pass</b>
4960	4909	4952	5011	-8	24.8	<b>Pass</b>



INSTRUMENT SPECIFICATIONS		
Test Fluid	Air	
Lower Range	40	fpm
Upper Range	7800	fpm
Rated Accuracy	+/- 1% reading +/-1 digit	
LABORATORY AMBIENT CONDITIONS		
Pressure	14.42	psia
Humidity	51.10	% RH
Temperature	78.65	F



Flow - Humidity - Temperature - Pressure - Design - Consulting - Engineering

**NIST Traceable Calibration Data Sheet**

Graftel, LLC. 870 Cambridge Drive, Elk Grove Village, IL 60007  
P. 847-364-2600 F. 847-364-2899

www.graftel.com

*[Signature]*  
sept 5<sup>th</sup> 2017





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-154 28/02/17

CLIENT		SPÉCIFICATION DE CALIBRATION	
Compagnie:	Services Polytests Inc	Procédure de service:	4IN9101
Adresse:	695 B rue Gaudette	Précision requise:	+/- 2°C
	St-Jean-sur-Richelieu, Québec, J3B 7S7	Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Keithley	Type de sortie:	Digitale
No. Model:	7700	Type de mesure:	Température
No. Série:	1306774	Gamme:	Divers
Emplacement:	N/A	No. Machine:	N.A.

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC16061306
No. Série:	7798010	Dernière date d'étalonnage:	27-Jun-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	27-Jun-17
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
-17.000 mV	-17.000 mV	-16.948 mV	+0.052 mV	-16.948 mV	0.1 mV	Input#1
0.000 mV	0.000 mV	0.038 mV	+0.038 mV	0.038 mV	0.1 mV	Input#1
20.000 mV	20.000 mV	20.030 mV	+0.030 mV	20.030 mV	0.1 mV	Input#1
30.000 mV	30.000 mV	30.068 mV	+0.068 mV	30.068 mV	0.1 mV	Input#2
Input#3 Non-Conforme						
100.0 °C	100.0 °C	99.5 °C	-0.5 °C	99.5 °C	1.0 °C	Input#4 TypeJ
30.000 mV	30.000 mV	29.518 mV	-0.452 mV	29.518 mV	0.1 mV	Input#5
30.000 mV	30.000 mV	29.574 mV	-0.426 mV	29.574 mV	0.1 mV	Input#6
100.0 Ohms	100.0 Ohms	100.0 Ohms	0.0 Ohms	100.0 Ohms	1.0 Ohms	Input#7
100.0 Ohms	100.0 Ohms	100.0 Ohms	0.0 Ohms	100.0 Ohms	1.0 Ohms	Input#8
100.0 Ohms	100.0 Ohms	99.9 Ohms	-0.1 Ohms	99.9 Ohms	1.0 Ohms	Input#9
100.0 Ohms	100.0 Ohms	99.9 Ohms	-0.1 Ohms	99.9 Ohms	1.0 Ohms	Input#10
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#11 TypeT
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#12 TypeT
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#13 TypeJ
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#14 TypeJ
100.0 °C	100.0 °C	99.7 °C	-0.3 °C	99.7 °C	1.0 °C	Input#15 TypeJ
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#16 TypeJ
100.0 Ohms	100.0 Ohms	100.2 Ohms	+0.2 Ohms	100.2 Ohms	1.0 Ohms	Input#17
100.0 Ohms	100.0 Ohms	100.1 Ohms	+0.1 Ohms	100.1 Ohms	1.0 Ohms	Input#18
100.0 Ohms	100.0 Ohms	100.2 Ohms	+0.2 Ohms	100.2 Ohms	1.0 Ohms	Input#19
100.0 Ohms	100.0 Ohms	100.1 Ohms	+0.1 Ohms	100.1 Ohms	1.0 Ohms	Input#20
12.000 mA	12.000 mA	12.002 mA	+0.002 mA	12.002 mA	1.00 mA	Input#21
12.000 mA	12.000 mA	12.002 mA	+0.002 mA	12.002 mA	1.00 mA	Input#22
Conditions Environnementales:      Température: 18 °C      Humidité: 33 %RH						





Instrumentation  
**Saint-Laurent**.inc.  
Accrédité ISO 17025



80 rue de la montagne  
St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
Fax: (450) 473-5207  
Email: inst.st-laurent@videotron.ca

## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-154 28/02/17

CLIENT	
Compagnie:	Services Polytests Inc
Adresse:	695 B rue Gaudette St-Jean-sur-Richelieu, Québec, J3B 7S7

SPÉCIFICATION DE CALIBRATION	
Procédure de service:	4IN9101
Précision requise:	+/- 2°C
Fréquence d'étalonnage: (jours)	365

SPÉCIFICATION DE L'INSTRUMENT			
Type d'instrument:	Enregistreur	Type d'entrée:	Temp
Manufacturier:	Keithley	Type de sortie:	Digitale
No. Model:	7700	Type de mesure:	Température
No. Série:	1306774	Gamme:	Divers
Emplacement:	N/A	No. Machine:	N.A.
Type d'Étalonnage:	Test avec EM-047		

Instrumentation St-Laurent Inc. Certifie que l'instrument ci-haut, rencontre ou excède les spécifications établies par le fabriquant. Le système qualité de l'entreprise est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour effectuer l'étalonnage est retraçable au CNRC et/ou au NIST. Le degré d'incertitude est basé sur un niveau de confiance=95%, K=2.

### DATE D'ÉTALONNAGE / ÉMISSION DU CERTIFICAT

Date d'Étalonnage:	28 Février 2017
Date du prochain Étalonnage:	28 Février 2018
Date d'émission du certificat:	28 Février 2017

### CONFORMITÉ D'ÉTALONNAGE

	Avant	Après
Conforme:	X	X
Non Conforme:		

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Numéro d'accréditation du CCN: # 669. Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

Stéphane - Technicien





# Certificat d'Étalonnage / Certificate of Calibration

**CLIENT :**  
 SERVICES POLYTESTS INC.  
 695-B GAUDETTE  
 ST-JEAN-SUR-RICHELIEU, QUEBEC

**Description:** CHRONOMÈTRE / STOPWATCH TIMER  
**Fabricant/ Manufacturer:** EXTECH  
**Modèle/ Model :** 365510  
**No série / Serial no :** 131636  
**# Inventaire / Asset # :** EM-175

**CERTIFICAT No / Certificate No:** **227991**

**PROCÉDURE / Procedure :**  
 TRESICAL - EXTECH\_365510

**Date étalonnage/ Calibration Performed :** **2017-12-28**  
yyyy-mm-dd

**Echéance/ Due Date :** **2018-12-28**

Type de résultat / Results type :	As-Found = As-Left
Résultats d'essais / Test results :	Conforme / In Tolerance

Conditions de mesure / Measurement conditions

TEMPÉRATURE / Temp. : 22°C  
 HUMIDITÉ / Humidity : 23%RH

Usage restreint/ Restricted use :   
 Réparation effectuée / Repair performed :   
 Ajustement effectué / Adjustment performed :

ÉTALONS UTILISÉS/ Standards Used:

Identification	Manuf.	Model	Description	Ser. #	Étalonné/ Cal.	Echéance/ Due
PR0313	H-P	53132A	UNIVERSAL COUNTER	3546A03142	2017-06-20	2018-06-20
PR0392	AGILENT	33250A	FUNCTION/ARBITRARY WAVEFORM GENERATOR	MY40008014	2017-06-19	2019-06-19

Les spécifications mentionnées comme limites de tolérances d'essai sont celles établies par le fabricant, sauf indication contraire.  
*Test tolerance limits are based on manufacturers specifications unless stated otherwise.*

**NOTES :**

2018-01-11

**Technicien :**  
**Technician**

M. ZAIDI

Le système qualité de la société est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour le processus d'étalonnage sont retraçables au SI par l'entremise du CNRC et/ou du NIST.  
*Our quality system complies with the requirements of ISO 17025 and the standards used for the calibration are traceable to SI through NRC and/or NIST.*

LE DROIT D'AUTEUR DE CE CERTIFICAT APPARTIEN À TRESICAL / PRIMO INSTRUMENT INC. CE CERTIFICAT NE PEUT ÊTRE REPRODUIT AUTREMENT QU'EN ENTIER ET AVEC LE CONSENTEMENT PRÉALABLE ÉCRIT DU GROUPE TRESICAL.  
 TRESICAL / PRIMO INSTRUMENT INC. OWN COPYRIGHT OF THIS CERTIFICATE. THE CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN CONSENT OF THE TRESICAL GROUP.





CLIENT / Customer :

DESCRIPTION / Description :

MANUFACTURIER / Manufacturer :

MODÈLE / Model :

227991

SERVICES POLYTESTS INC.

CHRONOMÈTRE / STOPWATCH TIMER

EXTECH

365510

DESCRIPTION Description	LIMITES Limits	LECTURES Readings	LIMITES Limits
----------------------------	-------------------	----------------------	-------------------

**Temps écoulé, chronomètre sous test / Elapsed time on test stopwatch**

Minutes	Seconds	1/100 sec
27	31	15

Total au compteur / Reference timer:  comptes/counts

( $\Delta t$ ) Deviation (1/100sec): 1.00

Deviation Par jour/ Per day (%): 0.0006 %  
Deviation Par jour/ Per day (sec): 0.52 sec

- \* Tolérances basées sur une déviation maximale de 3 sec/jour
- \* Tolerances based on a 3 sec/day maximum deviation

Incertitude/ Uncertainty:  $\pm 37$  ms

Lorsque fournies dans le rapport, les incertitudes de mesure sont des incertitudes élargies représentant un niveau de confiance d'approximativement 95% , obtenu en multipliant l'incertitude-type composée par un facteur de couverture de k=2.

When supplied in the report, the measurement uncertainties are expanded uncertainties representing a confidence level of approximately 95% , obtain by multiplying the combined standard uncertainty by a coverage factor of k=2.

Min

Comptes / Counts  
Chronomètre/timer  
165115

Max

\* Secondes  
-3.00

Deviation 24hrs  
0.52

\* Secondes  
3.00



## CERTIFICAT D'ÉTALONNAGE # 7275

Date d'étalonnage : 2017-09-29

Date d'émission du certificat : 2017-09-29

Services Polytests  
695 B Gaudette street  
St-Jean-sur-Richelieu, Québec, Canada  
J3B 7S7

Étalonnage d'un  
Shinigawa DCDA-2c S/N : 23544

### CONFORMITÉ AU PROGRAMME DE QUALITÉ

Tous les étalonnages sont effectués conformément au manuel d'assurance qualité de Polycontrols et sont conformes à la norme ISO/IEC 17025 – 2005, à la norme ISO 9001 – 2008 ainsi qu'à tout autre exigences de qualité définies dans la description d'achat des clients.

### TRAÇABILITÉ

La traçabilité des étalons de débit au National Institute of Standards and Technology, NIST, est maintenue par les laboratoires de Fluke Corporation de Phoenix, Arizona et est conforme aux normes ISO/IEC 17025, AINSI/NCSL Z540-1-1994, ISO-10012-1, MIL-STD 45662A.

Le Service d'évaluation des laboratoires d'étalonnage (CLAS) du Conseil national de recherches du Canada (CNRC) a évalué et certifié la capacité d'étalonnage du laboratoire et la traçabilité au Système international d'unités (SI) ou à des étalons acceptables selon le CLAS. Le présent certificat d'étalonnage est délivré conformément aux conditions de certification du CLAS et aux conditions d'accréditation du Conseil canadien des normes (CCN). Le CLAS et le CCN ne garantissent pas l'exactitude des étalonnages individuels effectués par les laboratoires accrédités.

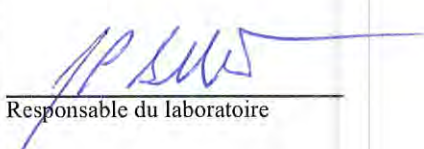
### APTITUDE EN MATIÈRE DE MESURE ET D'ÉTALONNAGE - CMC

Les références utilisées pour l'étalonnage de débit ont une incertitude de  $\pm 0.2\%$  de la lecture pour les mesures entre 5 SCCM à 10 SLPM,  $\pm 0.3\%$  de la lecture pour les mesures entre 10 SLPM à 30 SLPM,  $\pm 0.2\%$  de la lecture pour les mesures entre 30 SLPM à 3000 SLPM,  $\pm 0.3\%$  de la lecture pour les mesures supérieures à 3000 SLPM jusqu'à 6000 SLPM et  $\pm 0.5\%$  pour les mesures inférieures à 5 SCCM jusqu'à concurrence de 1 SCCM, équivalent air ou azote. Les incertitudes exprimées sont élargies avec un facteur d'élargissement  $k = 2$ , et ce, pour un niveau de confiance d'environ 95 %, dans l'hypothèse d'une distribution normale incluant la résolution de l'instrument. Le rapport d'incertitude des essais (RIE) de cet étalonnage respecte un ratio de 4:1 à moins d'indication contraire.

### SOMMAIRE DES CONDITIONS DE L'INSTRUMENT EN TEST

Conditions initiales	En bon état
Travail Effectué	Étalonnage de l'instrument
Résultats	Lectures Initiales = Lectures finales, aucun ajustement
Remarques	Lectures finales dans les tolérances
	Fréquence d'étalonnage aux 12 mois
	Tolérance placée à 2% OR à la demande du client

  
Métrologiste

  
Responsable du laboratoire



## Certificat d'étalonnage # 7275

Numéro de série:	23544	Station de mesure:	3
Date d'étalonnage:	2017-09-29	Procédure:	POS-CAL-005
Identification de l'instrument:	EM-178		

## Instrument de mesure de référence utilisé pour l'étalonnage final

Description	Modèle	# Série	Traçabilité	Date dû
DHI molbloc (30 slpm)	3E4-VCR-V-Q	3444	1500218603	2018-06-05
DHI molbox I	Molbox I	755	1500215634	2018-04-18
RTD Mist	M22	1871501	2017002165	2018-04-20
Module 44.5 PSI avec Baro 163671	Module 30	160659	2017002162	2018-04-26

## Spécifications finales de l'appareil

## Condition d'étalonnage

Gaz	Air	Gaz	Air
Température d'opération		Température ambiante	23 °C
Pression à l'entrée		Pression ambiante	1016.3 mbar
Pression à la sortie		Orientation	Horizontale
Température de référence		Élastomère	Viton
Pression de référence		Valve	
Étendue d'échelle	10-2000 ALH		
Signaux Entrée/Sortie	-		
Alimentation			
Tolérance	±2 %O.R.		

## Lectures finales

Débit du test ALH	Instrument en test L	Valeurs mesurées			Référence calculée L	Erreur calculée L	Tolérance acceptable L	TUR
		Pression PSIA	Température °C	Référence L				
379.0008	63.9100	14.7537	22.51	63.0822	63.1350	0.7750	1.2627	>4
603.4297	102.1200	14.7568	22.41	100.3666	100.3948	1.7252	2.0079	>4
1618.8469	273.9200	14.7824	22.31	269.9690	269.4835	4.4365	5.3897	>4

Facteur 0,98787357

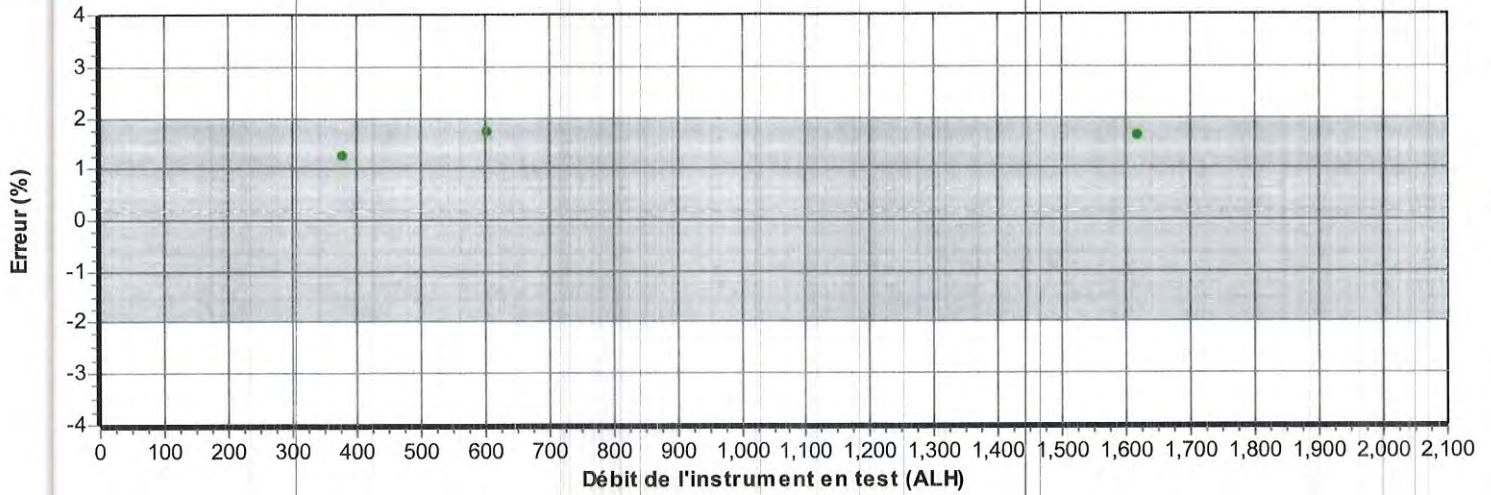
3 oct 2017  
  
 Signature

Bernard Poirier  
 Métrologiste

## Certificat d'étalonnage # 7275

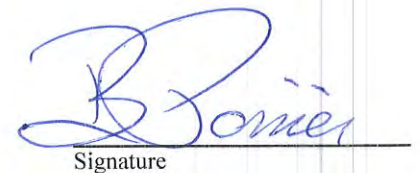
Numéro de série:	23544	Station de mesure:	3
Date d'étalonnage:	2017-09-29	Procédure:	POS-CAL-005
Identification de l'instrument:	EM-178		

## Résultats finaux



- La mesure (et son incertitude) se situe dans les tolérances
- La mesure (et son incertitude) se situe hors tolérance
- La mesure (et son incertitude) ne rencontre pas la marge de sécurité tel que spécifié dans le document G-8 de l'ILAC

Bernard Poirier  
Métrologue



Signature



## CERTIFICAT D'ÉTALONNAGE # 7276

Date d'étalonnage : 2017-09-29  
Date d'émission du certificat : 2017-09-29

Services Polytests  
695 B Gaudette street  
St-Jean-sur-Richelieu, Québec, Canada  
J3B 7S7

Étalonnage d'un  
Shinigawa DCDA-2c S/N : 23543

### CONFORMITÉ AU PROGRAMME DE QUALITÉ

Tous les étalonnages sont effectués conformément au manuel d'assurance qualité de Polycontrols et sont conformes à la norme ISO/IEC 17025 – 2005, à la norme ISO 9001 – 2008 ainsi qu'à tout autre exigences de qualité définies dans la description d'achat des clients.

### TRAÇABILITÉ

La traçabilité des étalons de débit au National Institute of Standards and Technology, NIST, est maintenue par les laboratoires de Fluke Corporation de Phoenix, Arizona et est conforme aux normes ISO/IEC 17025, AINSI/NCSL Z540-1-1994, ISO-10012-1, MIL-STD 45662A.

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### APTITUDE EN MATIÈRE DE MESURE ET D'ÉTALONNAGE - CMC

Les références utilisées pour l'étalonnage de débit ont une incertitude de  $\pm 0.2\%$  de la lecture pour les mesures entre 5 SCCM à 10 SLPM,  $\pm 0.3\%$  de la lecture pour les mesures entre 10 SLPM à 30 SLPM,  $\pm 0.2\%$  de la lecture pour les mesures entre 30 SLPM à 3000 SLPM,  $\pm 0.3\%$  de la lecture pour les mesures supérieures à 3000 SLPM jusqu'à 6000 SLPM et  $\pm 0.5\%$  pour les mesures inférieures à 5 SCCM jusqu'à concurrence de 1 SCCM, équivalent air ou azote. Les incertitudes exprimées sont élargies avec un facteur d'élargissement  $k = 2$ , et ce, pour un niveau de confiance d'environ 95 %, dans l'hypothèse d'une distribution normale incluant la résolution de l'instrument. Le rapport d'incertitude des essais (RIE) de cet étalonnage respecte un ratio de 4:1 à moins d'indication contraire.

### SOMMAIRE DES CONDITIONS DE L'INSTRUMENT EN TEST

Conditions initiales	En bon état
Travail Effectué	Étalonnage de l'instrument Lectures Initiales = Lectures finales, aucun ajustement
Résultats	Lectures finales dans les tolérances
Remarques	Fréquence d'étalonnage aux 12 mois Tolérance placée à 2% OR à la demande du client

  
Métrologiste

  
Responsable du laboratoire



## Certificat d'étalonnage # 7276

Numéro de série:	23543	Station de mesure:	3
Date d'étalonnage:	2017-09-29	Procédure:	POS-CAL-005
Identification de l'instrument:	EM-179		

### Instrument de mesure de référence utilisé pour l'étalonnage final

Description	Modèle	# Série	Traçabilité	Date dû
DHI molbloc (30 slpm)	3E4-VCR-V-Q	3444	1500218603	2018-06-05
DHI molbox1	Molbox1	755	1500215634	2018-04-18
RTD Mist	M22	1871501	2017002165	2018-04-20
Module 44.5 PSI avec Baro 163671	Module 30	160659	2017002162	2018-04-26

### Spécifications finales de l'appareil

### Condition d'étalonnage

Gaz	Air	Gaz	Air
Température d'opération		Température ambiante	23.5 °C
Pression à l'entrée		Pression ambiante	1016.63 mbar
Pression à la sortie		Orientation	Horizontale
Température de référence		Élastomère	Viton
Pression de référence		Valve	
Étendue d'échelle	10-2000 ALH		
Signaux Entrée/Sortie	-		
Alimentation			
Tolérance	±2 %O.R.		

### Lectures finales

Débit du test ALH	Instrument en test L	Valeurs mesurées			Référence L	Erreur calculée L	Tolérance acceptable L	TUR
		Pression PSIA	Température °C	Référence L				
358.4817	60.4100	14.7516	22.32	59.6919	59.7116	0.6984	1.1942	>4
608.1934	102.5600	14.7553	22.14	101.2793	101.2264	1.3336	2.0245	>4
1623.7775	271.8600	14.7817	22.09	270.7253	270.0544	1.8056	5.4011	>4

Fact. cor. : 0.988439

*[Signature]*  
3 oct 2017

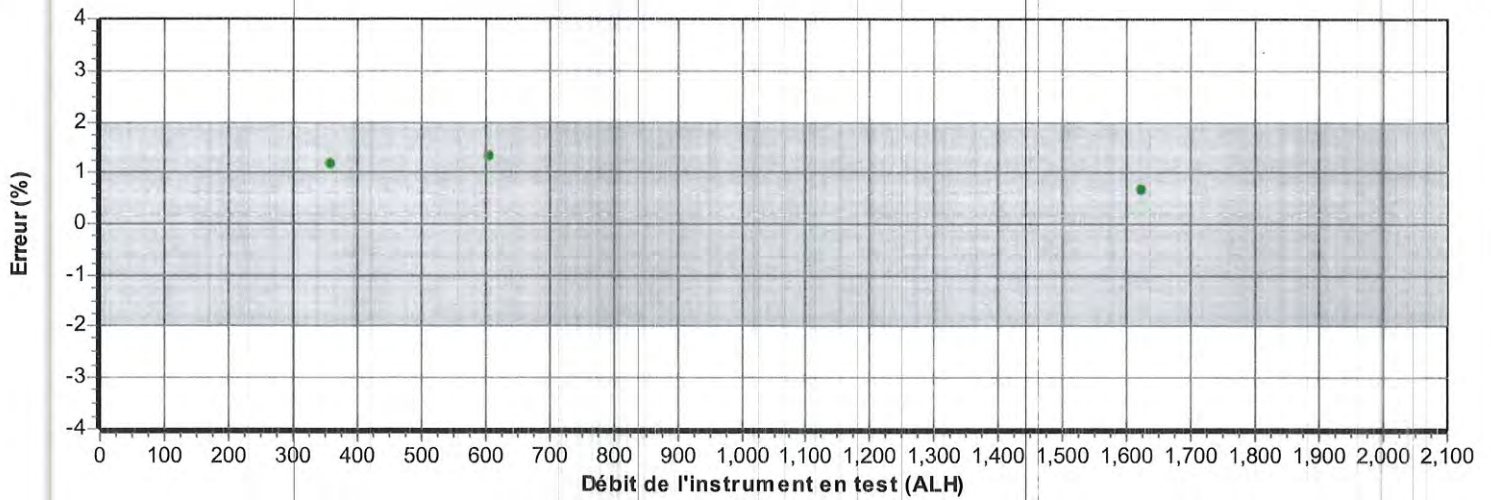
*[Signature]*  
Signature

Bernard Poirier  
Métrologue

## Certificat d'étalonnage # 7276

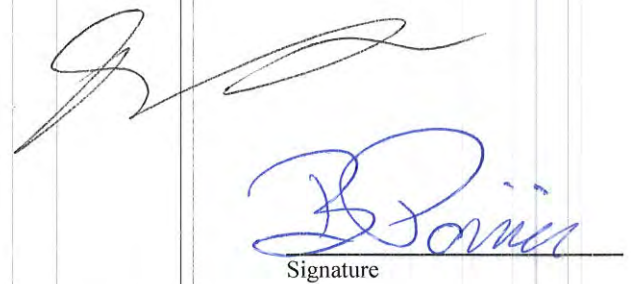
Numéro de série:	23543	Station de mesure:	3
Date d'étalonnage:	2017-09-29	Procédure:	POS-CAL-005
Identification de l'instrument:	EM-179		

## Résultats finaux



- La mesure (et son incertitude) se situe dans les tolérances
- La mesure (et son incertitude) se situe hors tolérance
- La mesure (et son incertitude) ne rencontre pas la marge de sécurité tel que spécifié dans le document G-8 de l'ILAC

Bernard Poirier  
Métrologue



Signature



EM-183

Airgas USA, LLC  
325 McCausland Court  
Cheshire, CT 06410  
(203) 250-6820  
(203) 272-1584 (FAX)

### CERTIFICATE OF ANALYSIS

Grade of Product: **CERTIFIED STANDARD-SPEC**


Part Number:	X04NI79C15A2VF3	Reference Number:	37-400238139-1
Cylinder Number:	SG9140147	Cylinder Volume:	151.0 CF
Laboratory:	ANE - Cheshire (SAP) - CT	Cylinder Pressure:	2015 PSIG
Analysis Date:	Aug 16, 2013	Valve Outlet:	590
Lot Number:	37-400238139-1		

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
CARBON MONOXIDE	1.000 %	1.031 %	+/- 2%
CARBON DIOXIDE	10.00 %	9.968 %	+/- 2%
OXYGEN	10.00 %	9.995 %	+/- 2%
NITROGEN	Balance		

Notes:

  
 \_\_\_\_\_  
 Approved for Release





Airgas USA, LLC  
325 McCausland Court  
Cheshire, CT 06410  
(203) 250-6820  
(203) 272-1584 (FAX)

## CERTIFICATE OF ANALYSIS

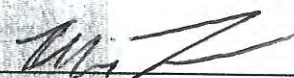
### Grade of Product: CERTIFIED STANDARD-SPEC

Part Number:	X04NI77C15A0004	Reference Number:	37-400429255-1
Cylinder Number:	CC46789	Cylinder Volume:	144.0 CF
Laboratory:	ANE - Cheshire (SAP) - CT	Cylinder Pressure:	1862 PSIG
Analysis Date:	Sep 29, 2014	Valve Outlet:	350
Lot Number:	37-400429255-1		

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
OXYGEN	2.000 %	1.989 %	+/- 2%
CARBON MONOXIDE	3.000 %	2.971 %	+/- 2%
CARBON DIOXIDE	18.00 %	17.87 %	+/- 2%
NITROGEN	Balance		

  
Approved for Release

## Certificat d'Étalonnage / Certificate of Calibration

**CLIENT :**  
SERVICES POLYTESTS INC.  
695-B GAUDETTE  
ST-JEAN-SUR-RICHELIEU, QUEBEC

**Description:** RUBAN A MESURER / MEASURING TAPE  
**Fabriquant/ Manufacturer:** STANLEY  
**Modèle/ Model :** 12 ft  
**No série / Serial no :** N/A  
**# Inventaire / Asset # :** EM-224

**CERTIFICAT No / Certificate No:** 202449

**PROCÉDURE / Procedure :**  
CAN / CGSB-39.22-94

**Certificat émis/ Certificate issued :** 2016-12-28

**Echéance/ Due Date :** 2017-12-28

<b>Type de résultat / Results type :</b>	<b>Tel que trouvé / As Found</b>
<b>Résultats d'essais / Test results :</b>	<b>Ok Pass</b>

**Conditions de mesure / Measurement conditions**

TEMPÉRATURE / Temp. : **20.2°C**

Usage restreint/ *Restricted use* :

HUMIDITÉ / Humidity : **32%RH**

Réparation effectuée / *Repair performed* :

Ajustement effectué / *Adjustment performed* :

**ÉTALONS UTILISÉS/ Standards Used:**

Identification	Fabricant / Manufacturer	Modèle / Model	Description	Ser. #	Echéance/ Due Date
PRO 10	STARRETT	SS8AAX	GAUGE BLOCK SET	111488.9	2018-03-16
PRO 17	MITUTOYO	516-902 GRADE 2	GAUGE BLOCK SET	106053	2017-02-17
PRO 26	NEWAGE IND.	0-4 mm	POCKET MAGNIFIER	N/A	2017-03-09
PRO 68	MITUTOYO	517-816	TABLE DE GRANITE	5053-471	2017-07-16

Les spécifications mentionnées comme limites de tolérances d'essai sont celles établies par le manufacturier, sauf indication contraire.

*Test tolerance limits are based on manufacturers specifications unless stated otherwise.*

**NOTES :**

  
2017-01-11

**Technicien :  
Technician**

  
T. DUMONT

Le système qualité de la société est conforme aux exigences de la norme ISO 17025 et les étalons utilisés pour le processus d'étalonnage sont retraçables au SI par l'entremise du CNRC et/ou du NIST.  
*Our quality system complies with the requirements of ISO 17025 and the standards used for the calibration are traceable to SI through NRC and/or NIST.*

LE DROIT D'AUTEUR DE CE CERTIFICAT APPARTIENT À PRIMO INSTRUMENT INC. CE CERTIFICAT NE PEUT ÊTRE REPRODUIT AUTREMENT QU'EN ENTIER ET AVEC LE CONSENTEMENT PRÉALABLE ÉCRIT DE PRIMO INSTRUMENT INC.  
PRIMO INSTRUMENT INC. OWNS COPYRIGHT OF THIS CERTIFICATE. THE CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN CONSENT OF PRIMO INSTRUMENT INC.



CERTIFICAT No / Certificate No :

202449

CLIENT / Customer :

SERVICES POLYTESTS INC.

DESCRIPTION / Description :

RUBAN A MESURER / MEASURING TAPE

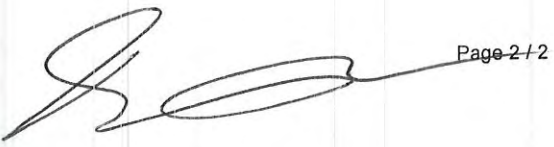
MANUFACTURIER / Manufacturer :

STANLEY

MODÈLE / Model :

12 ft

DESCRIPTION Description		LIMITES Limits	LECTURES Readings	LIMITES Limits
EXACTITUDE ACCROCHE / PULL	1 "	0.980	0.998	1.020
EXACTITUDE APPUYE / PUSH	1 "	0.980	0.992	1.020
ZONE VÉRIFIÉE / TESTED ZONE	NOMINAL			
0-4 PIEDS / FT	48 PO / IN	47.976	48.004	48.024
4-8 PIEDS / FT	48 PO / IN	47.976	48.000	48.024
8-12 PIEDS / FT	48 PO / IN	47.976	47.998	48.024



2017-01-11





Posttest dry gas meter calibration data

Date : January 22nd 2018		Barometric pressure: 102	Tech/Eng. Maxime Martin
Manufacturer. : Hearthstone Model : GM 60	Calibration factor 0.987873 DGM 1 : EM-178	Calibration factor 0.98844 DGM 2 : EM-179	Calibration factor 0.9864 DGM 3 : EM-070 Standardized DGM : EM-130

Standard meter							Dry gas meter #1					
Trail #	Press drop	Final ft3	Initial ft3	Change ft3	Temp F	STD ft3	Final Liter	Initial Liter	Change ft3	Temp F	STD ft3	Cal Factor
1	0	833,5	832,5	1,000	69	0,996	622980,520	622951,180	1,036	75,38	1,0218	0,9742
2	0	834,5	833,5	1,000	68,8	0,996	623009,860	622980,800	1,026	75,38	1,0121	0,9840
3	0	835,5	834,5	1,000	68,5	0,996	623039,200	623009,860	1,036	75,2	1,0222	0,9748
Average calibration factor :0.9777												

Previous cal factor	minus	Average cal factor	Divided by	Previous cal. factor	Multiplied * 100	Equals	Deviation percent Max5%
0.98788	-	0.9777	/	0.98788	*100	=	1.03 %

Standard meter							Dry gas meter #2					
Trail #	Press drop	Final ft3	Initial ft3	Change ft3	Temp F	STD ft3	Final Liter	Initial Liter	Change ft3	Temp F	STD ft3	Cal Factor
1	0	833,5	832,5	1,000	69	0,996	549126,34	549096,9	1,040	76,46	1,023	0,9729
2	0	834,5	833,5	1,000	68,8	0,996	549155,77	549126,34	1,039	76,28	1,023	0,9732
3	0	835,5	834,5	1,000	68,5	0,996	549185,2	549155,77	1,039	76,1	1,024	0,9735
Average calibration factor : 0.9732												

Previous cal factor	minus	Average cal factor	Divided by	Previous cal. factor	Multiplied * 100	Equals	Deviation percent Max5%
0.98844	-	0.9732	/	0.98844	*100	=	1.54 %



Posttest dry gas meter calibration data

Date : January 22nd 2018		Barometric pressure: 102		Tech/Eng. Maxime Martin	
Manufacturer. : Hearthstone Model : GM 60		Calibration factor 0.987873 DGM 1 : EM-178	Calibration factor 0.98844 DGM 2 : EM-179	Calibration factor 0.9864 DGM 3 : EM-070	Calibration factor 1.0027 Standardized DGM : EM-130

Standard meter							Dry gas meter #3					
Trail #	Press drop	Final ft3	Initial ft3	Change ft3	Temp F	STD ft3	Final Liter	Initial Liter	Change ft3	Temp F	STD ft3	Cal Factor
1	0	833,5	832,5	1,000	69	0,996	757,97	757,01	0,960	69,000	0,958	1,0390
2	0	834,5	833,5	1,000	68,8	0,996	759,06	757,97	1,090	68,800	1,088	0,9150
3	0	835,5	834,5	1,000	68,5	0,996	760,02	759,06	0,960	68,500	0,959	1,0390
Average calibration factor :0.9977												

Previous cal factor	minus	Average cal factor	Divided by	Previous cal. factor	Multiplied * 100	Equals	Deviation percent Max5%
0.9864	-	0.9977	/	0.9864	*100	=	-1.14 %

## APPENDIX 4: Unit pre burn





### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

Date	Time:	ET (min)	Scale (lbs)	Flue Temp (°F)	Cat Temp (°F)
11/28/2017	8:30 AM				
Crib					
		0	12.9	353	796
		5	12.5	372	939
		10	11.9	378	1120
		15	11.2	376	943
		20	10.5	393	1012
		25	9.8	402	1055
		30	9	410	1172
		35	8.3	415	1186
		40	7.71	411	1149
		45	6.99	412	1191
		50	6.4	413	1191
		55	5.7	415	1136
		60	5.18	406	1106
		65	4.68	402	1109
		70	4.19	391	1077
		75	3.78	376	1032
		80	3.39	361	949
		85	3.08	349	924
		90	2.77	340	904
		95	2.49	329	880
		100	2.29	322	865
		105	2.19	315	856
		110	1.98	312	901
		115	1.87	308	891
		120	1.79	308	922
		125	1.69	307	930
		130	1.59	306	928
		135	1.49	305	931
		140	1.38	304	926
		145	1.29	299	902
		150	1.18	296	893
		155	1.08	295	887
		160	1	292	875
		165	0.99	289	863
		170	0.88	288	884
		175	0.79	288	885
		180	0.68	289	887
		185	0.58	289	888
		190	0.49	289	889
		195	0.48	289	878
		200	0.39	286	865



**GM60 Stove / Catalyst Preconditioning**

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

		205	0.27	284	847
		210	0.18	280	836
		215	0.19	279	838
		220	0.08	279	837
		225	0.08	279	831
		230	0	277	819
11/27/2017	Time:	0	13.01	313	653
	8:30 AM	5	12.7	339	891
Crib		10	12.5	274	750
		15	12.31	264	748
		20	12.11	260	746
		25	11.8	258	790
		30	11.41	277	854
		35	11	293	955
		40	10.49	306	975
		45	10.11	306	970
		50	9.59	305	931
		55	9.2	303	928
		60	8.79	297	900
		65	8.39	291	865
		70	8	286	842
		75	7.69	285	864
		80	7.3	284	853
		85	7.01	283	853
		90	6.59	285	866
		95	6.19	285	872
		100	5.9	286	874
		105	5.49	288	889
		110	5.11	291	927
		115	4.78	293	941
		120	4.39	289	907
		125	4.21	285	896
		130	3.89	281	868
		135	3.61	276	858
		140	3.38	270	889
		145	3.28	271	983
		150	3.09	274	954
		155	2.98	270	884
		160	2.88	262	860
		165	2.69	256	850
		170	2.59	250	828
		175	2.49	244	823
		180	2.49	241	817
		185	2.38	236	792



## GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

		190	2.28	233	786
		195	2.17	229	787
		200	2.08	228	792
		205	1.98	227	797
		210	1.88	226	801
		215	1.89	225	802
		220	1.78	224	799
		225	1.69	223	794
		230	1.56	222	796
		235	1.49	222	801
		240	1.38	223	824
		245	1.39	224	820
		250	1.3	224	816
		255	1.17	225	839
		260	1.08	227	839
		265	1.09	227	832
		270	0.99	227	838
		275	0.88	228	835
		280	0.89	228	838
		285	0.79	229	846
		290	0.68	230	863
		295	0.69	231	851
		300	0.58	230	844
		305	0.49	229	834
		310	0.47	225	773
		315	0.38	221	777
		320	0.39	219	784
		325	0.28	220	791
		330	0.28	219	806
		335	0.18	221	806
		340	0.08	221	796
		345	0.08	220	800
		350	0	220	785
11/29/2017	Time:	0	12.7	384	818
	9:00 AM	5	12.1	407	1061
Crib		10	11.41	413	1084
		15	10.59	430	1177
		20	9.8	445	1181
		25	8.99	454	1256
		30	8.19	456	1224
		35	7.49	454	1240
		40	6.81	455	1214
		45	6.09	447	1200





### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

50	5.49	439	1180
55	4.8	438	1217
60	4.29	422	1079
65	3.89	407	1018
70	3.38	396	987
75	3.09	383	953
80	2.79	373	941
85	2.49	366	937
90	2.2	359	928
95	1.99	353	923
100	1.79	346	917
105	1.67	341	889
110	1.59	337	892
115	1.5	334	906
120	1.39	331	882
125	1.19	326	855
130	1.09	323	871
135	0.99	322	874
140	0.98	323	877
145	0.87	320	859
150	0.78	319	863
155	0.69	318	863
160	0.58	317	850
165	0.48	314	850
170	0.39	314	863
175	0.29	316	869
180	0.19	315	863
185	0.09	316	864
190	0.07	316	866
195	-0.02	314	857
200	-0.02	312	848
205	-0.02	310	823
210	-0.01	298	782
215	-0.01	294	777
220	-0.02	290	766
225	-0.03	288	756
230	-0.02	283	722
235	-0.03	282	737
240	-0.03	282	734
245	-0.01	280	731
250	0	279	735
255	-0.02	277	724
260	-0.02	268	664
265	-0.02	261	651
270	-0.02	258	641
275	-0.01	253	633
280	-0.01	249	628



## GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

285	-0.02	248	623	Temperatures recorded beyond end of crib test
290	-0.01	226	532	
295	-0.01	229	564	
300	-0.01	230	562	
305	-0.02	228	553	
310	-0.02	225	552	
315	-0.01	224	552	
320	-0.02	223	556	
325	-0.01	244	482	
330	-0.01	268	701	
335	-0.02	277	661	
340	-0.02	288	728	
345	-0.01	289	685	
350	-0.01	293	692	
355	-0.02	294	685	
360	-0.02	289	636	
365	-0.01	275	591	
370	-0.02	266	567	
375	-0.02	253	508	

11/30/2017  Crib	Time:	0	13.92	492	940
	8:30 AM	5	13.32	483	1049
		10	12.3	525	1297
		15	11.2	546	1350
		20	10.08	555	1340
		25	9.09	555	1340
		30	8.21	547	1317
		35	7.4	531	1269
		40	6.59	517	1217
		45	5.87	513	1216
		50	5.2	507	1158
		55	4.49	497	1125
		60	3.88	482	1081
		65	3.5	464	1029
		70	3.09	450	995
		75	2.68	440	979
		80	2.38	432	967
		85	2.07	426	963
		90	1.79	422	944
		95	1.58	413	938
		100	1.38	406	928
	105	1.18	405	943	
	110	1.09	402	927	
	115	0.98	398	917	
	120	0.89	396	907	



**GM60 Stove / Catalyst Preconditioning**

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

125	0.78	392	911
130	0.57	391	910
135	0.48	390	913
140	0.38	387	901
145	0.28	385	885
150	0.19	382	881
155	0.05	381	876
160	0	377	859

12/1/2017	Time:	0	14.41	428	778
	9:00 AM	5	13.8	393	1088
Crib		10	13.5	342	913
		15	13.2	328	867
		20	12.91	316	824
		25	12.39	333	949
		30	11.91	335	930
		35	11.3	352	1058
		40	10.6	376	1048
		45	9.89	383	1062
		50	9.21	393	1144
		55	8.48	399	1146
		60	7.8	402	1154
		65	7.09	403	1143
		70	6.5	401	1146
		75	5.91	393	1102
		80	5.29	380	1004
		85	4.9	366	962
		90	4.4	356	945
		95	4.09	346	935
		100	3.7	336	916
		105	3.39	329	909
	110	3.08	323	901	
	115	2.79	317	892	
	120	2.49	313	871	
	125	2.18	310	873	
	130	1.99	307	879	
	135	1.79	303	875	
	140	1.59	295	875	
	145	1.48	289	861	
	150	1.4	283	838	
	155	1.29	277	824	
	160	1.08	272	818	





### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

165	0.98	268	812
170	0.89	265	807
175	0.78	263	818
180	0.69	262	815
185	0.57	261	835
190	0.48	263	841
195	0.38	263	849
200	0.4	265	856
205	0.29	265	858
210	0.19	265	861
215	0.12	266	872
220	0.1	267	873
225	0.05	263	829
230	0	259	817

12/4/2017	Time:				
	9:00 AM	0	12.8	327	584
Crib		5	12.6	361	729
		10	12.41	281	676
		15	12.21	267	666
		20	12.01	258	650
		25	11.91	252	656
		30	11.7	250	656
		35	11.1	305	918
		40	10.5	314	898
		45	10	333	1010
		50	9.4	346	1022
		55	8.79	348	979
		60	8.31	347	960
		65	7.7	345	958
		70	7.19	344	966
		75	6.69	349	1064
		80	6.2	361	1104
		85	5.58	368	1117
		90	5.09	365	1078
		95	4.69	360	1004
		100	4.31	349	943
		105	3.9	341	912
		110	3.59	331	889
		115	3.28	324	881
		120	2.99	318	866
		125	2.69	310	853
		130	2.47	304	837
		135	2.29	298	854
		140	2.18	292	862



## GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

145	2.08	289	878
150	1.98	286	859
155	1.88	282	856
160	1.78	279	843
165	1.66	274	821
170	1.59	270	825
175	1.48	269	830
180	1.47	267	838
185	1.39	266	834
190	1.29	265	834
195	1.19	263	839
200	1.1	263	850
205	0.97	263	861
210	0.98	263	857
215	0.88	264	876
220	0.79	265	876
225	0.69	264	872
230	0.69	264	875
235	0.58	263	879
240	0.48	264	883
245	0.49	264	893
250	0.39	263	865
255	0.26	261	843
260	0.27	257	830
265	0.18	256	826
270	0.18	255	829
275	0.08	256	834
280	0.08	256	820
285	0	254	806

12/5/2017	Time:	0	13.01	347	738
	9:30 AM	5	12.4	389	1174
Crib		10	12.12	335	928
		15	11.5	359	1084
		20	10.79	381	1090
		25	10.21	376	1091
		30	9.49	390	1172
		35	8.79	394	1164
		40	8.1	394	1134
		45	7.4	395	1099
		50	6.7	394	1095
		55	6.01	390	1059
		60	5.48	384	1113
		65	4.99	372	1060
		70	4.6	358	971



**GM60 Stove / Catalyst Preconditioning**

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

75	4.19	348	943
80	3.79	339	936
85	3.45	331	938
90	3.18	325	908
95	2.88	319	894
100	2.68	314	903
105	2.42	307	912
110	2.28	304	929
115	2.18	301	919
120	1.97	297	920
125	1.89	295	927
130	1.8	292	906
135	1.67	289	921
140	1.58	286	915
145	1.59	285	932
150	1.49	284	937
155	1.38	284	947
160	1.3	282	943
165	1.18	282	933
170	1.18	281	935
175	1.09	280	940
180	0.99	280	944
185	0.86	280	949
190	0.78	279	929
195	0.78	278	931
200	0.68	276	924
205	0.58	276	899
210	0.46	271	877
215	0.49	269	884
220	0.37	267	880
225	0.28	265	857
230	0.29	261	834
235	0.19	259	838
240	0.08	258	833
245	0	258	835

12/6/2017 Crib	Time:	0	13.83	340	627
	8:45 AM	5	13.3	401	943
		10	13	318	893
		15	12.51	339	995
		20	12	320	925
		25	11.5	331	1037
		30	10.92	350	1035
		35	10.3	353	1013





### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

40	9.8	343	979
45	9.3	336	949
50	8.8	324	928
55	8.3	320	929
60	7.9	316	923
65	7.49	310	890
70	6.99	323	1073
75	6.5	335	1065
80	6.01	334	1030
85	5.59	333	1025
90	5.11	333	1032
95	4.69	327	981
100	4.29	318	938
105	3.98	308	924
110	3.8	293	854
115	3.59	285	891
120	3.38	283	912
125	3.08	279	873
130	2.87	272	837
135	2.78	270	917
140	2.61	267	890
145	2.52	264	875
150	2.39	260	860
155	2.29	255	853
160	2.19	252	842
165	2.08	248	843
170	1.98	247	845
175	1.89	245	825
180	1.79	243	820
185	1.7	240	815
190	1.69	239	806
195	1.58	236	816
200	1.49	236	817
205	1.39	236	817
210	1.29	236	820
215	1.27	235	818
220	1.17	235	818
225	1.08	235	816
230	0.97	235	812
235	0.97	232	805
240	0.89	233	818
245	0.79	234	823
250	0.77	233	829
255	0.68	234	829
260	0.58	234	842
265	0.58	237	857
270	0.47	238	850



### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

275	0.49	238	848
280	0.37	238	849
285	0.28	237	840
290	0.28	235	799
295	0.19	232	786
300	0.18	231	789
305	0.08	229	773
310	0.09	227	781
315	0	228	794

12/7/2017	Time:	0	12.9	360	807
	8:45 AM	5	12.3	424	1069
Crib		10	11.9	339	889
		15	11.72	320	844
		20	11.4	311	858
		25	11.1	313	884
		30	10.4	344	1002
		35	9.8	359	1032
		40	9.1	373	1078
		45	8.49	375	1019
		50	7.9	368	976
		55	7.3	365	988
		60	6.69	363	1009
		65	6.19	361	1006
		70	5.59	359	966
		75	5.09	353	968
		80	4.69	348	996
		85	4.29	339	951
		90	3.88	338	944
		95	3.58	330	899
		100	3.29	322	883
		105	3	316	871
		110	2.69	310	861
		115	2.49	306	919
		120	2.29	304	925
		125	2.08	302	910
		130	1.9	295	859
		135	1.79	294	915
		140	1.58	291	911
		145	1.5	288	896
		150	1.38	283	887
		155	1.28	281	870
		160	1.19	277	856
		165	1.18	273	853



### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

		170	1.09	270	850
		175	0.97	269	848
		180	0.88	266	839
		185	0.79	263	811
		190	0.67	262	816
		195	0.59	261	822
		200	0.57	259	830
		205	0.47	261	859
		210	0.37	263	871
		215	0.28	265	878
		220	0.18	265	877
		225	0.18	266	883
		230	0.07	267	889
		235	0	268	891
12/8/2017	Time:	0	13.4	372.67	801
	9:00 AM	5	12.71	454	1103
Crib		10	12.42	352	980
		15	11.9	354	1068
		20	11.3	362	1029
		25	10.7	374	1175
		30	10.1	382	1177
		35	9.41	388	1185
		40	8.79	385	1103
		45	8.21	369	1018
		50	7.79	352	972
		55	7.3	343	960
		60	6.79	338	949
		65	6.37	333	936
		70	5.99	328	936
		75	5.5	323	930
		80	5.19	319	924
		85	4.79	315	924
		90	4.38	312	926
		95	4.09	309	938
		100	3.69	311	967
		105	3.39	308	937
		110	3.07	302	902
		115	2.8	297	873
		120	2.6	291	852
		125	2.39	286	848
		130	2.18	282	836
		135	2.09	276	813
		140	2.01	275	889





## GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

		145	1.79	273	888
		150	1.67	270	876
		155	1.58	269	877
		160	1.49	265	835
		165	1.37	254	805
		170	1.29	248	799
		175	1.18	243	796
		180	1.07	241	805
		185	1.09	239	801
		190	0.98	236	780
		195	0.89	236	786
		200	0.78	233	777
		205	0.68	231	766
		210	0.59	230	778
		215	0.58	233	823
		220	0.48	235	830
		225	0.38	238	842
		230	0.28	239	835
		235	0.29	238	837
		240	0.19	239	839
		245	0.09	239	839
		250	0	239	832
12/11/2017	Time:	0	13.5	314	661
	8:30 AM	5	12.99	401	1104
Crib		10	12.7	299	829
		15	12.5	280	818
		20	12.29	270	826
		25	11.8	299	1045
		30	11.3	310	974
		35	10.8	325	1110
		40	10.2	338	1152
		45	9.6	333	1012
		50	9.06	328	979
		55	8.6	321	941
		60	8.21	312	910
		65	7.7	305	913
		70	7.39	299	897
		75	6.98	293	872
		80	6.56	293	889
		85	6.2	302	971
		90	5.69	309	1038
		95	5.28	310	1026
		100	4.9	297	880
		105	4.58	288	859



### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

110	4.29	282	860
115	4.09	278	858
120	3.79	272	865
125	3.58	268	890
130	3.38	269	886
135	3.29	264	802
140	3.1	263	917
145	2.88	263	946
150	2.79	260	923
155	2.7	255	893
160	2.57	251	882
165	2.46	248	890
170	2.39	246	885
175	2.29	242	877
180	2.17	240	860
185	2.08	238	844
190	1.97	233	815
195	1.88	232	839
200	1.8	233	853
205	1.69	233	859
210	1.59	234	867
215	1.49	234	871
220	1.38	235	886
225	1.37	237	901
230	1.29	238	882
235	1.18	238	891
240	1.08	239	897
245	1.1	241	896
250	0.99	240	877
255	0.88	238	873
260	0.89	238	885
265	0.78	239	862
270	0.68	237	858
275	0.69	236	857
280	0.61	234	844
285	0.6	231	810
290	0.48	228	800
295	0.49	226	795
300	0.38	223	788
305	0.3	221	780
310	0.29	218	758
315	0.26	215	747
320	0.17	213	746
325	0.17	212	742
330	0.1	210	740
335	0.08	208	739
340	0	207	732



### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

12/12/2017	Time:	0	13.21	294.43	582
	8:30 AM	5	12.9	361	861
Crib		10	12.6	277	735
		15	12.4	263	713
		20	11.92	295	1018
		25	11.59	285	844
		30	11.2	285	841
		35	10.59	320	1116
		40	10	330	1146
		45	9.4	338	1139
		50	8.79	339	1093
		55	8.2	333	1074
		60	7.7	329	1049
		65	7.2	328	1052
		70	6.8	319	987
		75	6.39	311	957
		80	5.9	311	946
		85	5.38	322	1015
		90	4.99	319	1007
		95	4.59	304	897
		100	4.29	292	867
		105	3.99	284	863
		110	3.79	278	865
		115	3.5	275	879
		120	3.3	271	858
		125	3.11	267	866
		130	2.88	265	890
		135	2.7	263	908
		140	2.58	261	934
		145	2.48	259	946
		150	2.38	258	915
		155	2.29	254	913
		160	2.29	252	902
		165	2.2	249	894
		170	2.09	247	911
		175	1.99	247	913
		180	1.89	246	925
		185	1.79	242	852
		190	1.78	236	826
		195	1.69	233	833
		200	1.6	231	836
		205	1.59	230	849
		210	1.48	230	876
		215	1.38	232	895
		220	1.29	232	880





### GM60 Stove / Catalyst Preconditioning

Model: GM60

Date: 12/15/2017

Test Engineer: D.Bryant

Total Hours: 56

\* All fuel is natural untreated wood (Western Douglas Fir), 15% to 25% moisture (wet basis)

225	1.29	233	889
230	1.17	234	879
235	1.19	234	879
240	1.08	233	870
245	1.11	232	863
250	0.98	231	861
255	1	230	859
260	0.87	228	842
265	0.78	226	820
270	0.79	224	805
275	0.78	221	798
280	0.69	219	773
285	0.58	216	782
290	0.57	216	791
295	0.5	214	770
300	0.48	213	788
305	0.39	214	793
310	0.39	214	792
315	0.3	213	779
320	0.28	212	773
325	0.17	210	759
330	0.17	208	746
335	0.09	208	755
340	0.08	206	741
345	0.09	203	707
350	-0.02	200	694

## APPENDIX 5: Participants

**Danick Power ing.**  
v-p operation  
**Services Polytests inc.**  
450.741.3636  
[www.polytests.com](http://www.polytests.com)

**Maxime Martin**  
Technicien  
**Services Polytests inc.**  
450.741.3636  
[www.polytests.com](http://www.polytests.com)

**Dave Bryant**  
**Hearthstone**



## APPENDIX 6: Drawings and specifications

## APPENDIX 7: Operator's manual



## Green Mountain 60

(Model 8660)

### Woodstove

### OWNER'S MANUAL

### Installation And Operating Instructions



**SAVE THIS OWNER'S MANUAL  
FOR FUTURE REFERENCE**

**PLEASE READ THIS ENTIRE OWNER'S MANUAL BEFORE YOU INSTALL AND USE YOUR  
NEW GREEN MOUNTAIN 60 WOOD STOVE.**

**If this room heater is not properly installed, a house fire may result.**

**To reduce the risk of fire, follow the installation instructions.**

**Failure to follow these instructions can result in property damage, bodily injury, or even death.**

**Conforms to UL Std. 1482**

**Certified to ULC Std. S627**

**CONTACT LOCAL AUTHORITIES WITH JURISDICTION (BUILDING DEPARTMENT or FIRE  
OFFICIALS), ABOUT PERMITS REQUIRED, RESTRICTIONS AND INSTALLATION  
INSPECTION IN YOUR AREA.**



# NOTES ON STOVE OPERATION AND EFFICIENCY

## **Rating:**

You have purchased a Hearthstone Green Mountain 60 tested to EPA Method 28R 40 CFR Part 60 where applicable. This stove is certified to comply with the U.S. Environmental Protection Agency 2020 particulate emissions standard using crib wood. It is certified at 0.6 gr/hr. emission rate and under specific test conditions has been shown to deliver heat at rates ranging from 12,600 to 33,600 Btu (output).

This wood heater has a manufacturer-set minimum allowable 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.

Please refer to the Warranty section of this manual for registration instructions. In case of warranty claims, please contact the point of original sale or the nearest authorized Hearthstone dealer. Our dealer network processes all warranty claims. Authorized Hearthstone dealers can be located at [www.hearthstonestoves.com](http://www.hearthstonestoves.com).

This heater is designed to burn natural wood only. Higher efficiencies and lower emissions generally result when burning air-dried seasoned hardwoods, as compared to softwoods or to green or freshly cut hardwoods. **DO NOT BURN:** *Garbage, lawn clippings, material containing rubber (including tires), materials containing plastic, waste petroleum products paints or paint thinners, asphalt products, materials containing asbestos, construction or demolition debris, railroad ties, pressure treated wood, manure or animal remains, salt water driftwood or other previously salt water saturated materials, unseasoned wood, paper products, cardboard, plywood or particleboard.* This prohibition against burning these materials does not prohibit the use of fire starters made from paper, cardboard, sawdust, wax and similar substances for the purpose of starting a fire in an affected wood heater. Burning these materials may result in a release toxic fumes or render the heater ineffective and cause smoke.

Following the maintenance guidelines set forth in this manual will help insure the efficient use of your wood heater and minimize visible emissions. Having your stove inspected by a trained professional on a regular basis will greatly increase the potential for recognizing potential impacts to efficiency.

Proper draft is important to the efficient operation of your heater. Refer to the Normal Operation section of this manual for information regarding adequate draft. Both excessive and sub-minimum draft can affect the efficiency of your wood heater. Excessive draft can lead to over-consumption of fuel, lower overall heating capacity of the stove and potential over firing. Low draft can result in inefficient burns, low heat output, expulsion of smoke into the living area when stove doors are opened and an increased potential for build-up of flammable materials in the flue.

## **Efficiency:**

Efficiency was measured and weighted using EPA Method 28R and CSA B415-10 methodology. A weighted average was used to calculate the overall efficiency across all of the 4 burn rate categories using the higher heating value (HHV). The weighted average efficiency is 79% (HHV).

To maximize the efficiency of your wood stove make sure it is sized properly for the space you plan to heat. An oversized stove will often be forced to burn at a lower and dirtier burn rate. Consult with your dealer for sizing and correctly placing the stove in your home. An incorrectly placed stove can greatly reduce efficiency. Maximizing the efficiency of your stove will heat your house quickly, burn cleaner and use less wood.

Refer to the Choosing Firewood section of this manual for appropriate fuel selection. Seasoned firewood is typically at or near 20% moisture content. This can be measured with any number of hand-held moisture meters available through your local hearth shop. Follow instructions included in the meter you purchase to measure fuel wood moisture content. Burn only dry, seasoned wood as using wet wood will greatly reduce your efficiency.

## **CO Emissions:**

The Green Mountain 60 has the following CO emission rates by burn level: Category 1 (low) – 9.0 g/hr., Category 2 (med. low) – 21.0 g/hr., Category 3 (med. high) – 33.0 g/hr. and Category 4 – 51.6 g/hr. Wet wood or unapproved fuel described above can greatly affect the emissions of a wood burning stove.

## **Smoke/Fire/CO Detectors:**

It is highly recommended that smoke and CO detectors be installed throughout the heated space when a wood burning heater is installed. Be certain to install these devices not only in the area where the wood appliance is located, but also in bedrooms, hallways leading to other areas of the house and all common areas of the heated space. Check the batteries in these devices and assure operation by performing whatever test operations are recommended by the manufacturer.

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# INTRODUCTION

Thank you for purchasing a Green Mountain 60 woodstove from Hearthstone Quality Home Heating Products. This stove will provide years of comfortable heat. This stove combines the warmth and comfort of soapstone and cast iron with the efficiency of advanced catalytic technology. The Green Mountain 60 blends modern technology with the unique beauty and qualities of cast iron. We trust that you will appreciate the quality of this handcrafted product.

Your Green Mountain 60 woodstove burns very efficiently, and produces a large amount of heat. However, you should not consider your Green Mountain 60 the primary heat source for your home. The Green Mountain 60's large glass window allows you to enjoy the fire from a variety of locations in the room.

Please read this manual in its entirety. Its purpose is to familiarize you with your stove's safe installation, proper break-in, operation and maintenance. It contains extremely important information so keep it handy and refer to it often.

A qualified heating technician may need this owner's manual as a reference when installing this stove in your home. There are national, state, and local building codes that direct the technician on how to install your stove. These codes stipulate the dimension of stovepipe and clearances to walls, ceilings, hearth, and other combustible surfaces. The codes exist to reduce the risk of fire. Failure to follow these instructions can result in fire, property damage, bodily injury, and even death.

Install the stove in a safe, open area, away from traffic flow, doors, and hallways. If possible, try to install the stove near an existing chimney and chimney connector. It is extremely important to install this stove with the proper clearance from combustible surfaces. You can purchase specific connector pipe and special wall coverings as specified by this manual and the NFPA 211 code to protect combustible surfaces. As a general rule, keep furniture, drapes, curtains, wood, paper, and other combustibles at least 36 inches (92 cm) away from the stove. Never install the stove in or near a storage location for gasoline, kerosene, charcoal lighter fluid or any other flammable liquids.

Install the stove in your central living area to allow heat to radiate naturally to distant rooms. Do not install your stove in a poorly insulated area. This is inefficient and would likely result in higher fuel usage.

- **SAFETY NOTICE:**

**AN IMPROPERLY INSTALLED STOVE CAN RESULT IN A HOUSE FIRE. FOR YOUR SAFETY, CAREFULLY FOLLOW THE INSTALLATION DIRECTIONS. CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA.**

The safety of your stove will depend on many factors, some of which include: distance to combustible objects, correct venting, and adequate chimney maintenance. Should you have any questions, do not hesitate to contact your dealer for additional information.

Contact your dealer for any necessary warranty service.

This Green Mountain 60 Model 8660 stove is warranted by:

**Hearthstone Quality Home Heating Products, Inc®**  
317 Stafford Ave.  
Morrisville, Vermont 05661, USA  
[www.Hearthstonestoves.com](http://www.Hearthstonestoves.com)



## CODES

When you install your Green Mountain 60 woodstove, it is imperative that you adhere to all Federal and local codes. Obtain these codes from either of the following sources:

**American National Standards Institute, Inc. (ANSI)**  
1430 Broadway  
New York, NY 10018  
www.ansi.org

**National Fire Protection Association, Inc. (NFPA)**  
Battery March Park  
Quincy, MA 02269  
www.nfpa.org

If you are installing your Green Mountain 60 in a mobile or manufactured home, follow the guidelines described in the Manufactured Home Construction and Safety Standard, Title 24 CFR, Part 3280 (United States).

## SAFETY INFORMATION

**Read and understand this Owner's Manual thoroughly before installing and using this stove.**

### Make sure to install your stove:

- According to the manufacturer's recommendations
- In accordance with all applicable codes
- With the proper sized chimney

### When using your stove, follow these safety precautions:

- **Never** modify this stove in any way.
- **Never** burn kiln dried, painted or treated wood in this stove.
- **DO NOT BURN GARBAGE.** **Never** burn garbage or trash, colored or glossy paper, solvents, plywood, artificial logs, cardboard, or driftwood, in this stove.
- **Never** burn coal in this stove.
- **DO NOT BURN FLAMMABLE FLUIDS.**
- **DO NOT USE CHEMICALS OR FLUIDS TO START THE FIRE.** **Never** use gasoline, kerosene, charcoal lighter fluid, or other flammable fluids to start or invigorate the fire. These fuels will cause dangerous burning conditions in the stove. Keep all such materials away from the stove.

- **Never** use a wood grate or other device to elevate the fire.
- **Never** allow logs in the firebox to hit the glass when the door is closed.
- **Never** slam the door or use the door to force wood in to the stove.
- **Never** over-fire your stove. (See page 23)
- **Never** put articles of clothing or candles on a hot stove.
- **Never** connect the stove to a flue used by another appliance.

### Other safety guidelines:

- Keep all combustible items such as furniture, drapes, clothing, and other items, at least 36" (0.92 m) from the stove (See page 8)
- Install a smoke detector, preferably in an area away from your wood stove.
- Keep a fire extinguisher handy. We recommend the type rated "A B C."
- Dispose of ashes properly. (See page 23)
- Keep children and pets away from the stove when it is burning; they could be seriously injured by touching a hot stove.
- Clean your chimney system as needed. (See page 28)
- Outside combustion air may be required if:
  1. This solid-fuel-fired appliance does not draw steadily, smoke rollout occurs, fuel burns poorly, or back-drafts occur whether or not there is combustion present.
  2. Existing fuel-fired equipment in the house, such as fireplaces or other heating appliances, smell, do not operate properly, suffer smoke roll-out when opened, or back-draft whether or not there is combustion present.
  3. Opening a window slightly on a calm (windless) day alleviates any of the above symptoms.
  4. The house is equipped with a well-sealed vapor barrier and tight fitting windows and/or has any powered devices that exhaust house air.
  5. There is excessive condensation on windows in the winter.
  6. A ventilation system is installed in the house.

If these or other indications suggest that infiltration air is inadequate, additional combustion air should be provided from the outdoors. Outside combustion air can be provided to the appliance by using the optional outside air kit #96-53400

## PERIODIC CHECKLIST

Perform each of these tasks at the specified intervals.

### At the End of Every Week:

- Empty ashes from the firebox, sooner if the firebox is full.

### At the Beginning of Every Other Month:

- Depending upon your use of the stove, visually inspect the chimney connector and chimney for creosote. (see page 28)
- Check door seals using the "dollar bill test." - When the stove is cool, shut the door on a dollar bill. If the bill pulls out without any resistance, then your stove's door is not sealing properly. To tighten the seal, adjust the door latch mechanism or change the door gasket. (Refer to page 28.)
- Inspect the face of the catalytic combustor for fly ash and soot. Use a soft-bristled brush to remove if present. It is recommended to visually inspect the catalytic combustor at least 3 times during the heating season, or every 2-3 months.

### At the End of Every Season:

- Dismantle the chimney connector and clean it thoroughly. Replace any pieces that show signs of rust or deterioration.
- Inspect and, if necessary, clean your chimney.
- Clean out the inside of the stove thoroughly.
- Check and clean the catalytic combustor, if necessary
- Inspect all door gasket material and replace if worn, frayed, cracked or extremely hard.

## EMERGENCY PROCEDURES

If you have a stovepipe or chimney fire, follow these instructions:

1. If the fire is too threatening, leave the area and call the fire department immediately! If not, perform the next three steps.
2. Close the primary air control.
3. Close the stovepipe damper (if present).
4. Close the bypass damper
5. Keep the stove front door closed!

- **WARNING: DO NOT ATTEMPT TO PUT OUT A STOVEPIPE OR CHIMNEY FIRE BY THROWING WATER ONTO THE STOVE, STOVEPIPE, OR CHIMNEY. THE EXTREMELY HIGH TEMPERATURE OF SUCH FIRES CAN CAUSE INSTANTANEOUS STEAM AND SERIOUS BODILY HARM.**

Once the chimney fire expires, leave the primary air control and bypass handle closed and let the fire in the stove die out completely. Inspect the stove, stovepipe, and chimney thoroughly for any sign of damage before firing the stove again. You must correct any damage before using your stove again.

Establish a routine for the fuel, wood burner and firing technique. Check daily for creosote build-up until experience shows how often you need to clean to be safe. Be aware that the hotter the fire the less creosote is deposited, and weekly cleaning may be necessary in mild weather even though monthly cleaning may be enough in the coldest months. Contact your local municipal or provincial fire authority for information on how to handle a chimney fire. Have a clearly understood plan to handle a chimney fire.

# SPECIFICATIONS

## Maximum Heat Output:

60,000 BTUs per hour of cordwood (based on independent laboratory test results).

## Floor Size of Heated Area:

Up to a maximum of 2,000 square feet. Factors unique to your home can reduce the square footage the stove will heat. Home insulation value, number and efficiency of windows, floor plan, stove placement, quality of the fuel and other conditions may limit the heating ability of the stove.

## Firebox Capacity:

2.0 cubic feet.

## Maximum Log Length: Up To 18" (45.7cm).

## Emissions: 0.9 g/hr.

**Burn Time:** Up to 24+ hrs. (*Heat Life™*: Up to 30 hours) Note: The amount and weight of wood contained per cubic foot of firebox volume can vary from 10 to 25 lbs. per cubic foot depending on type of wood, moisture content, packing density and other factors.

## Stove Dimensions:

**Height:** 31 1/2" (80.0cm)  
**Width:** 26" (66.0cm)  
**Depth:** 21 1/4" (54.0cm)  
**Weight:** 494 lbs. (269 kg)

**Connector Size:** 6" (152 mm) diameter  
**Metal Chimney:** 6" (152 mm) inside diameter  
**Masonry Chimney:** 6" (152 mm) inside diameter (round flue), 8" x 8" (203 x 203 mm) (square flue)

**Crate Dimensions:** H-40" W-29" L-36" or 102x74x 92cm

## Optional Equipment:

Outside Air Kit 96-53400  
 Blower Kit 96-57400

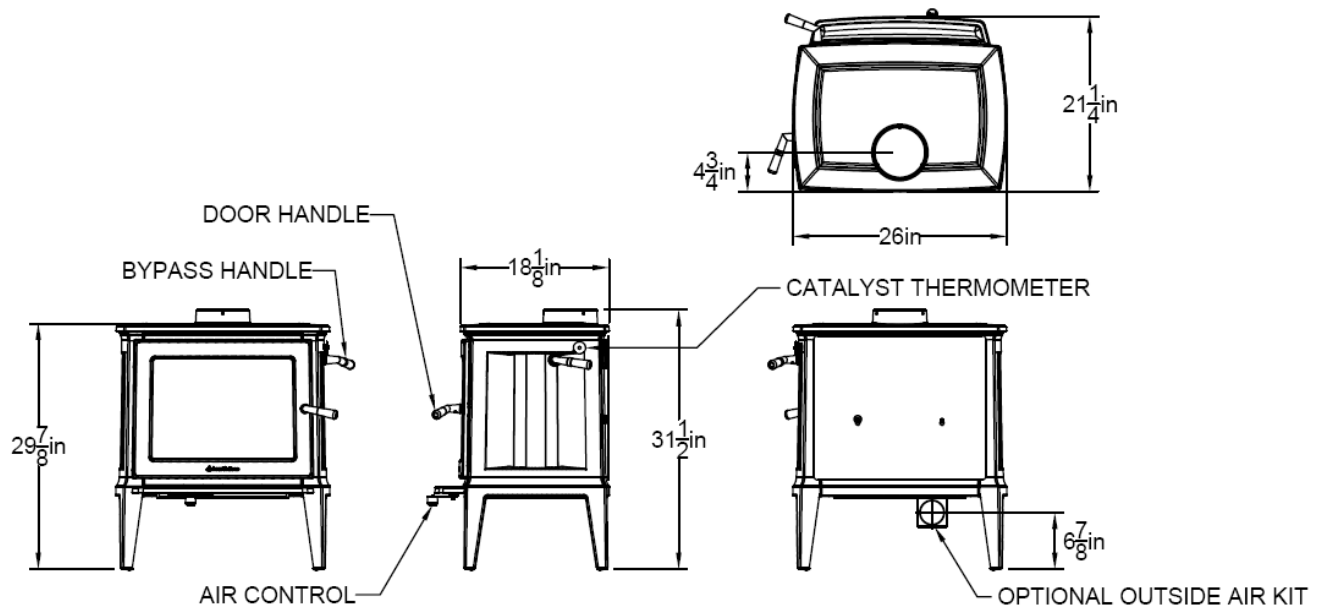


Figure 1 – Green Mountain 60 Dimensions



# INSTALLATION

## UNPACKING

Hearthstone packages your Green Mountain 60 woodstove with the greatest care so that it ships safely. Under certain circumstances, however, damage may occur during transit and handling. When you receive the Green Mountain 60, carefully unpack and inspect the stove and all accompanying parts. Ensure that all parts are included inside the stove. If any parts are damaged or missing, please contact your authorized Hearthstone dealer immediately.

## PACK LIST

Green Mountain 60 Model 8660 Woodstove  
Owner's Manual

The label is attached by a cable to the bottom of the stove. Take care when lifting the stove not to damage the label or cable. After final positioning of the stove, the label may be stored in the holding clip on the bottom shield of the stove.

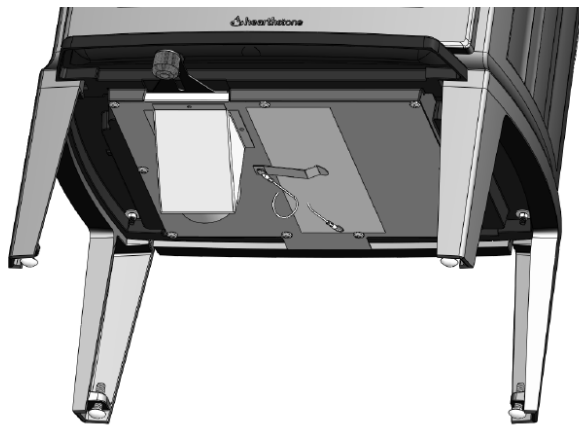


Figure 2 - Label Location

## INSTALLING YOUR STOVE

Choose a place to install your Green Mountain 60 woodstove. Consider the location of your stove for optimum heating efficiency. In general, it is better to place your stove in a main living area, rather than in a basement or other confined space.

Inspect this location to make sure that the stove and stovepipes will have the required clearance from combustible materials that are near the stove. Combustibles include walls, floor, ceiling, and chimney chase. You must carefully consider the clearances to all of these combustibles before actually connecting your stove.

If the floor is made of combustible material, then a non-combustible floor protector is required between the floor and the stove. An example of a non-combustible floor protector is a hearth constructed with a continuous layer of tile, brick, slate, glass or another non-combustible facing. There is no R-value requirement.

If you use a rear connector pipe, ensure it is listed with Underwriter's Laboratories. Check the listing of your pipe with UL for the correct clearances.

The diagrams in this manual represent typical installations, but are specific to the Simpson Dura-Vent DVL brand.

### Clearances to NFPA Code 211 Protected Surfaces

You can reduce the clearances to combustible surfaces by using any National Fire Protection Agency (NFPA) approved wall protection system with additional approval of the regulatory authority having jurisdiction in your area. Please refer to NFPA Code 211 for specifications and complete details. You can obtain this information directly from the NFPA.

### National Fire Protection Agency

Batterymarch Park  
Quincy, MA 02269  
1-800-344-3555  
1-617-770-3000  
[www.nfpa.org](http://www.nfpa.org)

## HEARTH REQUIREMENTS & FLOOR PROTECTION

Ensure you protect combustible flooring with a covering of noncombustible material. The Green Mountain 60 does not require an insulated hearth pad. The minimum floor protection must be met under the stove and extend beyond the stove as follows:

The minimum floor protection for US installations is 33 1/4in x 31-1/2in.  
 The minimum floor protection for installations in Canada is 42in x 43 1/2in.

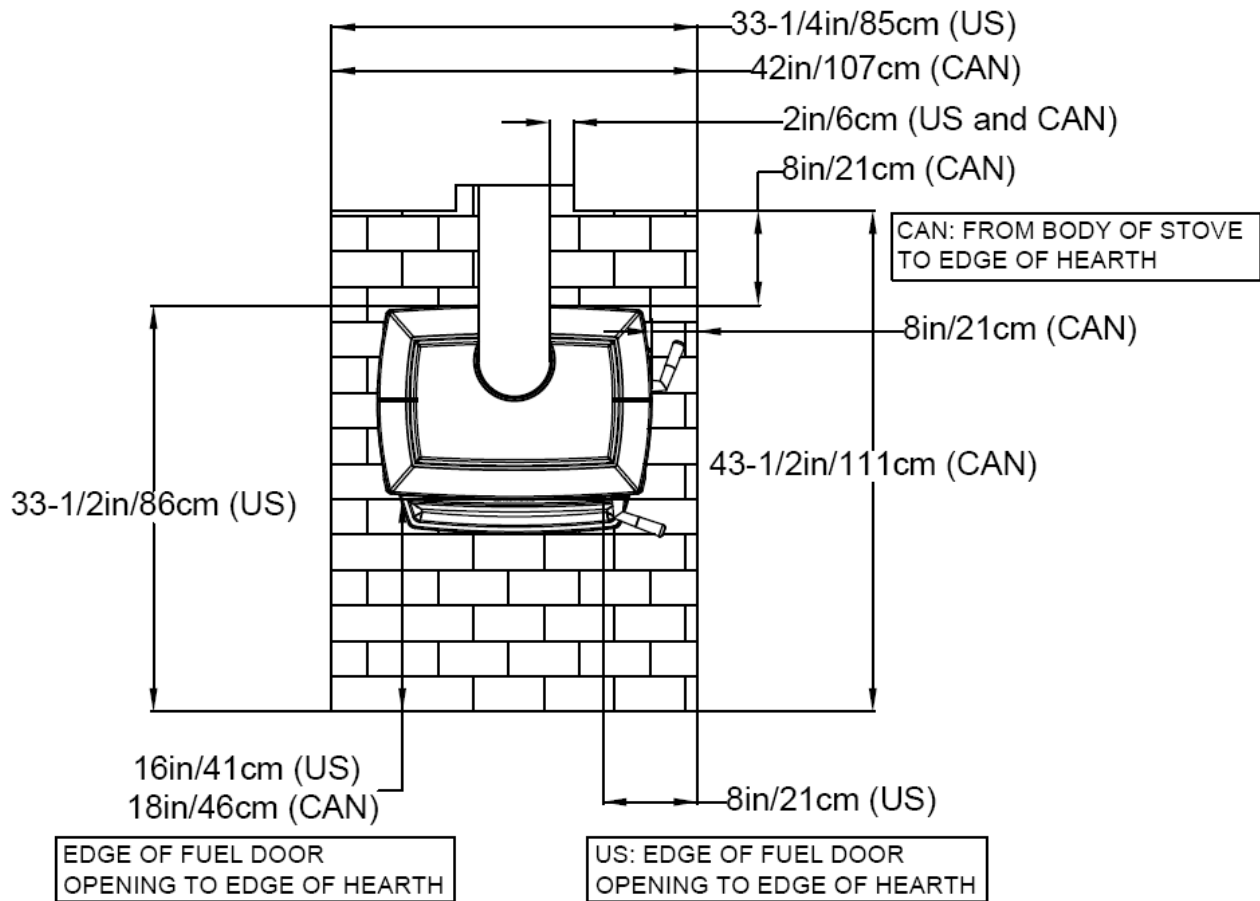


Figure 3 – Hearth Dimensions

## COMBUSTIBLE SURFACE REQUIRED CLEARANCES

**Note:** Dimensions shown in the following figures are from the body of the stove unless otherwise indicated.

It is very important to follow minimum clearances for chimney connectors to combustibles such as walls and ceilings when installing the stove near combustible surfaces.

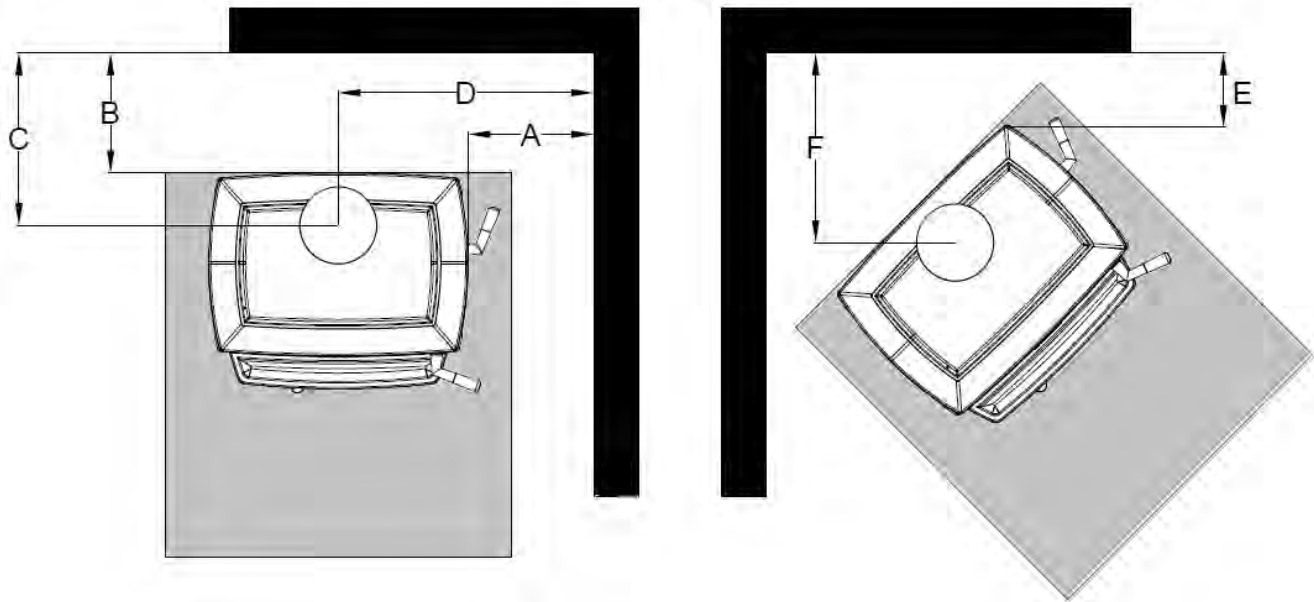


Figure 4 – Clearance to Combustibles

Clearances	Parallel				Corner	Corner
	A	B	C	D	E	F
Single wall Connector – Inc. Rear Heat Shield	13"-33cm	9"-23cm	14"-36cm	24.5"-63cm	6"-16cm	16.5"-42cm
Single Wall Connector – With Blower Kit Shield	13"-33cm	9"-23cm	14"-36cm	24.5"-63cm	6"-16cm	16.5"-42cm
Double Wall Connector – Inc. Rear Heat Shield	13"-33cm	7"-18cm	12"-32cm	24.5"-64cm	6"-16cm	16.5"-42cm
Double Wall Connector – With Blower Kit Shield	13"-33cm	7"-18cm	12"-32cm	24.5"-64cm	6"-16cm	16.5"-42cm
Alcove W/Single Wall Conn – Inc. Rear Heat Shield	13"-33cm	9"-23cm	14"-36cm	24.5"-63cm	6"-16cm	16.5"-42cm
Alcove W/Single Wall Conn – With Blower Kit Shield	13"-33cm	9"-23cm	14"-36cm	24.5"-63cm	6"-16cm	16.5"-42cm
Alcove W/Dbl Wall Conn – Inc. Rear Heat Shield	13"-33cm	9"-23cm	14"-35cm	24.5"-61cm	6"-16cm	16.5"-42cm
Alcove W/Dbl Wall Conn – With Blower Kit Shield	13"-33cm	9"-23cm	14"-35cm	24.5"-61cm	6"-16cm	16.5"-42cm

Alcove Clearances (inches)	Unprotected Surfaces	Protected Surfaces (NFPA-211)
Minimum alcove width	50" – 127cm	See NFPA-211
Min. Alcove ceiling from floor with single wall connector	56" – 142.3cm	See NFPA-211
Min. Alcove ceiling from floor with double wall connector	56" – 142.3cm	See NFPA-211

**FOR BLOWER KIT, USE KIT #96-57400**



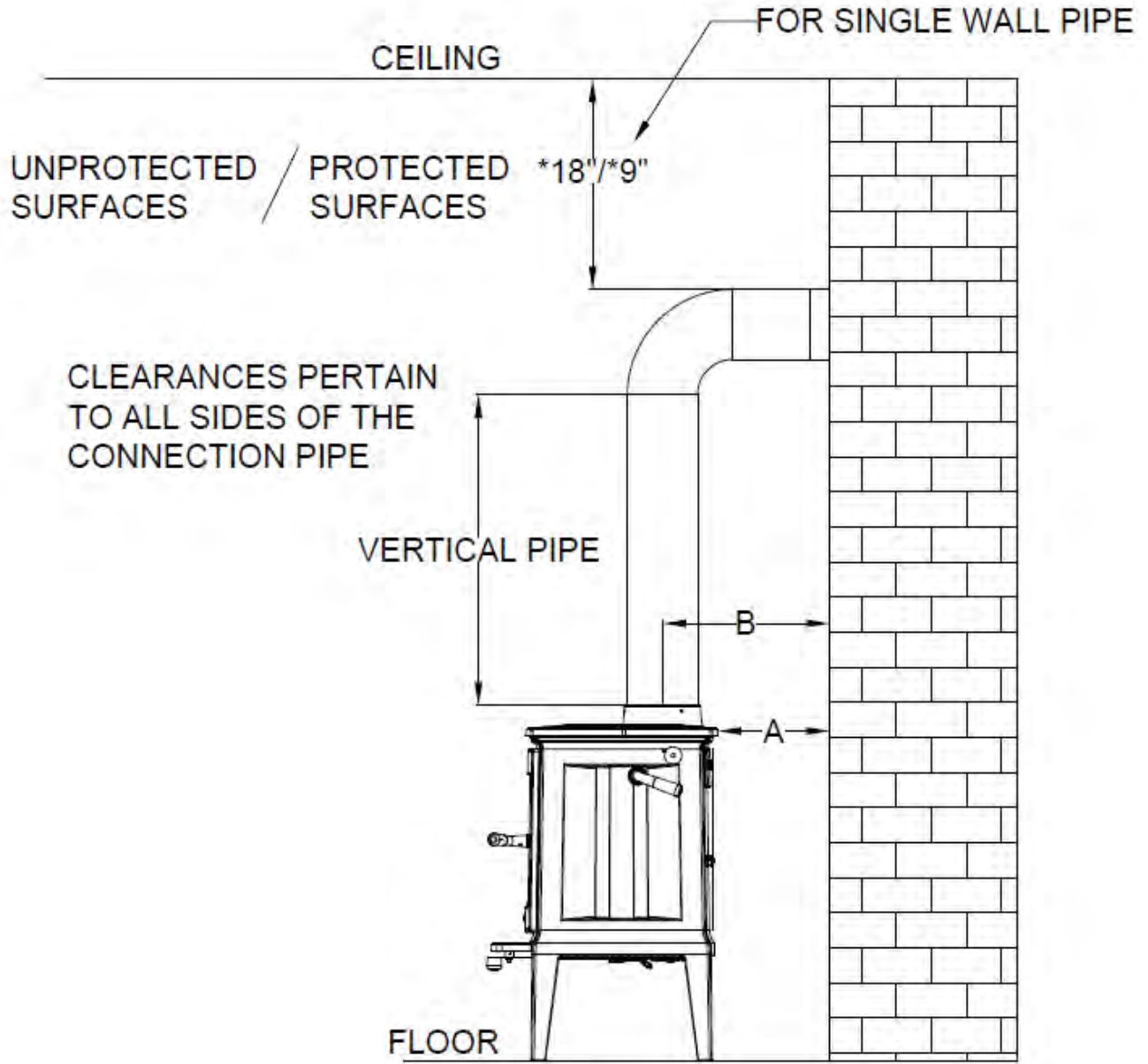


Figure 5 Chimney Connector Clearances

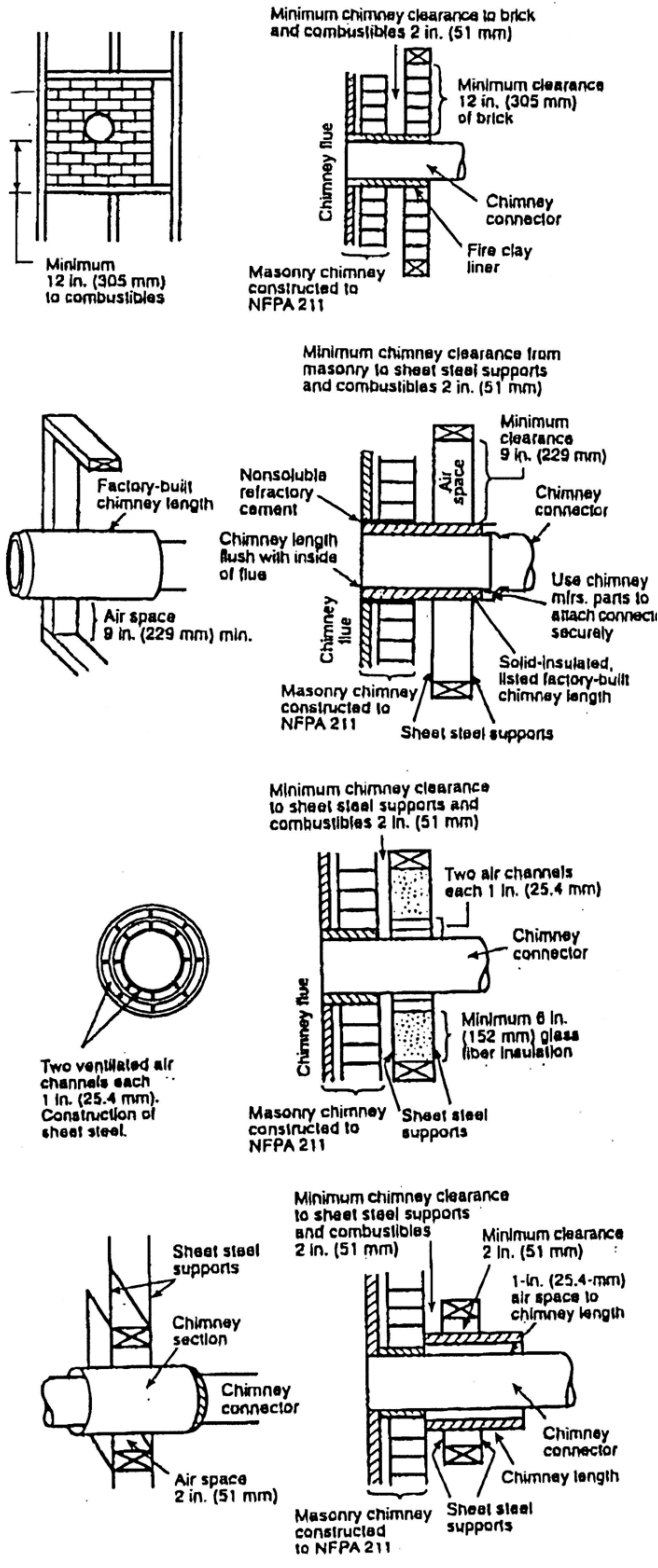
Through the wall top flue exit	Single Wall Pipe		Double Wall Pipe	
	With Blower Kit Shield**	Inc. Rear Heat Shield	With Blower Kit Shield**	Inc. Rear Heat Shield
A	9" (23cm)	9" (23cm)	7" (18 cm)	7" (18 cm)
B	14" (36 cm)	14" (36 cm)	12" (32cm)	12" (32cm)

\*For double wall pipe clearance to ceiling, refer to pipe manufacturer specifications.

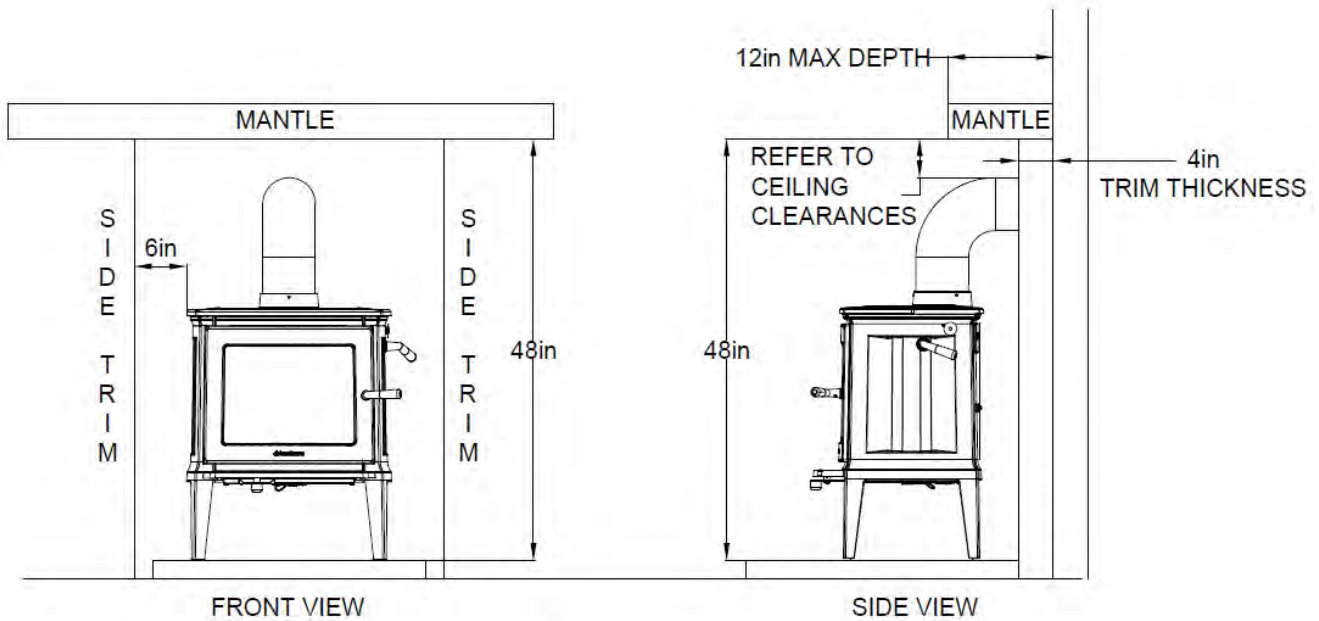
See Parallel Clearance to Combustibles for clearances to the sides of the stove.

\*\* FOR BLOWER KIT, USE KIT #96-57400

## CHIMNEY CONNECTOR SYSTEMS AND CLEARANCES FROM COMBUSTIBLE WALLS FOR RESIDENTIAL HEATING APPLIANCES



- A. Minimum 3.5in thick brick masonry all framed into combustibile wall with a minimum of 12in. brick separation from clay liner to combustibles. The fire clay liner shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.
- B. Solid-insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1in. or more of insulation with a minimum 9in. air space between the outer wall of the chimney length and combustibles.
- C. Sheet steel chimney connector, minimum 24 gauge in thickness, with a ventilated thimble, minimum 24 gauge in thickness, having two 1in. air channels, separated from combustibles by a minimum of 6in of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge in thickness.
- D. Solid insulated, listed factory-built chimney length with an inside diameter 2in. larger than the chimney connector and having 1in. or more of insulation, serving as a pass-through for a single wall sheet steel chimney connector of minimum 24 gauge thickness, with a minimum 2in. air space between the outer wall of chimney section and combustibles. Minimum length of chimney section shall be 12in. chimney section spaced 1in. away from connector using sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports securely fastened to wall surfaces of minimum 24-gauge thickness. Fasteners used to secure chimney section shall not penetrate chimney flue liner.



**CLEARANCES APPLY WITH STOVE IN FIREPLACE ALSO**

**Figure 6 Trim and Mantle Clearances**

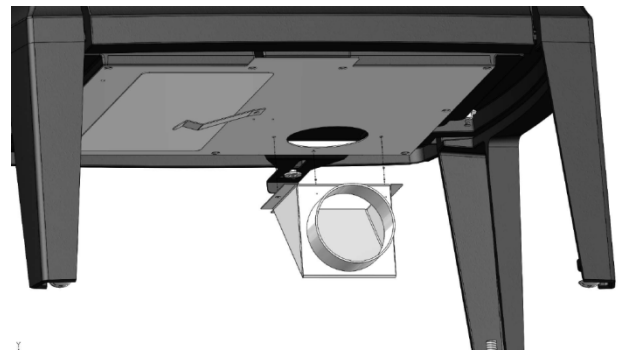
**OUTSIDE AIR SUPPLY**

(Optional Kit #96-53400)

You can connect an outside air source directly to this stove using an optional outside air kit. The advantage of providing outside air directly to the stove is that the air used by the stove for combustion is taken from outside the residence rather than from within the room where the stove is located.

The outside air kit for this stove allows for the direct connection of the stove's air intake to a minimum 3" (76 mm) diameter duct (supplied by others)\* which leads to the outside of the house. When considering placement of the duct from the outside of the house to the hearth, keep in mind the need to avoid structural members of the house. The outside air kit attaches to the underside of the stove. Refer to the instructions provided with the kit for installation.

\*An adaptor for 4" duct is available if needed. KIT #90-53308



**Figure 7 – Outside Air Kit Detail**

The International Residential Code (IRC) does not allow the outside air duct to terminate higher than the appliance. Some building officials restrict vertical rise in the duct's termination. Hearthstone recommends the termination be at the same level, or lower than the air intake on the stove.

Locate the termination of the duct on the outside wall of the home in such a manner to avoid the possibility of obstruction by snow, leaves or other material. Screen the termination using 1/4" x 1/4" mesh rodent screen and cover it with a rain/wind proof hood (flex pipe, outside termination, mesh, and hood supplied by others) Contact your dealer for availability.



## VENTING COMPONENTS & CONFIGURATION REQUIREMENTS

- **DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE USED BY ANOTHER APPLIANCE**
- Single wall connector that is at least 24 MSG or 25 MSG blued steel stovepipe.
- Double wall connector (Rear pipe) which is used with a listed, factory-built "Type HT" chimney or with a masonry chimney to reduce clearances, is available from several manufacturers, your dealer can help you choose. Some air insulated connector pipe models available are Simpson Dura Vent DVL and Metalbestos DS. Security, GSW and Ameritec also have acceptable Rear connector pipe.
- When used in a mobile home, a spark arrester is required. (See page 17)
- The chimney connector cannot pass through a floor or ceiling, nor any attic or roof space, closet or similar concealed space. Where venting requires passage through a wall or partition of combustible construction, the installation must conform to NFPA Code 211 or CAN/CSA - B365.
- Be sure to follow the manufacturer's instructions to maintain an effective vapor barrier at the location where the chimney of other component penetrates the exterior of the structure
- It is very important to follow minimum clearances for chimney connectors to combustibles such as walls and ceilings when installing the stove. Typical chimney connector clearances are outlined below. The single wall clearances are generic; the double wall clearances shown are specifically for Simpson DuraVent DVL and may vary with other brands. **Check the specifications from the manufacturer of your connector.**

### COMPONENTS OF A VENTING SYSTEM

The complete venting system consists of several components: chimney connector, wall thimble, wall pass-through, chimney, and liner. It is *absolutely necessary* that you install all of these components and maintain the clearances to combustibles discussed earlier to ensure a safe stove installation.

To protect against the possibility of a house fire, you *must properly install and constantly maintain the*

*venting system in good condition. Be sure to inspect the chimney and chimney connector and keep it clean.* Upon inspection, immediately replace rusted, cracked, or broken components. Failure to follow these instructions and specified components or using make-shift compromises can result in fire, property damage, bodily injury, and even death.

- The *chimney connector* is the stovepipe from the woodstove to the chimney. The chimney connector stovepipe is 6" (152 mm) diameter, 24 MSG or 25 MSG blued steel connector pipe. *Do not use aluminum or galvanized steel pipe* - they cannot withstand the extreme temperatures of a wood fire.
- The *thimble* is a manufactured (or site-constructed) device installed in combustible walls through which the chimney connector passes to the chimney. It keeps the walls from igniting. You must use a wall thimble when installing a chimney connector through a combustible wall to the chimney.
- A *wall pass-through* (or chimney support package) also keeps the walls from igniting. You must use one when connecting through a wall or ceiling to a prefabricated chimney.
- Only install this stove to a *lined masonry chimney* or an *approved high temperature prefabricated residential* type building heating appliance chimney. *Do not* connect this stove to a chimney serving another appliance; you will compromise the safe operation of both the wood stove and the connected appliance.
- A *liner* is the UL 1777 or ULC S635 (for factory built fireplace or masonry) chimney.

You must connect your stove to a chimney comparable to those recommended in this manual. *Do not use stovepipe as a chimney.* Use stovepipe for freestanding installations only to connect the stove to a proper chimney.

- **WARNING: DO NOT CONNECT THIS APPLIANCE TO ANY AIR DISTRIBUTION DUCT OR SYSTEM.**

### INSTALLING A VENTING SYSTEM

Attach stovepipe sections to the flue collar and to each other with the crimped end toward the stove. If creosote builds up, this allows the creosote to run into the stove and not on the outside of the stovepipe or onto the stove.

Secure all joints, including attaching the stovepipe to the stove's flue collar, with three sheet metal screws. Install #10 x 1/2" (3 mm x 13 mm) sheet metal screws into the holes pre-drilled in the flue collar. Disregarding the screws can cause joints to separate from the vibrations that result from a creosote chimney fire.

You can simplify connecting stovepipe by using additional accessories such as telescoping pipes, slip-connectors or clean-out tees. These accessories ease the periodic inspection of your chimney, as well as allow you to dismantle the stovepipe easily (without moving the stove).

Install the stove as close as practical to the chimney, while maintaining all proper clearances. Install stovepipe that is as short and as straight as possible. Horizontal runs of stovepipe must always rise away from the stove at a minimum of 1/4" per foot (21mm/m).

*We do not recommend long runs of stovepipe to increase heat dispersal.* Longer lengths of stovepipe, or more connecting elbows, than necessary increase the chances of draft resistance and the accumulation of creosote buildup.

In general, you do not need to install a stovepipe damper with the Green Mountain 60. Some installations, however, could benefit from a stovepipe damper, such as a tall chimney which can create a higher than normal draft. In such cases, a damper can help regulate the draft. The Green Mountain 60 requires a draft between 0.06" and 0.1" WC. For drafts above 0.1" WC, install a stovepipe damper. Check the draft at stove installation time.

Remember, the NFPA recommends minimum clearances for chimney connectors to combustibles such as walls and ceilings. Once the stove is installed at safe distances from these combustible surfaces, it is also important to maintain these connector clearances for the remainder of the installation.

## CONNECTING THE STOVE TO A CHIMNEY

You can install your Green Mountain 60 to a prefabricated metal chimney, or to a masonry chimney.

This room heater must be connected to (1) a listed Type HT (2100° F) chimney per UL 103 or ULC S629, or (2) a code-approved masonry chimney with a flue liner. The chimney size should not be less than the flue collar, or more than three times greater than the cross-sectional area of the flue collar.

We recommend installing a cleanout tee where possible to simplify chimney cleaning and maintenance.

## Connecting to a Prefabricated Metal Chimney

There are two ways to install a prefabricated metal chimney:

- An *interior* installation where the chimney passes inside the residence through the ceiling and roof.
- An *exterior* installation where the chimney passes through the wall behind the stove then up the outside of the residence.

Whenever possible, choose an interior chimney. An interior chimney heats up quickly and retains its heat; thus promotes a better draft and discourages the formation of creosote. An exterior chimney does not benefit from the warmth of the building, so it typically operates at lower flue temperatures than an interior chimney and may experience increased creosote accumulation.

When connecting the Green Mountain 60 to a prefabricated metal chimney, you must follow, precisely, the manufacturer's installation instructions. Use only Type HT (2100° F), prefabricated metal chimneys listed per UL 103 or ULC S629 standards.

Ensure the size of the prefabricated chimney's flue is appropriate for the Green Mountain 60. The Green Mountain 60 requires a 6" (152 mm) inside diameter flue for new installations. A 6" diameter flue provides adequate draft and performance. You can use an 8" (203 mm) diameter existing flue with a reducer. An oversized flue contributes to creosote accumulation. (In this case, bigger is NOT better.)

When purchasing a prefabricated chimney to install with your stove, Ensure you also purchase from the same manufacturer the wall pass-through (or ceiling support package), "T" section package, fire-stops (when needed), insulation shield, roof flashing, chimney cap, and any other required accessories. Follow the manufacturer's instructions when installing the chimney and accessories. In addition, ensure you maintain all manufacturers' recommendations for the proper clearances to the chimney.

## Connection to a Masonry Chimney

Consider two primary elements when connecting your stove to a masonry chimney: the chimney itself and the thimble where the stovepipe connects to the

chimney. **Use only code approved masonry chimneys containing a proper flue liner.**

Before connecting to a masonry chimney, hire a professional to examine the chimney for cracks, loose mortar, and other signs of deterioration and blockage. If the chimney needs repair, complete them before installing and using your stove. Do not install your stove until the chimney is safe for use.

Ensure the chimney's cleanout is complete and working properly. To avoid a loss of draft, the cleanout door must close completely and provide a tight seal. If the cleanout door leaks, the chimney will cool, your stove will perform poorly, and creosote can form.

Ensure the size of the chimney's flue is appropriate for this stove and that it is not too large. Use a masonry chimney with a maximum 6" Diameter or 8" x 8" (203 mm x 203 mm) tile size for best results. An oversized flue contributes to the accumulation of creosote.

Use the following checklist to ensure that your masonry chimney meets these minimum requirements:

#### MASONRY CHIMNEY WALL CONSTRUCTION:

- Mortared brick or modular block at least 4" (102 mm) thick – must use liner
- A mortared rubble or stone wall – must use liner

#### FLUE LINER OPTIONS:

- Tile - minimum wall thickness of 5/8" (16 mm), installed with refractory mortar, and with at least 1" (25 mm) air space around the liner

- Stainless steel - UL listed 6" diameter, insulated or wrapped liner, or the space around the liner filled with vermiculite or suitable material (these keep the liner warmer for better performance)
- Ensure any equivalent flue liner is a listed chimney liner system meeting type HT requirements or other approved material.

#### INTERIOR CHIMNEY REQUIREMENTS:

- Must have at least 2" (51 mm) clearance to combustible materials
- Must install fire stops at the spaces where the chimney passes through floors and/or ceiling
- Any insulation material must be at least 2" (51 mm) from the chimney

#### EXTERIOR CHIMNEY REQUIREMENTS:

- At least 1" (25 mm) clearance to combustible materials

#### CHIMNEY HEIGHT REQUIREMENTS (SEE FIGURE 9):

- At least 3 feet (0.9 m) higher than the highest part of the roof opening through which it passes.
- At least 2 feet (0.6 m) higher than any part of the roof within 10 feet (3 m) measured horizontally from the top of the chimney.

The recommended minimum chimney height is 10 feet (3 m) off the floor. The recommended maximum chimney height is 30 feet (9m). The Green Mountain 60 requires a draft between 0.06" and 0.1" water column. Ensure your chimney is long enough to provide the minimum draft, and use a damper if your installation has a required chimney height that provides too much draft.

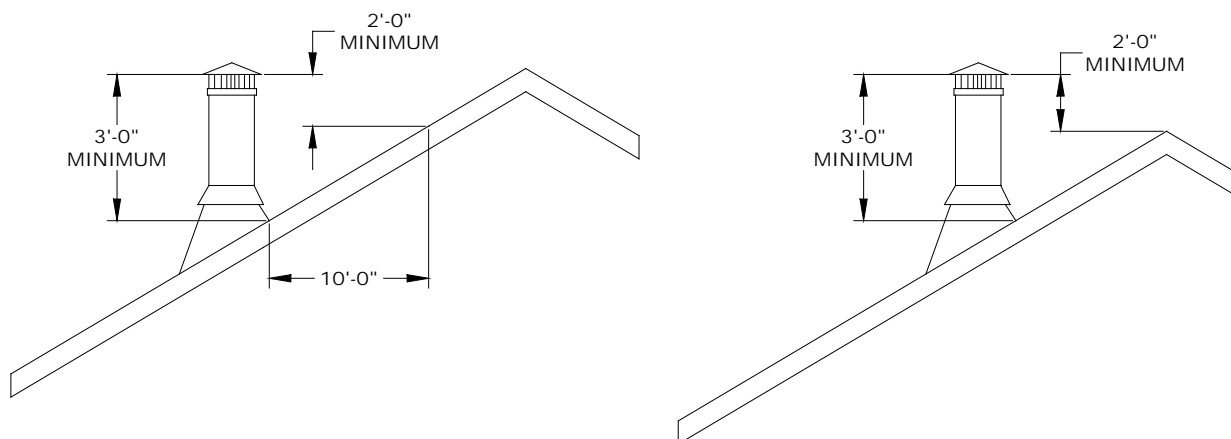
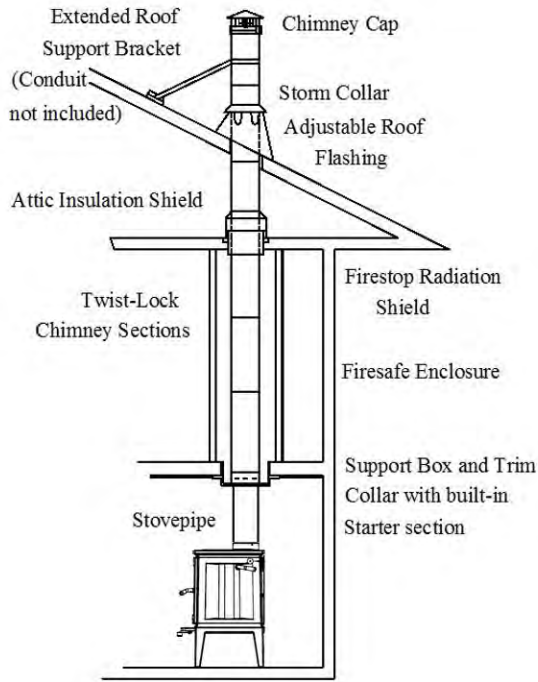
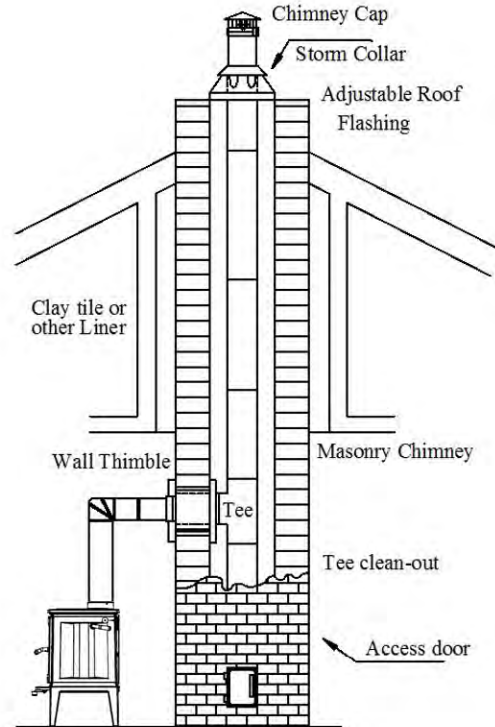


Figure 8 – Chimney Height Requirements

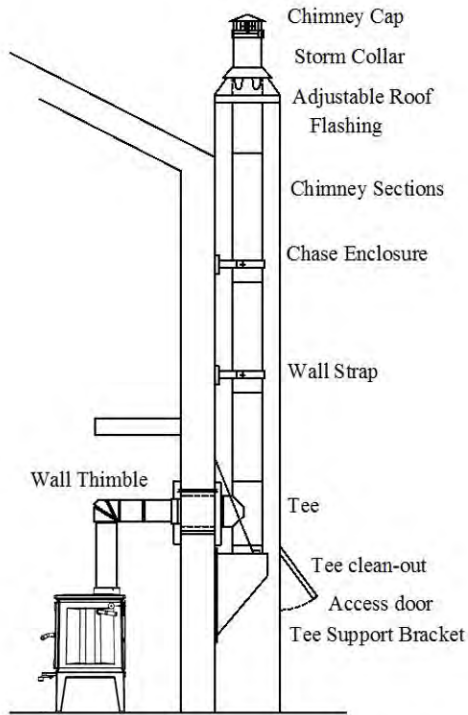




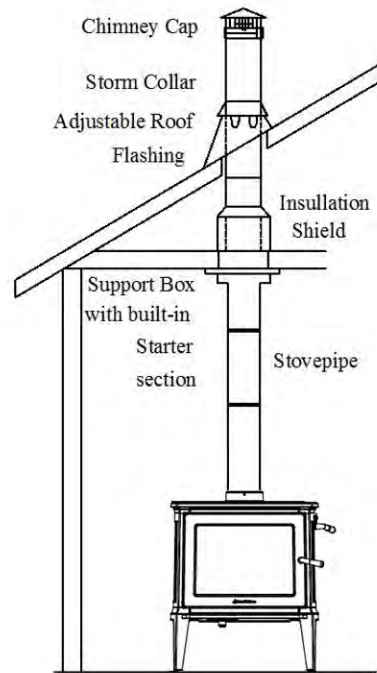
Two story house installation with attic.



Chimney pipe through Clay tile or other Lined Masonry Chimney



Chimney through outer wall with enclosed chase.



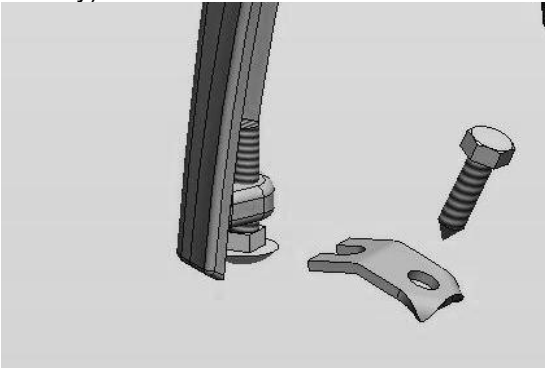
One story house installation with attic.

**Figure 9 – Typical Chimney Configurations**

## INSTALLING IN A MOBILE HOME

Follow these special requirements for installing your stove in a mobile home.

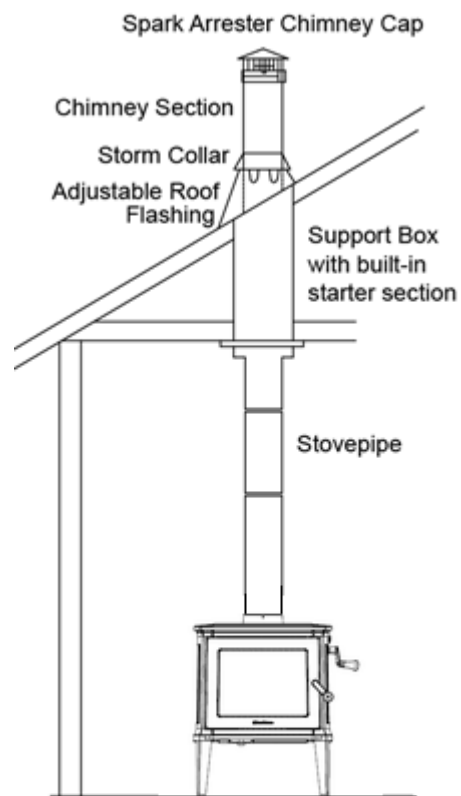
- Install the stove in accordance with 24 CFR, Part 3280 (HUD)
- An outside air kit must be used in all mobile home installations. See page 12 for details.
- Permanently attach the stove to your mobile home's floor. Use the shipping clips that came with the stove and fasteners long enough to attach securely to the subfloor. (The clips and fastener heads may be painted to minimize visibility).



**Figure 8 - Lock Down Detail**

- Install a Mobile Home Chimney & Connector Kit\*.  
Each kit must include:  
Stainless spark arrester cap, storm collar, Adjustable vented flashing – 0/12 – 6/12, Two 24" chimney pipes, 24" support box with built-in starter section and trim.  
\* Install a Mobile Home Chimney and Connector Kit conforming to US/UL103 or CAN/ULC-S629, Standard for Factory-Built Chimneys.
- **WARNING: DO NOT INSTALL IN A SLEEPING ROOM IN A MOBILE HOME.**
- **CAUTION: MAINTAIN THE STRUCTURAL INTEGRITY OF THE MOBILE HOME WALLS, FLOOR, CEILING, AND ROOF WHEN INSTALLING AND USING YOUR STOVE.**
- **FAILURE TO FOLLOW THESE INSTRUCTIONS AND SPECIFIED COMPONENTS OR USING MAKE-SHIFT COMPROMISES CAN RESULT IN FIRE, PROPERTY DAMAGE, BODILY INJURY, AND EVEN DEATH.**

- Burning any fuel other than wood in this unit could generate dangerous levels of carbon monoxide within the living space.
- **THE FRONT DOOR MUST REMAIN CLOSED WHEN IN OPERATION EXCEPT FOR START UP AND LOADING.** Leaving the door open during use could cause any smoke or fire detectors in the home to be set off or a fire could escape the firebox and start the room on fire.
- If this unit is installed in a mobile home, care must be taken to ensure adequate air is available. If not enough air is available it could starve the room of all the oxygen. (See page 27 for more details)



**Mobile home installation.**  
One story house installation with attic.  
Chimney is supported by Ceiling.

**Figure - 9**

- **CAUTION: REMOVE THE CHIMNEY WHEN TRANSPORTING THE MOBILE HOME!**
- Be sure to follow the manufacturer's instructions to maintain an effective vapor barrier at the location where the chimney or other component penetrates the exterior of the structure

# OPERATION

Once your Green Mountain 60 is installed, you are ready to light a fire.

Every installation, season's firewood, and operator's technique varies. Learn how to use your stove most efficiently for your installation. We can give you the basic principles, but only you can ensure maximizing the potential of your stove while also operating it safely.

- **WARNING: HOT WHILE IN OPERATION! KEEP CHILDREN, PETS, CLOTHING AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS.**

Read this entire chapter before lighting your first fire. It explains the controls and features of your wood stove, how to choose firewood, and how to use your stove on a daily basis.

## CONTROLS AND FEATURES

Before lighting any fires, become familiar with the location and operation of your stove's controls and features and learn how to use them (See Figure 10). For your own safety, do not modify these features in any way. We recommend you use fireplace gloves when the stove is in operation and hot.



Figure 10 - Controls & Features

**FRONT DOOR HANDLE:** The firebox door allows you to load wood into your stove; a wood handle operates the door. To open the door, pull up on the handle and swing the door away from the stove. To latch the door, push the door tightly towards the firebox then continue to push the handle in and down until it latches shut. Gently pull on the door handle to make sure it is properly latched.

**PRIMARY AIR CONTROL:** The primary air control lever is located under the ash lip. The primary air control allows you to regulate the amount of air

entering the firebox. Generally, the more air allowed into the firebox, the faster the rate of burn and the higher the heat output; conversely, less air creates a slower burn, with lower heat output. For maximum airflow, pull the lever out as far as possible; move the lever inwards as far as possible for minimum airflow (does not close completely).

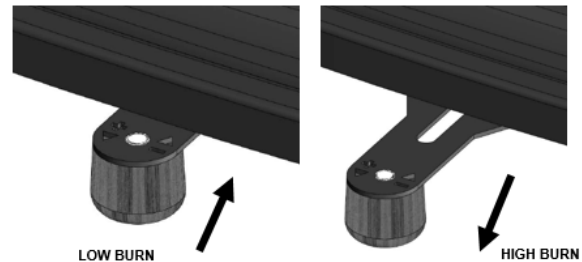


Figure 11 – Air Control

**BYPASS HANDLE:** The bypass handle controls the bypass door inside the stove. When the handle is pointed towards the front of the stove, the bypass door is open, and when the handle is pointed towards the rear of the stove, the bypass door is closed. The bypass door directs the flow of combustion products through or around the catalytic combustor. When the bypass handle is open, combustion products are directed around the catalytic combustor. The bypass handle should be open when first starting a fire until the catalytic combustor heats up to activation temperature, and whenever opening the front door to load the stove. When the bypass handle is closed, combustion products are directed through the catalytic combustor. The bypass handle should be closed once the catalytic combustor heats up to activation temperature, and remain closed whenever the stove is burning and in the active temperature range.

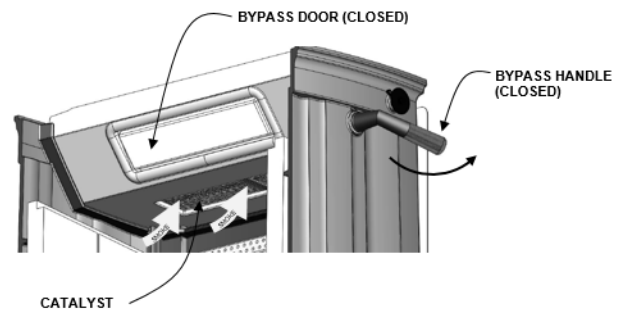


Figure 12 – Bypass Closed

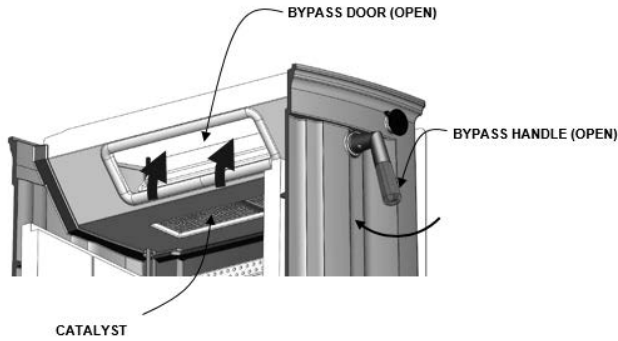


Figure 13 – Bypass Open

**CATALYST THERMOMETER:** The catalyst thermometer monitors the downstream temperature of the catalysts, and indicates when the stove is in the active range for the catalysts. When the stove is in the “active” range, the bypass handle should be closed. When the stove is in the “Inactive” range, the bypass handle should be opened until the stove heats up. If the thermometer is in the “Too Hot” range, keep the door closed, fully close the air control, and allow the stove to cool down until the thermometer falls into the “Active” Range. Once the catalyst thermometer has reached the active range, heat generated from burning smoke keeps the catalysts warm and active as long as fuel remains in the stove. The Green Mountain 60 typically operates in the 800 °F to 1300 °F range.



Figure 14 – Catalyst Thermometer

## CHOOSING FIREWOOD

Burn only natural firewood (known as cordwood) in the Green Mountain 60 Model 8660 Wood Heater. This stove is not designed to burn other fuels.

- **CAUTION: DO NOT USE CHEMICALS OR FLAMMABLE FLUIDS TO START THE FIRE. DO NOT USE CHARCOAL, PELLETS, COAL, ARTIFICIAL LOGS OR ANY OTHER MATERIALS AS FUEL; THEY ARE NOT SAFE. DO NOT BURN GARBAGE OR FLAMMABLE FLUIDS.**
- **THE USE OF UNAUTHORIZED FUEL SUCH AS COAL COULD PRODUCE HIGH LEVELS OF CARBON DIOXIDE IN THE LIVING SPACE. AT HIGH LEVELS CARBON DIOXIDE COULD RESULT IN PERSONAL INJURY OR DEATH.**

The quality of your firewood directly affects heat output, duration of burn and performance of your stove. Softwoods generally burn hotter and faster, while hardwoods burn longer and produce better coals. Density and moisture content are two critical factors to consider when purchasing wood.

The following is a list of some wood species and their relative BTU (British Thermal Unit) content. The higher the BTU content, the longer the burn. Firewood with higher BTUs is generally ideal for a wood stove.

Burn untreated wood only. Other materials such as wood preservatives, metal foils, coal, plastic, garbage, sulphur, or oil may damage the catalysts.

Wood Heat Value: Sorted By Btu Content		
Common Name	Lb/ cord	MBTU/ cord
<b>High</b>		
Osage Orange (Hedge)	4,728	32.9
Hickory, Shagbark	4,327	27.7
Hop Hornbeam (Ironwood)	4,267	27.3
Beech, Blue (Ironwood)	3,890	26.8
Birch, Black	3,890	26.8
Locust, Black	3,890	26.8
Hickory, Bitternut	3,832	26.7
Locust, Honey	3,832	26.7
Apple	4,100	26.5
Mulberry	3,712	25.8
Oak, White	4,012	25.7
<b>Medium High</b>		
Beech, European	3,757	24
Maple, Sugar	3,757	24
Oak, Red	3,757	24
Ash, White	3,689	23.6
Birch, Yellow	3,689	23.6



<b>Medium</b>		
Juniper, Rocky Mtn	3,150	21.8
Elm, Red	3,112	21.6
Coffee tree, Kentucky	3,112	21.6
Hackberry	3,247	20.8
Tamarack	3,247	20.8
Birch, Gray	3,179	20.3
Birch, White (Paper)	3,179	20.3
Walnut, Black	3,192	20.2
Cherry	3,120	20
Ash, Green	2,880	19.9
Cherry, Black	2,880	19.9
Elm, American	3,052	19.5
Elm, White	3,052	19.5
Sycamore	2,808	19.5
Ash, Black	2,992	19.1
Maple, Red	2,924	18.7
Fir, Douglas	2,900	18.1
<b>Medium Low</b>		
Boxelder	2,797	17.9
Alder, Red	2,710	17.2
Pine, Jack	2,669	17.1
Pine, Norway (Red Pine)	2,669	17.1
Pine, Pitch	2,669	17.1
Catalpa	2,360	16.4
Hemlock	2,482	15.9
Spruce, Black	2,482	15.9
Pine, Ponderosa	2,380	15.2
<b>Low</b>		
Aspen, American	2,290	14.7
Butternut (Walnut, White)	2,100	14.5
Spruce	2,100	14.5
Willow	2,100	14.5
Fir, Balsam	2,236	14.3
Pine, White (Eastern, Western)	2,236	14.3
Fir, Concolor (White)	2,104	14.1
Basswood (Linden)	2,108	13.8
Buckeye, Ohio	1,984	13.8
Cottonwood	2,108	13.5
Cedar, White	1,913	12.2

Moisture content also plays a key role in the performance of your stove. Wood freshly cut from a

living tree (green wood) contains a great deal of moisture. As you might expect, green wood burns poorly. You must season green wood before using it in your wood stove. To season green wood properly, split, stack, and allow it to air dry for a period of one year. Green wood may provide less than 2000 Btu per pound, whereas dry wood can provide up to 7000 Btu per pound.

Stack the firewood on skids or blocks to keep it off the ground, cover only the top of the stack. Plastic or tarps that cover the sides of the woodpile trap moisture and prevent the wood from drying. As for stacking, an old Vermonter said, "The spaces between the logs should be large enough for a mouse to get through, but not for the cat that's chasing it."

- **CAUTION: DO NOT STORE FIREWOOD WITHIN THE STOVE'S SPECIFIED CLEARANCES TO COMBUSTIBLE MATERIALS.**

#### **BUILDING A FIRE**

Once you understand the controls of your wood stove and have the appropriate firewood, you are ready to start a fire.

- **WARNING: NEVER USE GASOLINE, GASOLINE-TYPE LANTERN FUEL, KEROSENE, CHARCOAL LIGHTER FLUID, OR SIMILAR LIQUIDS TO START OR 'FRESHEN UP' A FIRE IN THIS HEATER. KEEP ALL SUCH LIQUIDS WELL AWAY FROM THE HEATER WHILE IT IS IN USE.**

#### **BREAKING IN YOUR WOOD STOVE**

It is imperative that your stove is "broken in" gradually. Soapstone must be "seasoned"; over-firing a new stove may cause soapstone to crack or may damage other stove parts. Natural moisture in the freshly quarried soapstone must be driven out slowly to minimize the "shock" to the stone of its first exposure to high firebox temperatures. In addition, the asbestos-free furnace cement must be cured slowly to ensure adequate sealing and bonding.

When you light your first fires, the woodstove will emit some smoke and fumes. This is normal "off-gassing" of the paints and oils used when manufacturing the woodstove. If you find it necessary, open a few windows to vent your room. The smoke and fumes will usually subside after 10 to 20 minutes of operation. The odor and smoke will end once the stove is "cured".

The first few fires of the season may produce other odors from impurities that exist in the area immediately surrounding the stove. Some potential impurities are cleaning solvents, paint solvents,

cigarette smoke, and soot from scented candles, pet hair, dust, adhesives, a new carpet, and new textiles. These odors will dissipate over time. You can alleviate these odors by opening a few windows or otherwise creating additional ventilation around your stove. If any odor persists, contact your dealer or an authorized service technician.

If you adhere to the operating procedures in this manual, the steel, cast iron, and soapstone components of your stove will give you many years of trouble-free use. With use, the color of the soapstone may change and small fractures may appear on the surface. These changes do not affect the function of the stove. If a panel breaks completely, it must be replaced.

Avoid the following conditions that can cause the glass, soapstone, steel or cast iron pieces to break:

- Do not throw wood into the stove.
- Do not use the door as a lever to force wood into the stove.
- Do not load wood encrusted with ice into a burning stove - the thermal shock can cause damage.
- Do not use a manufactured log grate or otherwise support the fuel. Burn the fire directly on the floor of the firebox.

### BUILDING A BREAK IN FIRE

- 1) Open the bypass handle. Open the front door and place five or six double sheets of tightly twisted newspaper in the center of the firebox. Arrange kindling in a crisscross pattern over the newspaper. Kindling should be approximately ten pieces, 1/2" (13 mm) in diameter and 10" to 16" (254 mm to 457 mm) long.
- 2) Fully open the primary air control by pulling the control handle towards you, away from the firebox.
- 3) Light the paper under the kindling. Leave the door slightly ajar momentarily until the kindling has started to burn and draft begins to pull.
- 4) Close the door and allow the fire to burn. Keep the door closed while the stove is in use.
- 5) KEEP A WATCHFUL EYE ON YOUR STOVE to maintain a steady, low-heat fire. Your first fire should make the stove warm but **not hot to the touch**. Visible steam, or boiling moisture and hissing indicate the soapstone is too hot. At most, a few small chunks of wood should be added to the fire to reach safe break-in temperatures.

- 6) Once the stove is warm but **not hot to the touch**, close the primary air control by pushing it fully inward toward the stove to allow the fire to die out completely.

- 7) Let the stove return to room temperature.

Your first fire and first fire each season thereafter should be built and maintained as outlined above. Your patience will be rewarded by a properly seasoned stove.

- NOTE: The cool flue gas temperatures present during the break-in procedure may cause rapid creosote build-up. The door glass may also get dirty. A good hot fire will clean it. We recommend a visual inspection (and cleaning if necessary) of your stovepipe and chimney once the break-in procedure is completed.

## NORMAL OPERATION

### BUILDING A FIRE FOR EVERYDAY USE

- 1) Open the bypass handle. Open the front door and place five or six double sheets of tightly twisted newspaper in the center of the firebox. Arrange kindling in a tee-pee configuration over the newspaper. Use approximately 10 pieces of kindling, 1/2" (13 mm) in diameter and 10" to 16" (254 mm to 406 mm) long.
  - 2) Fully open the primary air control by pulling the lever completely out, away from the firebox.
  - 3) Light the paper under the kindling. Leave the front door slightly ajar momentarily until the kindling begins to burn and draft begins to pull.
  - 4) Close the door and allow the fire to burn.
  - 5) Once the kindling is burning, open the front door and add logs, small at first, to build the fire up. Ensure you keep the logs away from the glass in front in order for the air-wash system to work properly. Keep the front door closed while the stove is in use.
- CAUTION: DO NOT BUILD THE FIRE TOO CLOSE TO THE GLASS. KEEPING THE FIRE TOWARDS THE CENTER OF THE FIRE BOX WILL KEEP COALS FROM BUILDING UP AGAINST THE GLASS DURING RELOADING.**
- 6) Once the fire is burning well, and the catalyst thermometer indicates that the stove is in the active range, close the bypass handle. Now the combustion products are passing through the catalytic combustor, and your stove will be burning at its optimal efficiency.

- 7) After closing the bypass door, allow the stove to run on a high setting for around 20 minutes to ensure the catalytic combustor stays in the active range. This will also allow the fire to burn off any residue on the door glass from any previous low-burn fires
- 8) Use the primary air control to regulate the desired rate of burn. Pull the handle towards you for a higher burn rate, and push the handle towards the stove for a lower burn rate. The air control does not close completely.

**Note:** Always remember to open the bypass handle before opening the front door. When opening the front door to reload or re-arrange logs, it is advisable to open the door just a crack, pause for a moment then open the door completely. This procedure allows the firebox to clear of smoke before the door is open fully. In addition, reloading on a bed of hot, red coals reduces smoking time and brings fresh fuel up to a high temperature rapidly. During the refueling and rekindling of a cool fire, or a fire that has burned down to the charcoal phase, operate the stove at a medium to high firing rate for about 10 minutes to ensure that the catalysts reach approximately 600 °F. Once the catalysts reach operating temperature, the bypass handle can be closed. When reloading the stove, try to keep an open path behind the Lower Primary Air Opening (LPAO). It is helpful to leave a small valley in the coal bed behind the LPAO to insure faster re-lighting.

### CATALYTIC COMBUSTOR OPERATION

The Green Mountain 60 uses a catalytic combustor to ensure highly clean and efficient burns. The catalytic combustor is made from a stainless steel corrugation that is coated with a catalytic material. The catalytic combustor becomes active around 500 °F (260°C), helping to burn up smoke and any remaining particles that were not fully burned in the firebox. During the startup of a cold stove, a medium to high firing rate must be maintained for about 20 minutes. This ensures that the stove, catalysts, and fuel are all stabilized and at proper operating temperatures. Even though it is possible to have gas temperatures reach 500 °F (260°C) within 2 to 3 minutes after a fire is started, if the fire is allowed to die down immediately, it may go out or the combustor may stop working. Once the stove and catalytic combustor heat up, heat generated from burning smoke keeps the catalysts warm and active as long as fuel remains in the stove. You stove will burn the cleanest and most efficiently when the catalysts are in the active range. There should be

little to no visible smoke from your chimney when the catalysts are in the active zone and fully functional.

### BURN RATE

**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**

**LOW BURN:** Move the air control lever all the way inward toward the stove. (See figure 13). This closes the air shutter to its minimum opening. A low burn rate over extended periods is not advisable as it can promote the accumulation of creosote. Inspect the venting system frequently if using low burn rates consistently.

**MEDIUM LOW BURN:** With the primary air control in the low position, pull the air control forward (a little less than 1/4"). A medium-low burn rate is the typical setting and is preferable if the stove is unattended. At this burn rate, a little goes a long way.

**MEDIUM HIGH BURN:** With the primary air control in the low position, pull the air control forward (a little less than 1/2")

**HIGH BURN:** Completely open the primary air control by moving it all the way outward toward the operator. Fully load the firebox with wood on a bed of hot coals or on an actively flaming fire. To minimize creosote accumulation, run the stove on high once or twice daily for 35 to 45 minutes to fully heat the stovepipe and chimney.

**CAUTION:** Do not burn fuel other than cordwood in your stove.

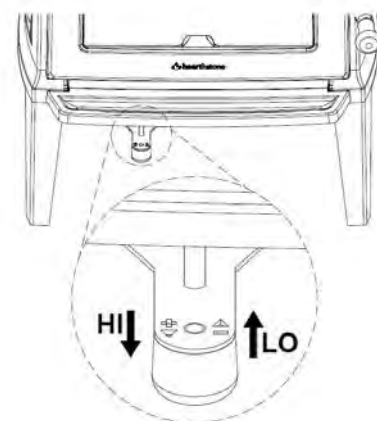


Figure 15 – Air Control Position

## OVER-FIRE CAUTION

Over-firing means the stove is operating at temperatures above normal temperatures reached during High Burns outlined in the *BURN RATE* section. Carefully avoid over-firing, as it will damage the stove. Symptoms of chronic over-firing can include warped components, short burn times, a roaring sound in the stove or stovepipe, and discoloration of the stovepipe. A properly installed stove using fuel and following operating procedures as outlined in this manual should not over-fire.

Excessive draft, inappropriate fuel, and operator error can cause over-firing. Correct an over-fire situation as follows:

- **EXCESSIVE DRAFT:** Contact your local dealer to have a draft reading taken. Any draft in excess of 0.1 WC requires a damper in the stovepipe. Some installations may require more than one damper.
- **INAPPROPRIATE FUEL:** Do not burn coal; kiln dried lumber, wax logs, compressed wood, highly volatile fuels or combustibles, or anything other than natural cordwood.
- **OPERATOR ERROR:** Ensure all the gaskets are in good condition. Replace worn out or compressed gaskets. Only burn the stove with the firing and ash doors in the closed position.

If you suspect your stove is over-firing, discontinue use and contact your dealer immediately. **Damage caused by over-firing is not covered by your warranty.** Results of over-firing can include warped or burned out internal parts, cracked refractory panels, discolored or warped external parts, and damaged finish.

- **ANY SIGNS OF OVER-FIRING WILL VOID YOUR WARRANTY!**
- **THE FRONT DOOR MUST REMAIN CLOSED WHEN IN OPERATION**

## REMOVAL AND DISPOSAL OF ASHES

You can leave a thin layer of ashes in the firebox if preferred. Allow fire to die down or go out

completely. It is important to prevent ashes from building up around the front door opening or they will spill out, or they can pack into the gasket channel and prevent proper sealing. To remove ashes, use a fireplace shovel. Avoid removing large live coals by pushing them to the side and removing only the finer ash with a shovel.

Disposal of ashes - Ashes should be placed directly into a **metal** container with a tight fitting lid. Do not place any other items or trash into the metal container. Do not pour water into the container. Replace the container's lid and allow the ashes to cool. Never place the ash disposal container on a combustible surface or vinyl flooring, as the container could be **hot!**

Pending disposal, place the closed ash container on a noncombustible floor or on the ground outside, well away from all combustible materials, liquid fuels, or vehicles. Retain ashes in the closed container until all coals thoroughly cool.

If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in the closed container until all cinders have thoroughly cooled.

**NEVER** place ashes in wooden or plastic containers, in trashcans with other trash, or in paper or plastic bags, no matter how long the fire has been out. Coals within a bed of ashes can remain hot for several days once removed from the firebox.



# MAINTENANCE

## CATALYTIC COMBUSTOR INSPECTION AND REPLACEMENT PROCEDURES

- **WARNING: THIS WOOD HEATER CONTAINS A CATALYTIC COMBUSTOR, WHICH NEEDS PERIODIC INSPECTION AND REPLACEMENT FOR PROPER OPERATION. IT IS AGAINST FEDERAL REGULATIONS TO OPERATE THIS WOOD HEATER IN A MANNER INCONSISTENT WITH OPERATING INSTRUCTIONS IN THIS MANUAL, OR IF THE CATALYTIC ELEMENT IS DEACTIVATED OR REMOVED**

It is important to periodically monitor the operation of the catalytic combustor to ensure that it is functioning properly and to determine when it needs to be replaced. A non-functioning combustor will result in a loss of heating efficiency, and an increase in creosote and emissions. Following is a list of items that should be checked on a periodic basis

-Combustors should be visually inspected at least three times during the heating season to determine if physical degradation has occurred. Actual removal of the combustor is not recommended unless more detailed inspection is warranted because of decreased performance. If any of these conditions exists, refer to Catalyst Troubleshooting section of this owner's manual.

-This catalytic (or hybrid) heater is equipped with a thermometer to monitor catalyst operation. Properly functioning combustors typically maintain temperatures in excess of 500 °F, and often reach temperatures in excess of 1,000 °F. If catalyst temperatures are not in excess of 500 °F, refer to the

Catalyst Troubleshooting section of this owner's manual.

-You can get an indication of whether the catalysts are working by comparing the amount of smoke leaving the chimney when the smoke is going through the combustor and catalysts light-off has been achieved, to the amount of smoke leaving the chimney when the smoke is not routed through the combustor (bypass mode).

1. Light stove in accordance with operator's instructions
2. With smoke routed through the catalysts, go outside and observe the emissions leaving the chimney.
3. Engage the bypass mechanism and again observe the emissions leaving the chimney. Significantly more smoke will be seen when the exhaust is not routed through the combustor (bypass mode)

## INSPECTING THE CATALYSTS AND REMOVING/REPLACING THE BAFFLE

1. Allow the stove and ashes to fully cool.
2. Remove the metal baffle protector by sliding it to the left or right, and then rotating it towards you.
3. Lift up on the right side baffle, and gently pull the left side baffle down and out of the stove

**CAUTION - Do not force the baffle pieces. Gently adjust the baffle orientation until each side can be removed freely from the stove.**



Figure 16 - Removing/Replacing the Baffle for Inspection



**Figure 18 (cont.) - Removing/Replacing the Baffle for Inspection**

4. Use a small vacuum nozzle or soft bristled brush to remove any accumulated ash or soot on the face of the catalysts.
  5. Inspect the catalysts for any unusual warping, corrosion, or plugged openings.
  6. If any unusual conditions are found, remove the catalyst blocks – See replacing the catalysts.
  7. Replace the baffles and baffle protector. Installation is the opposite of removal.
  8. Ensure that the baffle pieces are pushed together at the center joint.
5. Inspect the catalysts for visible damage or fly ash. If fly ash exists, gently brush the catalysts off with a narrow soft-bristle brush, or vacuum with a crevice tool.
  6. If fly ash exists, or if there are suspected catalyst performance issues, fully remove the catalysts by gently pulling upwards from the ribs in the cast iron, and then pulling outwards through the catalyst access opening.
  7. Remove any remaining gasket material from the opening and from the catalysts.
  8. Inspect the catalysts for any fly ash or clogging, and remove with a soft bristled brush or vacuum crevice tool. If extra cleaning is needed, follow the guidelines below:
    - You may use compressed air under 35 psi, air only, no chemicals.
    - You may soak the catalysts in a hot water mix (not boiling), 4 parts water, 1 part vinegar. Rinse with cold water until vinegar smell is mostly gone.
    - No metal tools such as gun cleaners should be used.
    - No detergents or chemicals.

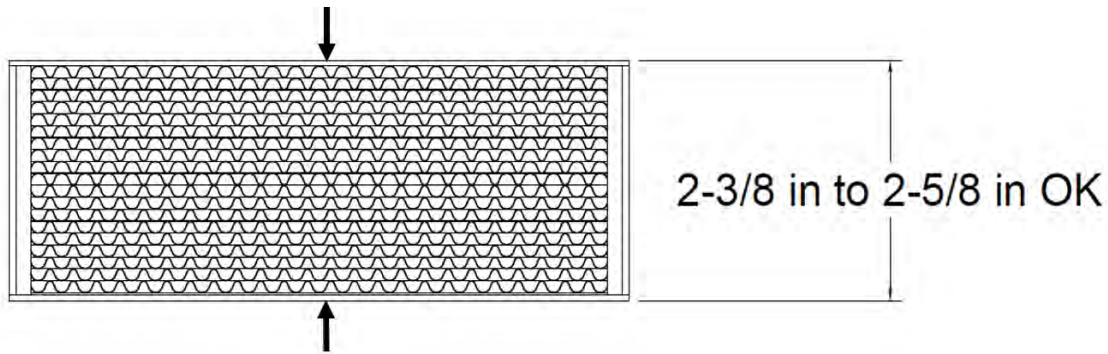
**REMOVING OR REPLACING THE CATALYSTS**

Refer to the Catalytic combustor warranty on page 35 for catalyst replacement information. **DO NOT OPERATE UNIT WITHOUT CATALYSTS.**

1. Allow the stove and ashes to fully cool.
2. Loosen, but do not remove the screws securing the rear heatshield. (If stove is so equipped).
3. Remove the heat shield by sliding the screw heads through the slots in the heatshield.
4. Remove the 2 bolts securing the cast iron catalyst access cover, and remove the cover.

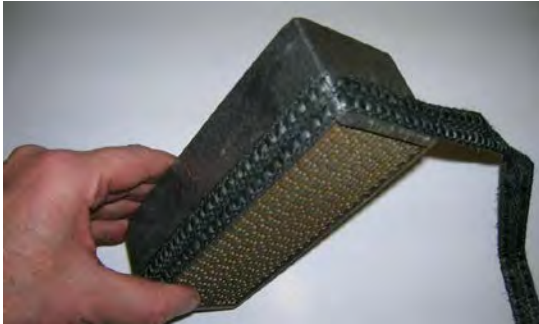


**Figure 19 – Catalyst Access Door**

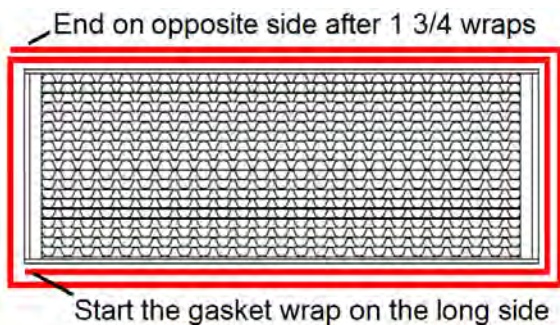


**Figure 20 - Acceptable Catalytic Distortion**

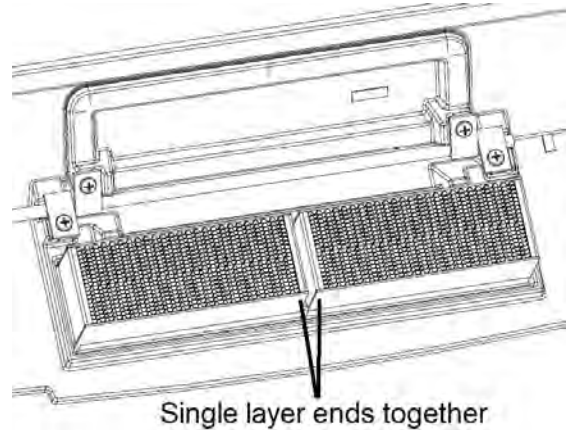
9. Only remove the catalysts if required. In general, the less you handle the catalysts, the better. If any unusual conditions are found, remove the catalyst blocks – See replacing the catalysts.
10. Some warping or bowing of the catalysts over time is acceptable, as long as the catalyst gasket continues to seal. Measure the catalysts in the middle section – if the dimensions are outside the range shown in Figure 20 on the next page, replace the catalysts.
11. Remove existing gasket material from the catalysts.
12. Beginning at one corner, re-install fiberglass gasket material on the catalysts.



13. Wrap the gasket tape around the catalysts so it is reasonably tight. Double layer the material on three sides of the individual catalyst cartridges as shown in the following picture.



14. Once the gasket is installed on the catalysts, gently push the catalysts into the catalyst opening until the catalysts hit against the bottom wall of the cavity. Take care to ensure the gasket is not damaged and position the two cartridges so that the single layer gasket edges touch one another in the center.



15. Replace the catalyst access door.
16. Heat the stove slowly during your next fire to allow the fiberglass gasket to properly seat and seal the catalysts.

### REPLACING THE REFRACTORY STONE AND SECONDARY RISER ASSEMBLY

1. Allow the stove and ashes to fully cool.
2. Open the front door of the stove and fully clean any ash in the firebox
3. Remove the baffle following the instructions in "Inspecting the Catalysts and Removing/Replacing the baffle."
4. Remove the side stones one at a time by tipping them towards the inside of the firebox from the top.
5. With side stones and baffle removed, the secondary riser assembly and rear stones can be lifted up and out of the stove.

6. Installation is the reverse of disassembly. Make sure that the secondary riser tube is seated in the pocket at the rear of the bottom casting.

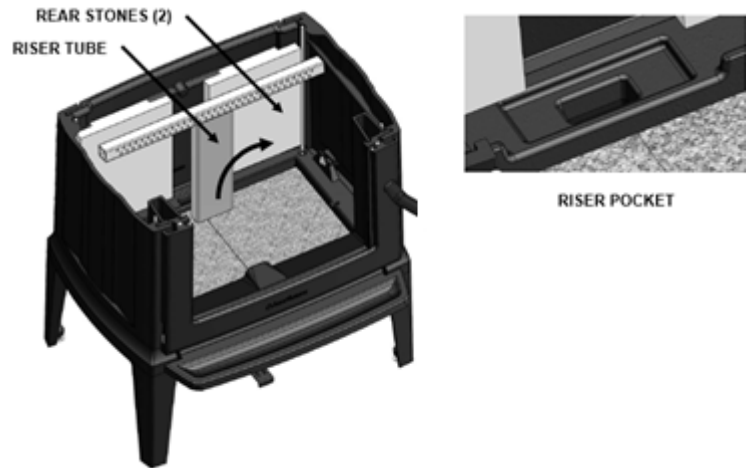


Figure 21 - REMOVING RISER AND REAR STONES

### GLASS REPLACEMENT PROCEDURES

- **WARNING: DO NOT OPERATE THIS APPLIANCE WITH THE GLASS PANEL REMOVED, CRACKED, OR BROKEN. DO NOT SUBJECT THE DOOR TO ABUSE, SUCH AS STRIKING OR SLAMMING SHUT. ONLY A QUALIFIED SERVICE PERSON SHOULD REPLACE THE GLASS PANEL.**

**Required Glass Kit:** Part Number: 96-58607. Use only 4mm x 343mm x 459mm Ceramic, or Neoceram glass. Contact your Hearthstone dealer.

1. Follow the instructions included with the replacement glass kit.
2. Remove the door.
3. Remove the screws from the glass clips (use penetrating oil if necessary) – Set aside for reinstallation.
4. Carefully lift the damaged glass off the door and discard.
5. Remove any remaining glass and old gasket material.
6. Clean the screw holes and place a small amount of anti-seize compound in each one.
7. Install a new glass gasket in the glass gasket groove.
8. Place the new glass onto the door.
9. **Important! Center the glass** and ensure that the edges of the glass are parallel with the edges of the opening.
10. Check glass position again (centered, and parallel), then screw the glass retainer clips with the glass pads back on the door using a crisscross pattern. Tighten the screws no more than 1/8<sup>th</sup> of a turn after they seat. The glass will break at this point if not positioned correctly.
11. Apply a light film of anti-seize lubricant on the door's hinge pins if needed.
12. Install the door.
13. After 5 or 6 fires, check the glass retainer screws, and retighten if necessary.

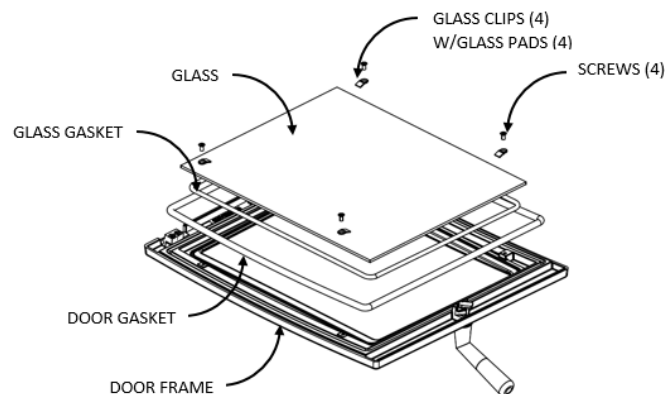


Figure 22: Front Door assembly



## CREOSOTE FORMATION & REMOVAL

When wood burns slowly at low temperatures, it may produce tar and other organic vapors, which combine with expelled moisture to form creosote. These creosote vapors condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited, this creosote makes an extremely hot fire, which may damage the chimney or even destroy the house. When burning wood, inspect the chimney connector and chimney at least once every two months during the heating season to determine if there is a creosote buildup.

If a creosote build-up occurs, inspect the stovepipe connector and chimney more often, at least monthly during the heating season to monitor the accumulation. If a creosote residue greater than 1/4" (6 mm) accumulates, remove it to reduce the risk of a chimney fire.

## PREVENTION

Burn the stove with the primary air control fully open for 35 - 45 minutes daily to burn out creosote deposits from within the stove and the venting system.

After reloading with wood, burn the stove with the primary air control fully open for 15 to 20 minutes. This manner of operation ensures early engagement of the secondary combustion system that minimizes creosote buildup in the chimney.

If your glass always remains dirty, your operating temperatures are too low or your wood is wet; therefore, there is a higher risk of creosote buildup.

Inspect the venting system at the stove connection *and* at the chimney top. Cooler surfaces tend to build creosote deposits faster, so it is important to check the chimney at the top (where it is coolest) as well as from the bottom near the stove.

## CLEANING

Remove accumulated creosote with a cleaning brush specifically designed for the type of chimney in use. We recommend you use a certified chimney sweep to perform this service. Contact your dealer for the name of a certified chimney sweep in your area (your dealer may be a certified sweep!).

We recommend that before each heating season you have the entire system professionally inspected, cleaned and repaired, if necessary.

## GASKETS

Replace door gasket material every two to three seasons, or whenever it becomes deteriorated or loose, depending on stove use. If the door seal leaks, a new gasket will ensure a tight seal and improve stove performance.

We recommend you only use Hearthstone replacement gaskets when you need to replace your door gasket. Contact your dealer for a gasket kit that includes instructions, and the gasket for your stove.

## GLASS

The glass used in our stoves is actually not plain glass, but a tough, clear ceramic material capable of operating at temperatures up to 2300° F. Do not operate the stove with a broken door glass. Do not abuse the front door by striking or slamming.

When necessary, clean the glass. For the inside surface of the glass, we recommend using a damp paper towel dipped in gray ash. Rub the inside of the glass with a circular motion. When all the deposits are removed, clean up with window cleaner or with commercial stove glass cleaners, which are available from your local dealer. Use this type of cleaner for the outside surface as well. Never attempt to clean the glass while the fire is burning or while the glass is hot. Remove deposits by following the instructions provided with the cleaner. Wipe the cleaner off with a soft cloth, or black & white newsprint.

**Important:** scratching or etching the glass will weaken the integrity of the glass. Do not use a razor blade, steel wool, or any other abrasive material to clean the glass. Use a cleaner specifically manufactured for woodstoves only.

The front door glass is a ceramic, thermal shock-resistant glass, made specifically for use in woodstoves. Do not use any replacement glass other than the ceramic glass manufactured and supplied for use in this woodstove. Replacement glass is available through your local dealer.

Replace the door glass immediately if broken or chipped. Contact your local dealer for replacement glass. The glass kit includes instructions and everything needed for the repair. If you replace the glass yourself, wear work gloves and safety glasses.

**Required Glass Kit:** PN: 96-58607.

# TROUBLESHOOTING

## COMMON ISSUES

Virtually all woodstove operators experience basic common problems at one time or another. Most are correctable and generally require only a minor adjustment of the stove, installation, or operating technique. In cases where weather conditions dramatically affect stove performance, the problems are typically temporary and solve themselves once the weather changes.

If you question whether your stove is producing adequate heat, the best way to troubleshoot the problem is to monitor the temperature of the stack no more than 12 inches (30 cm) above the flue collar. A 400° F (200° C) stovepipe confirms the stove is supplying sufficient heat. Keep in mind that your house itself will regulate room/house temperatures. How well the walls, floors and ceilings are insulated, the number and size of windows, the tightness of outside doors, and the construction or style of your house (vaulted ceilings or other open spaces which collect large percentages of heat, ceiling fans, etc.) all are determining factors of room temperature.

Your stove's performance is also dependent on its installation. One common cause of poor performance is an oversized chimney flue. Oversized chimney flues result in decreased draft, which prevents the smoke from rising out the chimney. Oversized flues are also more difficult to heat effectively, especially when burning a high efficiency stove. Cool flue temperatures inhibit the establishment of a strong draft (and encourage the accumulation of creosote). The lack of a strong draft will cause the fire to die down and may even force smoke to pour into the room.

If your chimney is the proper size and a strong draft is not easily established, there is the possibility that the chimney is too cold. Again, hot chimneys promote stronger drafts. Opening a window briefly in the room while lighting the stove may help.

Other draft guidelines are as follows:

An "**AIRTIGHT**" HOUSE: The air supply (infiltration) to the interior of the house may be inadequate if your home is super-insulated or especially well sealed. This phenomenon of air starvation within the

building is exacerbated if exhaust fans, such as clothes dryers, bathroom fans or cook stove exhaust fans, are in operation within the home. Outfitting your stove with the optional outside air adaptor connected to an air duct, which leads to the outside of the building, can correct this problem.

**Tall Trees or Buildings:** These obstructions, when located close to the top of the chimney can cause chronic or occasional downdrafts. When selecting a site for a new chimney, consider the placement of other objects near the proposed chimney location.

**Wind Velocity:** Generally, the stronger and steadier a wind, the stronger (better) the draft. However, "gusty" wind conditions can cause erratic downdrafts. For consistent problems, consider a high wind cap, such as the Vacu-Stack.

**Barometric Pressure:** Chimney drafts are typically sluggish on balmy, wet or muggy days (low barometric pressure). This is a weather-related phenomenon, which generally is self-correcting as the weather changes.

**Briskness of Fire:** The hotter the fire in your stove, the hotter your chimney and, therefore, the stronger the draft.

**Breaks in the Venting System:** An unsealed clean-out door at the bottom of the chimney, leaky stovepipe joints, a poor stovepipe-to-thimble connection, missing caps, or a leaky chimney all can cause inadequate draft.

**Seasonal Factors:** Early fall and late spring are generally difficult seasons in which to establish proper drafts. The colder the outside air is relative to room temperature, the stronger the draft.

## OPERATING THE STOVE

As outlined above, there are days when a good draft is just not easy to establish. The causes are usually seasonal factors or a cold chimney. Try starting the fire by using small kindling and fuel to obtain a quick, hot fire. Tend the fire frequently with small fuel until the chimney is hot and the draft is well established. Sometimes, partially opening a first floor window briefly will help quickly get draft established.

## TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTIONS
STOVE SMOKES	Operating Technique	Fully open the primary air control one minute before opening doors, and ensure the bypass is open before opening door.
	Cold Chimney or reverse draft	Preheat the chimney when first starting a fire. Briefly open a window in the room containing the stove.
	Blocked Chimney	Examine the chimney and stovepipe for blockage or creosote accumulations.
	Oversized Chimney	Reline the chimney to the appropriate diameter
	Undersized Chimney	Install a draft inducer or replace the chimney.
	Chimney Too Short	Lengthen the chimney.
	Air Infiltration Into The Chimney	Seal chimney connections and openings. Check clean-out doors.
	Bypass not closed	Ensure that the bypass door is closed when the catalysts are in the active range.
	Catalysts not functioning	Inspect catalysts for damage, ash build-up, or plugging. Brush catalysts with a soft-bristled brush, or vacuum lightly. Replace if required. Follow instructions to ensure catalyst light-off.
	Not burning proper fuel	Ensure cordwood is seasoned and dry.
More Than One Appliance Connected to the Flue	Disconnect all other appliances and seal openings.	
BACK-PUFFING OR GAS EXPLOSIONS	Operating Technique	Fully open the primary air control one minute before opening the door and keep it fully open for a few minutes after reloading. Ensure the bypass door is open before opening the door
	Extra Low Burn Rate	Burn the stove at a higher burn rate.
	Chimney Down-draft	Install a chimney cap.
	Excessive Ash Build-up	Empty the ash pan more frequently. Increase efficiency of burns, and avoid using poor quality or green wood.
UNCONTROLL- ED OR SHORT BURN	Unsealed or Open Door	Close the door tightly or replace the gaskets. Air leakage around glass gasket – replace gasket
	Excessive Draft	Check the installation. Operate at LOW BURN. Install stovepipe damper. Draft in excess of 0.1 wc should be corrected with a stovepipe damper(s)
	Extra Long Chimney	Shorten the chimney. Install stovepipe damper(s).
	Oversized Chimney	Reline the chimney to the proper diameter.
	High Winds or Hilltop Location:	Install a chimney cap.
INSUFFICIENT HEAT	Poor Quality, low Btu content, or Green Wood	Use only air-dried wood, preferably dried <u>at least</u> one year. Use a wood with a high Btu content if available.
	Low Burn Rate	Operate the stove at a higher burn rate.
	Cold Exterior Chimney	Reline or insulate the chimney.
	Leaky Stovepipe or Chimney	Check the installation. Replace with a pre-fabricated insulated chimney system or a properly sized masonry chimney.
	Too Much Heat Loss From House	Add insulation, use energy efficient windows, or caulk windows, and seal openings in home.
	Excessive Ash Build-up	Empty the ash pan more frequently. Increase efficiency of burns, and avoid using poor quality or green wood.
BLISTERING OF FINISH	Operating Technique	Do not over-fire the stove. Monitor stove temperatures. Use seasoned wood only.
	Excessive Draft	Check the DRAFT. A damper may be required. Operate the stove at a LOW BURN range.

## ADDITIONAL CATALYST TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTIONS
FLY ASH BUILD UP ON CATALYSTS	Catalysts have not maintained light-off temperature	Brush cold combustor with soft-bristled brush or vacuum lightly. Follow instructions in the manual for a proper catalyst light-off
	Burning materials that cause a lot of char and fly-ash	Don't burn cardboard, gift wrap paper, or garbage. Burn only dry, seasoned wood, per the owner's manual.
	Bypass closed too soon	Follow instructions in the manual for a proper catalyst light-off
CATALYSTS PLUGGING OR MASKING (SOOT/CREOSOTE)	Burning wet, pitchy woods, or burning large loads of small diameter wood with the combustor in the operating position without catalyst light off occurring	Burn dry seasoned wood. Follow instructions in the manual for a proper catalyst light-off, and ensure catalyst light-off as occurred before closing bypass damper. It may be possible to burn the soot or creosote off by building a hot fire, and allowing the stove to run until the catalysts are well within the operating range before closing the bypass. Continue to run the stove at a high temperature for one hour, while ensuring the catalysts stay in the upper operating range, but not too hot.
WARPING OR BOWING OF THE CATALYSTS	Excessive catalyst temperatures for long periods of time.	Ensure that the catalysts remain in the operating zone, and does not get too hot. Reduce air control settings for a lower burn rate to ensure catalyst temperatures do not exceed the operating range.



## REPLACEMENT PARTS & OPTIONAL ACCESSORIES

PART #	DESCRIPTION
	<b>REPLACEMENT PARTS</b>
5660-002	BOTTOM HEAT SHIELD
5640-008	HINGE PIN
5640-009	HINGE BLOCK
5660-010	SECONDARY AIR RISER ASSEMBLY
5660-012	TIE ROD
5660-016	BAFFLE GUARD
5640-018	BYPASS ROD RETAINER
5640-020	LATCH STRIKER PLATE
5640-022	DOOR LATCH
5660-024	REAR SHIELD (INCLUDED)
7200-520	CATALYST THERMOMETER
	<b>REPLACEMENT KITS AND ACCESSORIES</b>
96-58400	GASKET KIT
96-58607	GLASS KIT
96-71400	HANDLE KIT
96-73400	FRONT DOOR LATCH KIT
96-75400	CATALYST REPLACEMENT KIT
96-76600	BAFFLE KIT
96-57400	BLOWER KIT

Refer to the Illustrated Parts list for further detail about stove components, available online at [www.hearthstonestoves.com](http://www.hearthstonestoves.com).

# SAFETY LABEL

CONTACT YOUR LOCAL BUILDING OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA

Listed Room Heater, Solid Fuel Type  
Also Suitable for Mobile Home Installation Pursuant to (UM)84-HUD



Conforms to UL STD 1482  
Certified to ULC STD S627

Manufactured by:



317 Stafford Ave.  
Morrisville, VT 05661

MODEL NAME:  
GREEN MOUNTAIN 60  
MODEL NUMBER: 8660  
SERIAL NUMBER:  
[REDACTED]



**CAUTION: HOT WHILE IN OPERATION. DO NOT TOUCH. KEEP CHILDREN, CLOTHING, AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS. SEE NAMEPLATE AND INSTRUCTIONS. INSPECT AND CLEAN CHIMNEY AND CONNECTOR FREQUENTLY. UNDER CERTAIN CONDITIONS OF USE, CREOSOTE BUILDUP MAY OCCUR RAPIDLY.**

**WARNING**

Do not use grate or elevate fire. Build wood fire directly on hearth. Do not overfire. If the heater or chimney connector glows, you are overfiring. (See Operator's Manual)

OPERATE ONLY WITH DOORS CLOSED. DO NOT OBSTRUCT SPACE UNDER HEATER.  
TYPE OF FUEL: CORDWOOD ONLY - BURNING FUELS OTHER THAN CORDWOOD MAY DAMAGE THE APPLIANCE

"PREVENT HOUSE FIRES"

Install and use only in accordance with manufacturer's installation instructions and your local building codes.

CAUTION: Special methods are required when passing chimney through a wall or ceiling, refer to local building codes. Do not connect this unit to a chimney flue serving another appliance.

NOTE: Replace glass only with 5mm ceramic glass.

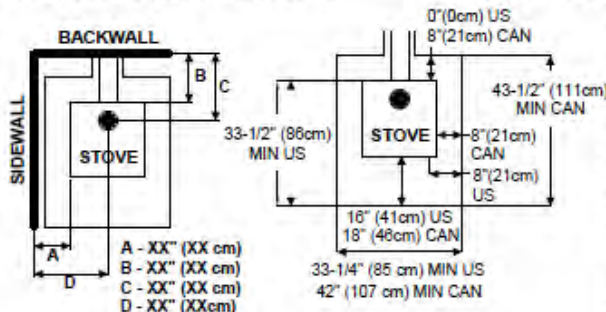
This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual.

WARNING: (Mobile Home) An outside air inlet must be provided for combustion and be unrestricted while the unit is in use.

THIS APPLIANCE USES A CATALYTIC COMBUSTOR (PIN PIN WF-416000/1076)  
The performance of the catalytic device or its durability has not been evaluated as part of the certification  
CAUTION: Burning materials other than the specified fuels may make the catalyst inactive

**Minimum Clearance to Combustible Materials\***

**Floor Protection\***



When installed on a combustible floor, non-combustible floor protection is required to cover the area beneath the heater, and extend at least 18" (41cm) [18" (46cm) CAN] to the front and 8" (21cm) beyond each side of the fuel loading and ash removal openings (side of stove in CAN), the floor protection must extend under the flue connector and extend 2" beyond each side of pipe.

VENT REQUIREMENTS: 8" diameter, single wall, minimum 24 MSG blue steel connector with listed factory-built Type HT chimney or masonry chimney.

OPTIONAL COMPONENTS:  
Outside Air Kit Part # 98-63400  
Blower Kit Part # 98-67400

\*Refer to the Installation Manual for additional clearance information, installation instructions, and operating instructions.

U.S. ENVIRONMENTAL PROTECTION AGENCY  
Particulate Emissions: 0.6 g/hr. Tested to: EPA Method 28R  
Certified to comply with 2020 crib wood particulate emission standards.

Date of Manufacture



DO NOT REMOVE OR COVER THIS LABEL

MADE IN USA

5300-XXXX



## LIMITED WARRANTY

**These warranties give you specific legal rights. You may also have other rights, which vary from State to State.**

Hearthstone Quality Home Heating Products, Inc. (Hearthstone) warrants to the original retail purchaser only (the "Original Purchaser") the new appliance manufactured by Hearthstone, purchased by the Original Purchaser and installed by an authorized Hearthstone dealer or their designated representative against any of the occurrences listed in this document that result from defects in material or workmanship. This warranty is not transferrable. All obligations of Hearthstone under this document commence on the date of the Original Invoice (the "Purchase Date"). The term "Limited Lifetime" is defined as 10 years from the beginning of warranty coverage.

Hearthstone appliances are designed to be operated only with the fuels listed in your owner's manual.

**Catalytic combustor LIMITED LIFETIME WARRANTY:** The catalytic combustors are covered directly by the combustor manufacturer, Applied Ceramics. Included with your stove you will find the LIMITED LIFETIME WARRANTY for the catalysts, as well as a warranty card.

Catalyst Model Number: ACI-6M2 Catalyst Manufacturer: APPLIED CERAMICS

APPLIED CERAMICS warrants to the consumer who purchases a FIRECAT STEEL COMBUSTOR as a component in an EPA certified solid fuel appliance, to replace at no charge to the consumer the FIRECAT STEEL COMBUSTOR that ceases to function with two (2) years from the date of purchase by the original consumer, provided that the following conditions are met:

- (1) A copy of the original bill of sale that includes place and date of purchase must be submitted with the warranty claim.
- (2) The original FIRECAT STEEL COMBUSTOR must be returned to APPLIED CERAMICS
- (3) The FIRECAT STEEL COMBUSTOR must not have been mechanically abused, nor must the wrong fuels have been used in the appliance.

If after two years the FIRECAT STEEL COMBUSTOR fails to function, the prorated warranty will allow replacement at the following special price schedule:

Year 3	\$130.00
Year 4	\$140.00
Year 5	\$150.00
Year 6	\$160.00
Year 7 and after	at current retail price

Conditions 1, 2, and 3 also apply to the Prorated portion of the warranty. Any EPA certified solid fuel appliance will receive one replacement catalyst for each defective catalyst returned during the three year period. The consumer will be responsible for any removal, any servicing, and return of any items required for filing the warranty claim. This warranty is APPLIED CERAMIC'S exclusive warranty, and APPLIED CERAMICS, disclaims any other express or implied warranty for the FIRECAT STEEL COMBUSTOR, including any warranty or merchantability fitness for a particular use.

Ensure the catalyst is well wrapped and padded for shipment in bubble wrap, or similar material. Ship the catalyst with padding inside of a cardboard box.

All warranty claims must include \$12.50 for postage and handling within the continental U.S. Alaska and Canada claims must include \$35.00.  
 Please allow 2-3 weeks for delivery. Order online @ [www.firecatcombustors.com](http://www.firecatcombustors.com)

Please read and understand the full warranty. Please return the completed warranty card promptly to Applied Ceramics. The warranty card, and any warranty claims can be shipped to:

**Applied Ceramics**  
**55555 Pleasantdale Road**  
**Doraville, GA, 30340**

**Stove components Limited Warranty**

Warranty Period	Wood	Gas	Pellet	Covered Components
Limited Lifetime	X	X	X	Stone
	X	X	X	Cast iron not listed elsewhere
	X			Clean burning air supply system*
5 Year	X	X	X	Door handles and latches
	X	X	X	Steel Components and Firebox
		X		Burner and logs
3 Year			X	Burn Pot and Baffles
2 Year	X	X	X	Appliance Electrical and Gas Components
	X	X		Refractory, Vermiculite Panels, Baffles
1 Year	X	X	X	Enamel finish against peeling or fading
	X	X	X	Accessories
	X	X	X	Glass
	X			Ash Grate
	X	X	X	All components not listed elsewhere

Any parts repaired or replaced during the limited warranty period will be warranted under the terms of the limited warranty for a period not to exceed the remaining term of the original limited warranty or one year, whichever is longer.

**Parts:** Hearthstone will replace through an authorized dealer, defective parts covered by the foregoing warranty at no charge.

**Labor:** Within the first (1<sup>st</sup>) year after the Purchase Date, Hearthstone will pay for warranty labor performed by an authorized Dealer at Hearthstone’s published labor rates in effect at the time the labor is performed only if the appliance is installed by an authorized dealer or their designated representative. Otherwise or thereafter, the Original Purchaser is responsible for the cost of labor.

**Shipping cost for parts:** Within the first ninety (90) days after the Purchase Date, Hearthstone will pay for the shipping of appliance parts covered by any of the foregoing warranties to and from Hearthstone or an authorized Dealer, as the case may be. Thereafter, the Original Purchaser is responsible for all shipping costs related to shipping appliance parts to and from Hearthstone or an authorized Dealer, as the case may be.

**Shipping cost for the appliance:** Within the first (1<sup>st</sup>) year after the Purchase Date, if the Original Purchaser is instructed to return the appliance to Hearthstone or an authorized Dealer for repair, Hearthstone will pay fifty percent (50%) and the Original Purchaser will pay fifty percent (50%) of the shipping costs related to shipping the appliance to and from Hearthstone or an authorized Dealer, as the case may be. Thereafter, the Original Purchaser is responsible for one hundred percent (100%) of all of the shipping costs related to shipping the appliance to and from Hearthstone or an authorized Dealer, as the case may be. Notwithstanding any other provision of this document, in no event will Hearthstone pay for any Dealer fees or other fees for pick up or delivery of the appliance returned for repair; the Original Purchaser shall be responsible for any such fees.



## EXCLUSIONS & CONDITIONS

The warranties contained in this document do not cover, nor is Hearthstone responsible for:

1. Damages resulting from:
  - a. Failure to install, operate, or maintain the appliance in accordance with the owner's manual, operating instructions, installation instructions, or safety rating label provided with the appliance.
  - b. Over-firing the appliance. Over-firing can be identified by, but not limited to, warped cast iron or steel, rust colored cast iron, bubbling, cracking and discoloration of steel or enamel finishes.
  - c. Failure to install the appliance in accordance with all national or local building codes.
  - d. Shipping or improper handling.
  - e. Improper operation, abuse, misuse, continued operation with damaged, corroded, or failed components, accident, or improper/incorrect service or repairs.
  - f. Environmental conditions, inadequate ventilation, negative pressure, or improper drafting caused by tightly sealed constructions, insufficient make-up air supply, or air handling devices such as exhaust fans, forced air furnaces, or other such causes.
  - g. Damage caused by direct exposure to water.
  - h. Use of fuels other than those specified in the owner's manual.
  - i. Installation or use of components not supplied with the appliance, or any other components not expressly authorized and approved by Hearthstone.
  - j. Modifications of the appliance not expressly authorized and approved by Hearthstone in writing
  - k. Interruptions or fluctuations of electrical power supplied to the appliance.
2. All stones are warranted against cracking or breakage due to thermal stress, excluding surface and hairline cracks and scratches that do not affect the operation, or safety of the appliance.
3. Repair or replacement of wear parts. Such parts that are subject to normal wear and tear during the warranty period such as paint, gaskets, baffles, refractory materials, ash grates, and glass.
4. Damage resulting from installation, modification, alteration, repair or service of the appliance by any party other than an authorized Hearthstone dealer (a "Dealer") or their designated representative, or Hearthstone.
5. Damage due to water or condensation due to installation of the appliance in a high moisture area.
6. Damage due to installation of the appliance in an atmosphere contaminated by damaging chemicals, including but not limited to chlorine, fluorine or salts.
7. Scratches on glass, enameled surfaces or stones due to mechanical abrasion.
8. Noise caused by expansion or contraction caused by the heating and cooling of the appliance.
9. Odors caused by the heating of the appliance, or surrounding materials
10. Consequential damage caused by leaking of condensate during startup
11. A defect in any part of the appliance if the Original Purchaser fails to comply with Hearthstone's or a Dealer's request to ship the part or the appliance to Hearthstone or a Dealer, as the case may be.
12. Replacement stones and enameled parts are taken from current stock, and may not match originals in color, grain, or pattern. Hearthstone will supply replacement parts for discontinued parts in finishes or colors as available, or at their discretion.
13. Hearthstone's obligation under this warranty does not extend to the appliance's ability to heat the desired space. Information is provided to assist the customer and the dealer in selecting the appropriate appliance for the application. Consideration must be given to appliance location and configuration, environmental conditions, insulation and air tightness of the structure.

THE WARRANTIES CONTAINED IN THIS DOCUMENT ARE EXCLUSIVE AND ARE GIVEN BY HEARTHSTONE AND ACCEPTED BY THE ORIGINAL PURCHASER IN LIEU OF ALL OTHER EXPRESS WARRANTIES AND ANY OBLIGATIONS, LIABILITIES, RIGHTS, CLAIMS, OR REMEDIES IN CONTRACT OR TORT, WHETHER OR NOT ARISING FROM HEARTHSTONE'S NEGLIGENCE, ACTUAL OR IMPUTED. ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE GIVEN ONLY TO THE EXTENT REQUIRED BY FEDERAL OR STATE LAW. EXCEPT AS OTHERWISE REQUIRED BY STATE LAW, UPON THE EXPIRATION OF THE EXPRESS LIMITED WARRANTIES CONTAINED HEREIN, NO IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, SHALL APPLY TO THE SUBJECT APPLIANCE. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

THE WARRANTIES CONTAINED IN THIS DOCUMENT EXTEND ONLY TO THE ORIGINAL PURCHASER OF THE APPLIANCE WARRANTED HEREUNDER. THEY ARE NOT TRANSFERRABLE AND DO NOT EXTEND TO ANY SUBSEQUENT OWNERS.

UNDER NO CIRCUMSTANCES SHALL HEARTHSTONE BE LIABLE TO THE ORIGINAL PURCHASER OR ANY OTHER PERSON FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO DAMAGE TO PROPERTY OR PERSONAL INJURIES, WHETHER ARISING OUT OF LOSS OF USE, BREACH OF WARRANTY, TORT, OR OTHERWISE, EVEN IF HEARTHSTONE HAS BEEN APPRAISED OF THE POSSIBILITY OF SUCH DAMAGES. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

### **QUALIFYING FOR WARRANTY COVERAGE**

To obtain performance of any obligation under this document, the Original Purchaser must, within the applicable warranty time period, contact their original Hearthstone dealer, or the current responsible local Hearthstone dealer, for instructions regarding the return of defective parts for repair, the return of the appliance for repair, or to schedule a Dealer service call. The Original Purchaser should refer to the Dealer Network search engine contained on Hearthstone's Web site ([www.hearthstonestoves.com](http://www.hearthstonestoves.com)) if the original dealer is not available, to find a Hearthstone dealer nearest to the Original Purchaser's location.

### **REMEDY**

The remedy for any breach of the foregoing warranties will consist of repair or replacement, at Hearthstone's option, of any covered defect in the appliance. When the Original Purchaser contacts a Hearthstone Dealer, the Dealer on behalf of Hearthstone, as the case may be, will instruct the Original Purchaser to either return the defective part, or the entire appliance (if requested), to the Dealer or Hearthstone or allow a Dealer to make a service call at the place where the appliance is located. Hearthstone may require that a digital picture be provided to support the claim. Notwithstanding any other provision of this document, the Original Purchaser shall pay for any fees and service charges related to a Dealer's service call or the shipping charges associated with the return.

### **WARRANTY REGISTRATION**

The Original Purchaser can complete their warranty registration on our website at [www.hearthstonestoves.com](http://www.hearthstonestoves.com), or send a completed and signed Warranty Registration Form, which is enclosed in the appliance document packet, to the following address:

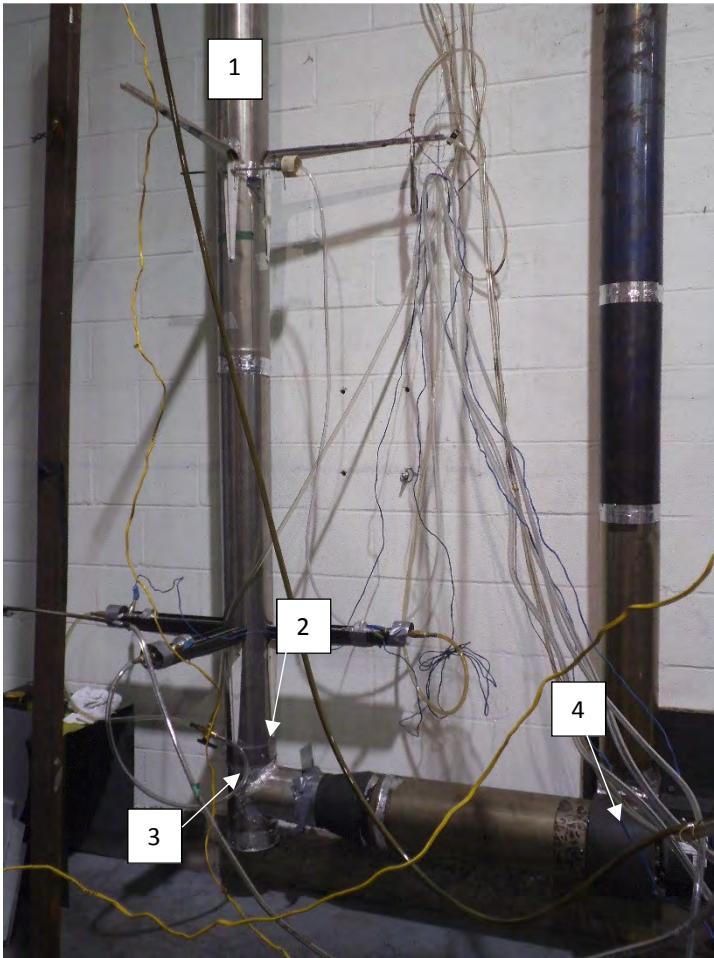
Hearthstone Quality Home Heating Products, Inc.  
Warranty Department  
317 Stafford Avenue  
Morrisville, VT 05661

**NOTE: SENDING IN THE SIGNED WARRANTY REGISTRATION FORM IS *NOT REQUIRED* AS A CONDITION OF WARRANTY COVERAGE OR HEARTHSTONE'S PERFORMANCE.**

## APPENDIX 8: Photographs of test set up

**Dilution picture dia 6**

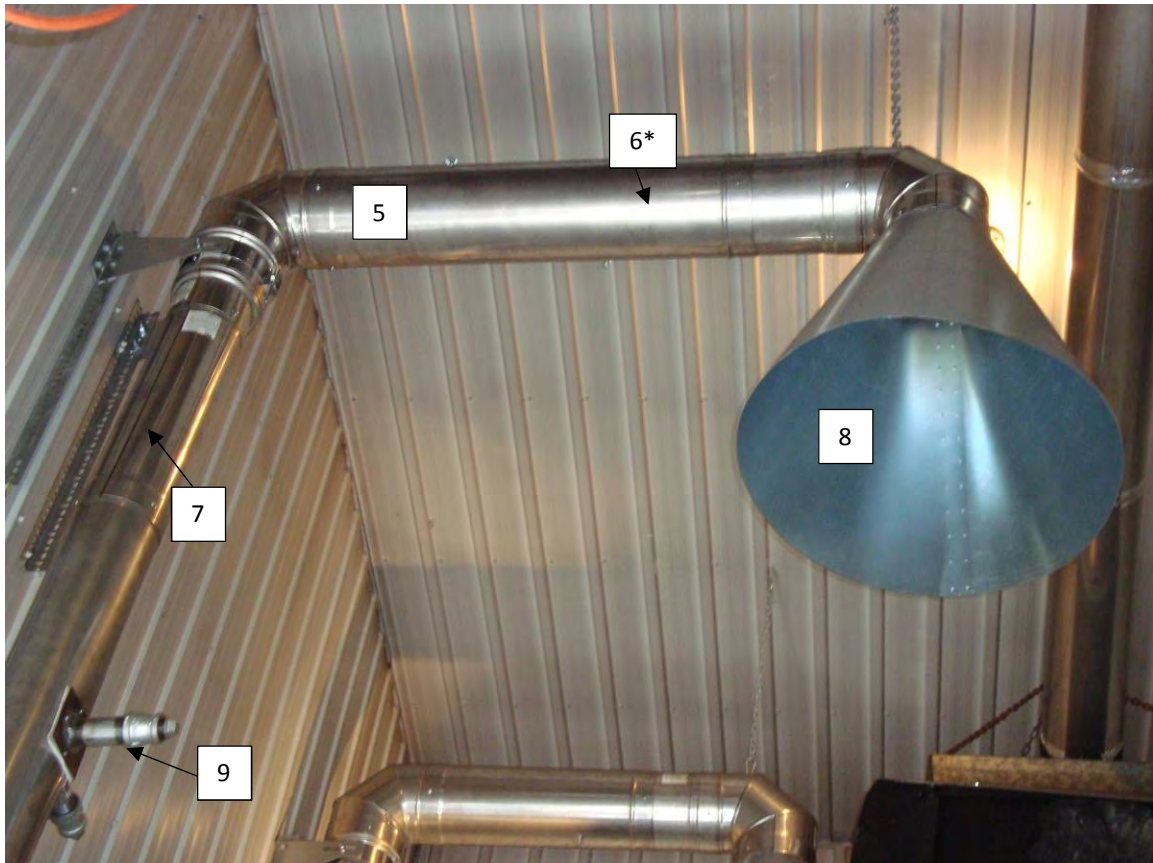
**Picture 1** : Sampling system



- 1** : 6 in dia Stainless steel pipe
- 2** : 16 in. Between sampling probe and lower elbow
- 3** : Air intake with damper to adjust flow rate
- 4** : Exhaust blower



Picture 2 : Hood and mixing baffle



\*The arrow point the deflectors inside of the pipe

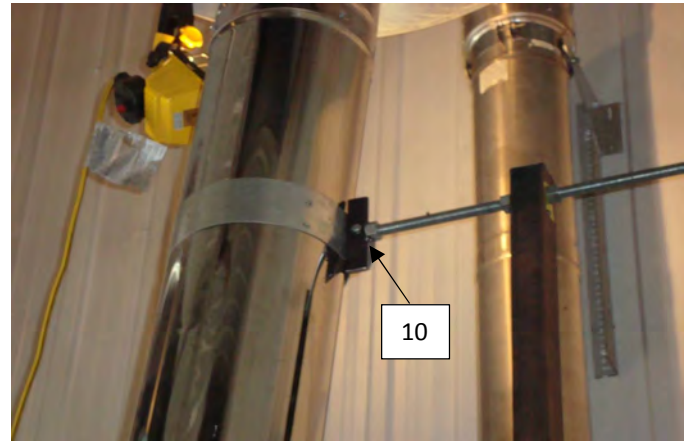
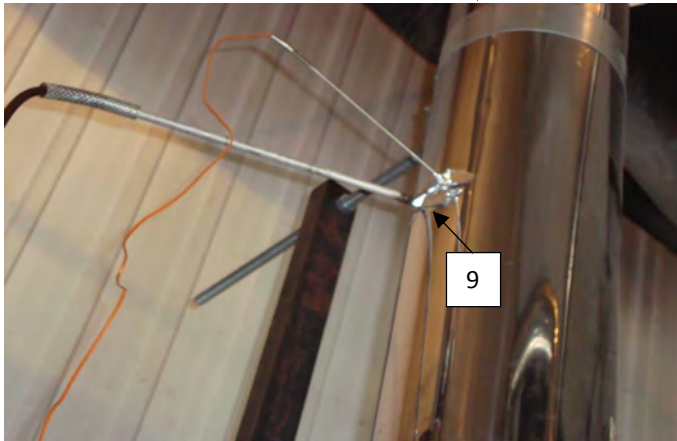
- 5 : 8 in. dia. Stainless steel pipe
- 6 : Mixing baffle (2) location 1 foot between baffles
- 7 : 4 feet long between velocity port and upper elbow
- 8 : 24 in. dia. Galvanized steel smoke captures hood, located 3 feet away from dilution tunnel
- 9 : Velocity port

Picture 3: Stack sampling



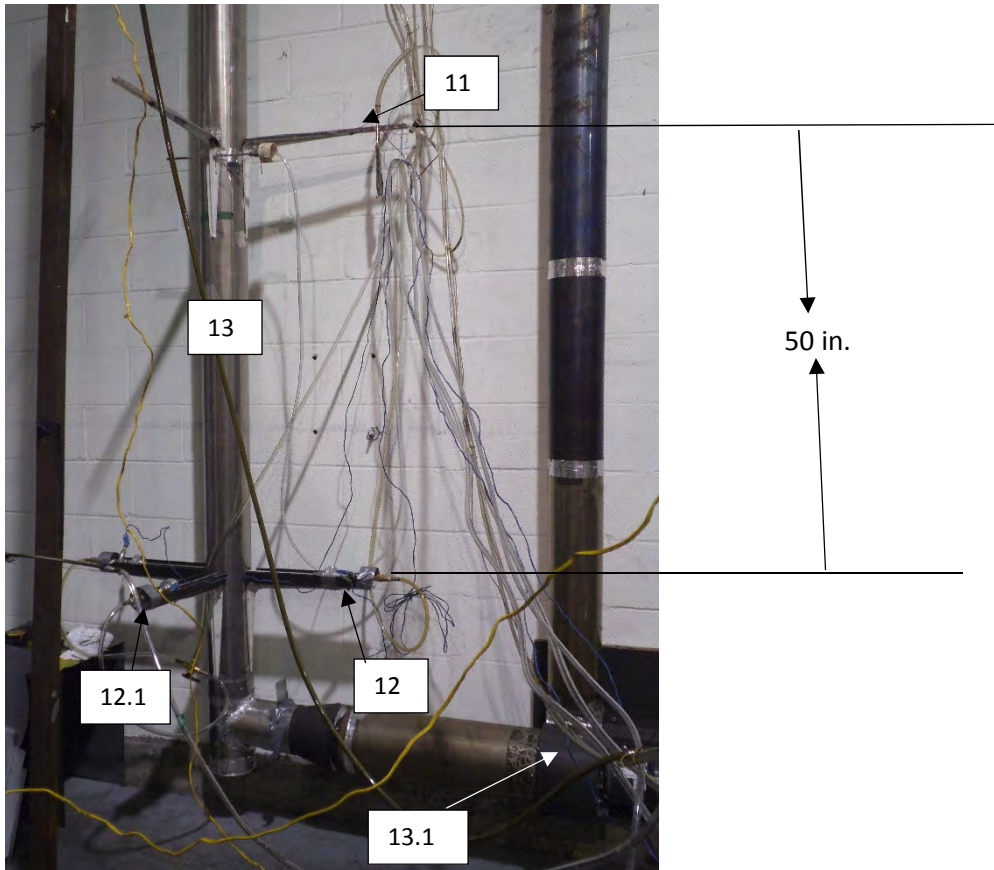
Picture 3.1: Gas analysis and temperature probe

Picture 3.2: chimney support



- 9 : Temperature and gas analyser sampling ports located 9 feet above platform
- 10 : Exhaust system support bracket

Picture 4: Tunnel flow measurement and sampling probe



11 : Velocity port

12 :Sampling port, 2 sampling probes with 2x48 mm. dia.filter each. Filter used:  
Millipore AP4004700

12.1 :Sampling port, sampling probes with 2x48 mm. dia.filter each. Filter used:  
Millipore AP4004700, for first hour sampling

13 :15 feet long dilution tunnel

13.1 :Extraction blower



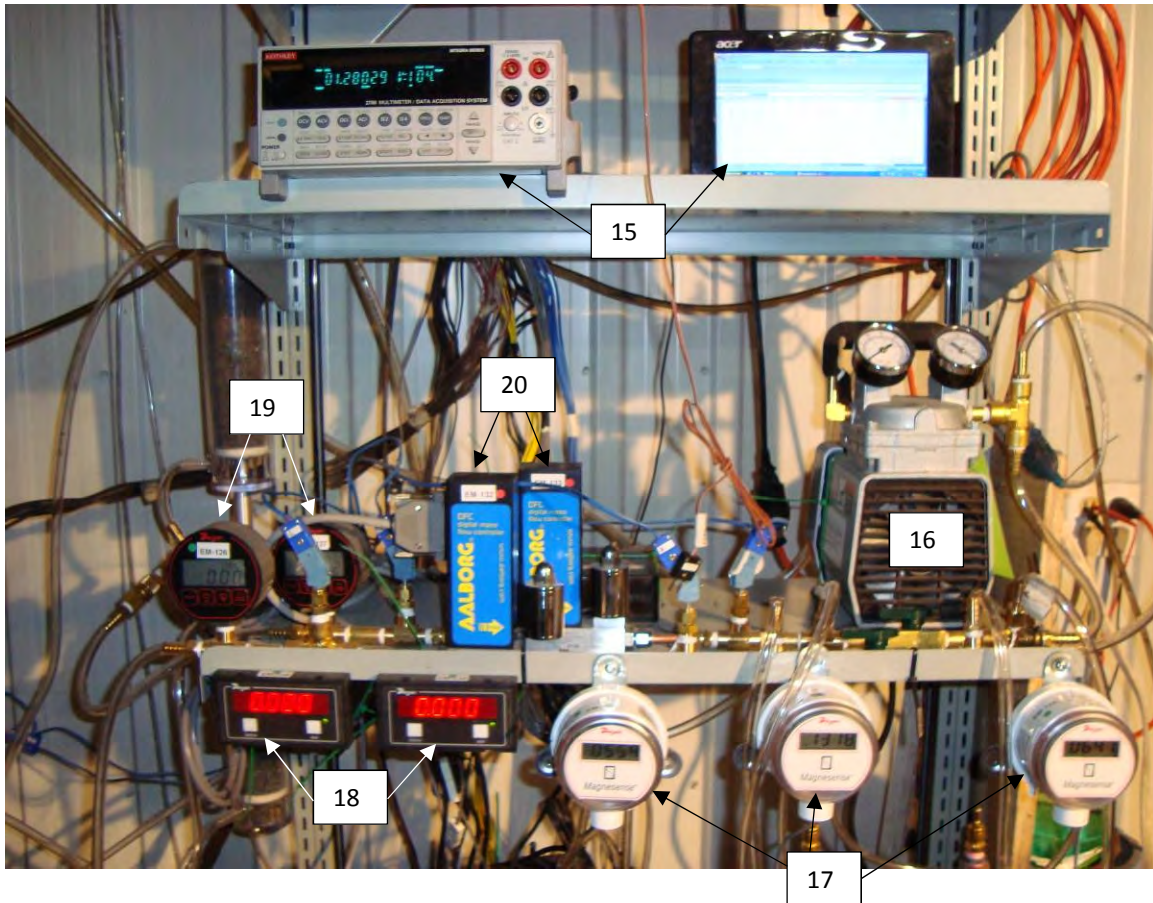
Picture 5: Draft sampling



**14** : Draft sampling port located 6 in. from the flue outlet



Picture 6: Equipments



- 15 : Acquisition system
- 16 : Vacuum pump
- 17 : Digital manometer
- 18 : Digital read out for mass flow meter
- 19 : Digital vacuum gage
- 20 : Mass flow meter

Picture 7: Gaz analyser



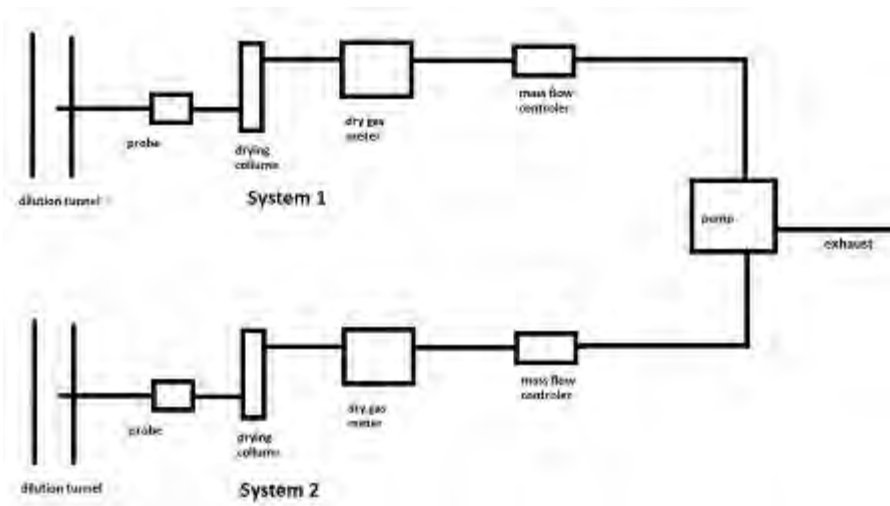
Picture 8: Reference dry gas meter



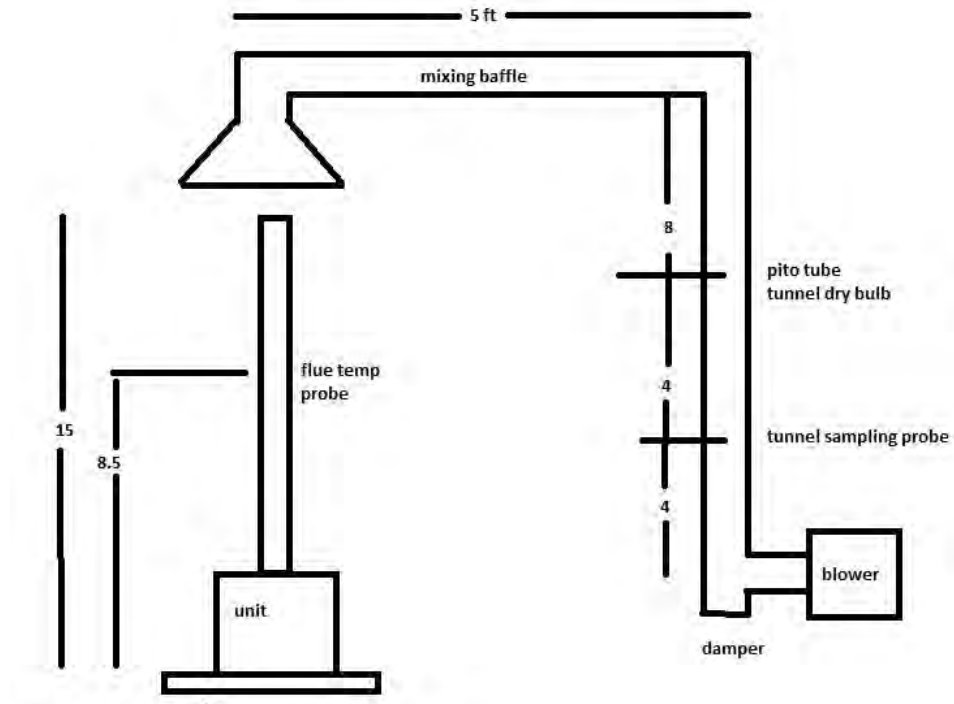
Picture 11: Dry gas meter



Picture 12 : Dilution tunnel sample system



Picture 13: Dilution tunnel





## APPENDIX 9: Test load photographs

**Run 1 January 15<sup>th</sup> 2018 minimum burn rate**

Testing load



Testing load



Left view of stove



Load in the stove



**Run 2 January 16<sup>th</sup> 2018 minimum burn rate**

Testing load



Testing load



Back view of stove



Testing load





## Run 3 January 17<sup>th</sup> 2018 NO fan confirmation test

Testing load



Testing load



Load in the stove



Testing load





**Run 4 January 18<sup>th</sup> 2018 Category 3 burn rate**

Testing load



Testing load



Load in the stove



Testing load



**Run 5 January 22<sup>nd</sup> 2018 Maximum burn rate**

Testing load



Testing load



Load in the stove



Testing load



## APPENDIX 10: Laboratory Operating Procedures

# **POLYTESTS Services inc.**

## **SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE**

### **INTRODUCTION**

This document provides a step by step guide for the technician conducting tests to EPA standard requirements. Procedures outlined here, when followed, will result in tests in conformance with EPA Methods 28R, ASTM E2780, ASTM E2515, ASTM E2618, Method 28WHH, Method 28 PTS.

The primary measurements to be made are particulate emissions rates. The technician's duties include the following steps.

1. Incoming inspection of test units.
2. Set-up of test units.
3. Preliminary testing to establish unit operating procedures and familiarity with operating controls.
4. Calibration of test equipment.
5. Set-up, checking and operation of sampling apparatus.
6. Conduct of tests including complete record keeping and data recording for non-automated functions.
7. Operation of hardware and software included in automatic data acquisition system.
8. Review and analysis of data at test completion to ensure test validity.

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

### **EPA METHODS**

1. EPA Methods 28R
2. ASTM E2780
3. ASTM E2515
4. ASTM E2618
5. Method 28WHH
6. Method 28 PTS



# POLYTESTS Services inc.

## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

### I. APPLIANCE INSPECTION AND SET-UP

#### A. INCOMING INSPECTION

1. Check for completeness of unit including parts, accessories, installation and operating instructions, drawings and specifications etc. Note any discrepancies or missing parts or information.
2. Check for shipping damage. If damage has occurred, notify the laboratory manager. In some cases, repairs may be made, provided the manufacturer and laboratory manager concur that repairs will not affect the unit's performance. If damage is irreparable, a new unit will need to be obtained.
3. Note whether unit is catalytic or non-catalytic.
4. Mark unit with manufacturer's name, model number, work order number and date received.
5. If unit is safety listed, note label data including listing agency and serial number. If unit is not listed, mark all data sheets "UNLISTED". Test results will not be released until unit passes safety tests without modification unless authorized by laboratory manager.

#### B. UNIT SET-UP

1. All new units must be operated for a breaking in period as follows.
  - a) Non-catalytic units: Ten (48) hours at medium burn rate with Douglas Fir scrap or cordwood.
  - b) Catalytic units: Fifty (50) hours at medium burn rate with Douglas Fir scrap or cordwood.

During these break-in runs the unit may be connected to a lab chimney and fuel additions noted into the corresponding data acquisition file. For catalytic units, a thermocouple must be installed in the catalyst.

Record catalyst temperature at 1-hour intervals or on chart recorder. Operating should continue until data shows at least fifty (50) hours of operation with catalyst temperature in excess of 800 degrees Fahrenheit (active range).

For non-catalytic units a stack thermocouple should be installed and stack temperature recorded at 1-hour intervals. Fourty-eight (48) hours minimum burn time with a stack temperature of at least 250 degrees Fahrenheit is required.

2. Once break-in is completed, allow unit to cool. Clean unit thoroughly.

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3. Unit is to be placed on scale for testing. Prior to proceeding with verification process, scale should be turned on and allowed to warm up for one (1) hour minimum. Zero scale and check calibration with standard weights. One (1) 1 kg weight and one (1) 2 kg weight are provided for this purpose. Use scale verification test form no. EPA-7-TP to record results. If scale fails to reproduce weights within tolerance, check with laboratory manager before proceeding.
  4. If scale checks out, place unit on scale and align so chimney will be centered in hood.
  5. Attach chimney connector and chimney. Be sure all joints are sealed below sampling points. Chimney and connector should be cleaned with a wire brush. Be sure chimney connector terminates and chimney 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. Thermocouples should be attached to surfaces of unit prior to testing. EPA requires a thermocouple on the bottom of the firebox. This must be installed prior to putting the unit on the scale. In some cases, the required thermocouple locations will be inaccessible on finished units. These units should have thermocouples installed by the manufacturer during construction. Check with the laboratory manager if problems are encountered in proper thermocouple attachment.
  7. Measure firebox dimensions and record on data forms nos. EPA-2-TP. Make a three dimensional sketch of the firebox including firebrick, baffles and obstructions. Calculate firebox volume in cubic feet with both addition and subtraction methods using forms nos. EPA-3-TP and EPA-4-TP. See Section 6.2.4 of EPA Method 28 for details of firebox volume determination.
  8. If unit is catalytically equipped, additional thermocouples must be installed upstream and downstream of catalyst. Thermocouples should also be placed in the primary and secondary combustion chambers of all units.
  9. Plug thermocouples into data acquisition system jacks making a check of locations and jack numbers for each test on data form no. EPA-5-TP.
  10. Note that inserts are tested as if they are freestanding stoves.
  11. Dilution tunnel should be cleaned prior to each certification test series and at anytime a higher burn rate follows a lower test burn rate.
- II. SAMPLING SYSTEM – SET-UP
- A. GAS ANALYSIS**
1. Instruments should be turned on and allowed to warm up for one (1) hour minimum.

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### 2. Calibrate analyzers as follows:

NOTE : Prior to proceeding with calibration, make sure to use NIST traceable calibration gas bottles. Adjust flow meter if necessary at each instrument to required flow value.

- a) Using span gas, adjust span control to values specified on calibration gas label.
- b) Using nitrogen, adjust zero controls to provide a 0.00 analyzer readout.
- c) Repeat a) and b) until no further adjustment is required.
- d) Check readout vs. calibration gases (2) labels.

The CO<sub>2</sub> and CO analyzers are “ZEROED” on nitrogen. The O<sub>2</sub> analyzer is spanned on air and set for 20.9%. It is zeroed on nitrogen as well.

### 3. Check for response time synchronization.

- a) With no fire in unit, allow reading to stabilize (O<sub>2</sub> should be 20.93, CO and CO<sub>2</sub> should equal 0).
- b) Flow the calibration gas in the unit and start stop watch. Note the time required for each unit to reach .90 of the calibration gas bottle value. If all three analyzers reach this value within 15 seconds of each other, synchronization is adequate. If not, contact the laboratory manager. Synchronization is adjusted by internal instrument setting.

### 4. Set-up sample clean-up and water collection train as follows.

- a) Load impingers as follows:  
Impinger #1: 100 ml distilled water and 5 ml H<sub>2</sub>SO<sub>4</sub>  
Impinger #2: 100 ml distilled water and 5 ml H<sub>2</sub>SO<sub>4</sub>  
Impinger #3: Empty  
Impinger #4: 200 – 300 grams silica gel (dry)
- b) Place impingers in container and connect with “U TUBES”. Grease carefully on bottom half of ball joint so that grease will not get into tubes.
- c) Connect filter to first impinger and sample line to last impinger.
- e) Leak check system as follows.

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- 1) Plug probe.
  - 2) Turn on sample system.
  - 3) Observe sample flow rotometer and vacuum gauge. If necessary, use vacuum; adjust valve to set vacuum to the maximum inches Hg.
  - 4) If the float in rotometer does not stabilize below 10 on scale, system must be resealed.
  - 5) Repeat leak check procedure until satisfactory results are obtained.
- f) Just prior to starting test, fill impinger container with water and ice and record ambient conditions on data form no. EPA-8-TP.

### **B. DILUTION TUNNEL SAMPLE TRAIN SET-UP**

1. Filters and holders.
  - a) Clean probes and filter holder front housings carefully and desiccate for at least 24 hours prior to use.
  - b) Filters should be numbered and filter and probe combinations labeled prior to use.
  - c) Weigh desiccated filters and probe-filter units on analytical balance. Record weights data form no. EPA-10-TP. Note that probe and front half of front filter are to be weighed as a unit.
  - d) Carefully assemble filter holder units and connect to sampling systems. Check "DRIERITE" columns for adequate dry absorbent (blue).
2. Leak checking.
  - a) Each sample system is to be checked for leakage prior to inserting probes in tunnel.
  - b) Plug probes and start samplers, adjust pump bypass valve to produce a vacuum reading of 5 inches Hg. (NOTE: During test, vacuum must not exceed 5 inches unless posttest leak check shows acceptable results.)



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- c) Allow vacuum indication to stabilize for two (2) minutes, then record time and dry gas (DGM<sub>1</sub>) and (DGM<sub>2</sub>) meter readings. Wait ten (10) minutes and record dry gas meter readings again (DGM<sub>3</sub>, DGM<sub>4</sub>). NOTE: If mark, system is leaking too much and all seals should be checked.
- d) Calculate leakage rate as follows.
- 1) System 1:  $\frac{(DGM_3 - DGM_1)}{10} = CFM_1$
- 2) System 2:  $\frac{(DGM_4 - DGM_2)}{10} = CFM_2$

If CFM<sub>1</sub> or CFM<sub>2</sub> is greater than .02 CFM, leakage is unacceptable and system must be resealed.

If CFM<sub>1</sub> or CFM<sub>2</sub> is greater than 0.04 X sample rate, leakage is unacceptable. For most tests, the sample rate will be about 0.15 CFM, thus leakage rates in excess of 0.04 X 0.15 = 0.006 CFM are not acceptable. Record leakage rates on form no. EPA-5-TP

- e) Once leakage check is satisfactory, unplug probe and set flow to appropriate rate for test. This should be done in the minimum amount of time necessary and with the probes in ambient air. Do not insert probes in tunnel until the start of the test run. When flow is established, replug probes to prevent contamination.

### III. TEST CONDUCT

#### A. FUEL LOAD

1. Determine optimum load weight by multiplying firebox volume in cubic feet by 7. This is the load weight on an as-fired basis.
2. Determine piece size to obtain the requested load configuration and meet the test load weight criteria. The load should consist of the following: **TO BE DETERMINED**
3. Weigh out test load and adjust weight by shortening all pieces equally if necessary. Record individual piece load on form no. EPA-11-TP.

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4. Measure and record moisture content of each fuel piece using Delmhorst moisture meter. Determine if fuel load moisture content is in required range. If not, construct new load using wood with required moisture content. All wood in the humidity chamber should be within range. Contact project manager if you cannot find suitable pieces. Record moisture of each individual piece load on form no. EPA-11-TP.

### **B. UNIT START-UP**

1. Before lighting a fire, turn on dilution tunnel and set flow rate to 140 SCFM if burn rate is to be less than 3 kg/hr or to an appropriate rate from table provided in laboratory for higher burn rates. Record readings on data form no. EPA-9-TP.
2. Check draft imposed on cold stove with all inlets 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.
3. Check for ambient airflow around unit with hot wire anemometer. Must be less than 50 ft/min.
4. Check all equipment for proper operation. Analyzers should be on and in sample mode. Computer should be loaded with test program and awaiting test start command.
5. Zero scale and start fire with uncolored newspaper and kindling representing 10 % of test load with the same type of fuel.
6. Once kindling is burning well after 5 minutes, add splitted pieces having a bottom surface around 4 sq. inches and representing 25% of test load weight. Operate at high fire for 15 minutes. Then adjust settings to intended test run levels as per the manufacturer's.
7. Following addition of pretest fuel load (splitted pieces), start computer for data logging.

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8. All fuel additions, air intake settings and operational characteristics shall be noted with associated time stamp on form no. EPA-1-TP.

### C. TEST RUN

1. Once the targeted test fuel bed weight is obtained, the test is to be started as follows:
  - 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. (Pitot should be carefully cleaned prior to each test.)
  - c) Turn on probe sample systems and stack sampler.
  - d) Open stove door, rake coals and load stove as follows: **TO BE DETERMINED**
  - e) Close door or follow manufacturer's start-up procedures. (Five (5) minutes maximum time before all doors and controls must be set to final positions for duration of test.)
  - f) An alarm will sound an audible signal at the (10) minutes intervals. This signal a reading interval. You must verify at each interval that the following readings are correctly logged by the data acquisition system and make observations of any unusual or non routine events that could occur.
    - 1) Rotometer readings.
    - 2) Tunnel pitot tube reading.  
(Zero regularly between readings)
    - 3) Gas meter readings.
    - 4) Temperature readings.
    - 5) Draft reading
    - 6) Test load weight
    - 7) CO, CO<sub>2</sub> and O<sub>2</sub> readings
    - 8) Observations of any unusual or non-routine events.
  - g) During the test, any condition approaching unacceptable limits will be noted. The filter probes and housings are installed in small holders just outside the tunnel. If the filter temperature gets too high, you will have to increase the water flow through the cooling unit until acceptable temperatures are obtained. In between readings, check on

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other equipment. Be sure dryers and filters are working and monitor impinger train for proper water and ice levels etc.

- h) When the fuel charge is consumed, it will signal end of test and shut down the sampling systems. When this occurs, remove filter holder and probes from tunnel and impingers from sample line.

### IV. POST TEST PROCEDURES

#### A. SAMPLE RECOVERY – FILTER TRAINS

1. Carefully clean outside of probes and filter housings with alcohol.
2. Disassemble filter holder and transfer filters to clean petri dish. Scrape gasket with scalpel and collect any loose material on filters.
3. Place probe and front half of first filter holders (still assembled) and filters in desiccator. Allow 24-hour desiccation before weighing.
4. Weigh probe filter holder units and filters at six (6) hour intervals until weight change between weighings is less than 0.2 mg. Record all weights taken on data form no. EPA-10-TP.

#### B. CALCULATION OF RESULTS

The computer program carries out all final calculations. When run, it will ask for data from forms used during the test. Enter data as called for.

### GENERAL

This guide cannot cover every possible contingency, which may develop during a particular test program. Many questions, which 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.

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.



## APPENDIX 11: Sample calculations

**Validation du fichier de calcul avec les équations provenant des normes:**

ASTM E2515-11

ASTME2618

**Dry burn rate (BR)**

**Equation used**

B415.1, 13.4

$$BR = \left[ \frac{60W_{WD}}{\theta} \right] \left[ \frac{100 - \%M_W}{100} \right]$$

**Nomenclature**

- BR Dry wood burn rate, kg/hr (lb/hr)
- $W_{WD}$  Total mass of wood burned (wet basis) during the test run, kg (lb)
- $\theta$  Total time of test run, minutes
- $\%M_W$  Average moisture in test fuel charge, wet basis, %  
To convert from dry basis to wet basis: % moisture wet basis =

**Sample calculation**

**Data**

- $W_{WD}$  13,072 lbs
- $\theta$  354 min
- $\%M_W$  17,02 %

**Calculation**

- BR 0,834 Dry kg/hr

## Volume of gas sample corrected to dry standard conditions ( $V_{m(std)}$ )

### Equation used

ASTM 2515, equation 6

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

### Nomenclature

$V_{m(std)}$	Volume of gas sample , corrected to standard conditions, dscm <sup>3</sup> (dscf)
$K_1$	17.64 R/in Hg
$V_m$	Volume of gas sample
$Y$	DGM calibration factor
$P_{bar}$	Barometric pressure mmHg (in Hg)
$\Delta H$	Average pressure at the outlet of the dry gas meter mm water (in. Water)
$T_m$	Absolute average dry gas meter temperature K (R)

### Sample calculation

#### Data

$V_m$	63,98 dcf
$Y$	0,98843
$P_{bar}$	30,33 in Hg
$\Delta H$	-0,7656 in Hg
$T_m$	535,0 R

#### Calculation

$V_{m(std)}$	61,64 dscf
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## Total amount of particulate matter collected ( $m_n$ )

### Equation used

ASTM 2515, equation 12

$$m_n = F_1 + F_2 + \Delta PF$$

### Nomenclature

$m_n$	Total amount of particulate matter collected, mg
$F_1$	Particulate matter collected on front filter, mg
$F_2$	Particulate matter collected on second filter, mg
$\Delta PF$	Post-test weight gain of probe and filter holder assembly, mg

### Sample calculation

#### Data

$F_1$	-0,0005 g
$F_2$	-0,001 g
$\Delta PF$	0,004 g

#### Calculation

$m_n$	2,200 mg
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Calculation based of train 2 data



## Particulate concentration ( $C_s$ )

### Equation used

ASTM 2515, equation 13

$$C_s = (0,001 \text{ g/mg}) \times \left( \frac{m_n}{V_{m(\text{std})}} \right)$$

### Nomenclature

$C_s$	Concentration of particulate matter in stack gas or dilution tunnel, dry basis, corrected to standard conditions, $\text{g/dsm}^3$ (g/dscf)
$m_n$	Total amount of particulate matter collected in the sampling train, mg
$V_{m(\text{std})}$	Volume of gas sample measured corrected to dry standard conditions, $\text{dsm}^3$ (dscf)

### Sample calculation

#### Data

$m_n$	2,200 mg
$V_{m(\text{std})}$	61,64 dscf

#### Calculation

$C_s$	0,000036 g/dscf
Calculation based of train 2 data	

## Particulate concentration for room air ( $C_r$ )

### Equation used

ASTM 2515, equation 14

$$C_r = (0,001 \text{ g/mg}) \times \left( \frac{m_r}{V_{mr(std)}} \right)$$

### Nomenclature

$C_r$	Concentration of particulate matter in room air, dry basis, corrected to standard conditions, g/dsm <sup>3</sup> (g/dscf)
$m_r$	Total amount of particulate matter collected in the sampling train, mg
$V_{mr(std)}$	Volume of room air sample measured corrected to dry standard conditions, dsm <sup>3</sup> (dscf)

### Sample calculation

#### Data

$m_r$	0,000 mg
$V_{mr(std)}$	43,03 dscf

#### Calculation

$C_r$	0,000000 g/dscf
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Calculation based of train 2 data

## Adjustment factor for alternative pitot tube placement (FP)

### Equation used

ASTM 2515, equation 1

$$F_P = \frac{V_{strav}}{V_{scent}}$$

### Nomenclature

$V_{strav}$	Average gas velocity cacluated after the Pitot tube traverse
$V_{scent}$	Average gas velocity at the center of the dilution tunnel cacluated after the multi-point Pitot traverse
$F_P$	Adjustment factor for center of tunnel pitot tube placement

### Sample calculation

#### Data

$V_{strav}$	0,230817133
$V_{scent}$	0,243924065

#### Calculation

$F_P$	0,946266
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## Average dilution tunnel gas velocity ( $V_S$ )

### Equation used

ASTM 2515, equation 9

$$V_S = F_p K_p C_p (\sqrt{\Delta P})_{avg} \sqrt{\frac{T_S}{P_S M_S}}$$

### Nomenclature

$V_S$	Average dilution tunnel gas velocity, m/s (ft/s)
$K_p$	Pitot tube constant For the metric units: $34.97 \text{ m/sec} \left[ \frac{(\frac{g}{\text{mole}})(\text{mm Hg})}{(^{\circ}\text{K})(\text{mm H}_2\text{O})} \right]^{1/2}$ For English units: $85.49 \text{ ft/sec} \left[ \frac{(\frac{\text{lb}}{\text{mole}})(\text{in Hg})}{(^{\circ}\text{R})(\text{in H}_2\text{O})} \right]^{1/2}$
$C_p$	Pitot tube coefficient (use 0.99 for standard pitot tube, 0.84 may be used for S-type tubes constructed according to Method 2 specifications)
$F_p$	Pitot tube correction factor
$(\sqrt{\Delta P})_{avg}$	Average square root of each individual velocity head ( $\Delta P$ )
$P_{bar}$	Barometric pressure at measurement site, mm H <sub>2</sub> O (in. H <sub>2</sub> O)
$P_g$	Stack static pressure, mm Hg (in. Hg)
$P_S$	Absolute dilution tunnel static gas pressure, mm Hg (in. Hg), or $P_{bar} + P_g$
$M_S$	Molecular weight of dilution tunnel gas, wet basis, g/g-mole (lb/lb-mol) may be assumed to be 28.78 or 29 for CSA B415
$t_S$	Dilution tunnel temperature, °C (°F)
$T_S$	Absolute dilution tunnel temperature, °K (°R), or $273 + t_S$ for metric units, $460 + t_S$ for English units

### Sample calculation

#### Data

$K_p$	85,49
$C_p$	0,99
$F_p$	0,946
$(\sqrt{\Delta P})_{avg}$	0,2446 in H <sub>2</sub> O <sup>1/2</sup>
$P_{bar}$	30,33 in Hg
$P_g$	0,24 in H <sub>2</sub> O
$P_S$	30,35 in Hg
$M_S$	28,78 lb/lb-mol
$t_S$	84,29 F



$T_s$  544,29 R

**Calculation**

$V_s$  15,4622 ft/s

## Average dilution tunnel gas flow rate (Qstd)

### Equation used

ASTM 2515, equation 3

$$Q_{std} = 60(1 - B_{ws})V_S A \left(\frac{T_{std}}{T_S}\right) \left(\frac{P_S}{P_{std}}\right)$$

### Nomenclature

$Q_{std}$	Total gas flow rate corrected to dry standard conditions, $\text{dsm}^3/\text{min}$ (dscf/min)
60	Conversion factor minutes per hour
$B_{ws}$	Water vapour in the dilution tunnel stream, proportion by volume (may be assumed to be 2%)
$V_S$	Average dilution tunnel gas velocity, m/s (ft/s)
A	Cross-sectional area of dilution tunnel, $\text{m}^2$ ( $\text{ft}^2$ )
$T_{std}$	Standard absolute temperature, 293 °K (528°R)
$T_S$	Absolute average dilution tunnel temperature, $\text{K}$ ( $^{\circ}\text{R}$ ), or $273 + t_s$ for metric units, $460 + t$ for English units
$t_s$	Dilution tunnel temperature, °C (°F)
$P_S$	Absolute dilution tunnel static gas pressure, mm Hg (in. Hg), or $P_{bar} + P_g$
$P_{bar}$	Barometric pressure at measurement site, mm Hg (in. Hg)
$P_g$	Dilution tunnel static pressure, mm Hg (in. Hg)
$P_{std}$	Standard absolute pressure, 760 mm Hg (29.92 in. Hg)

### Sample calculation

#### Data

$B_{ws}$	0,02
$V_S$	15,462
A	0,196 $\text{ft}^2$
$T_{std}$	528 R
$T_S$	544,29 R
$P_S$	30,345 in Hg
$P_{std}$	29,92 in Hg

#### Calculation

$Q_{std}$	175,63 dscf/min
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## Particulate emission rate (E)

### Equation used

$$E = (C_s - C_r)Q_{std}$$

### Nomenclature

E	Particulate emission rate, g/hr
$C_s$	Concentration of particulate matter in stack gas or dilution tunnel gas, dry basis corrected to standard conditions, g/dscm <sup>3</sup> (g/dscf)
$C_r$	Concentration of particulate matter in room air, g/dscm <sup>3</sup> (g/dscf)
$Q_{std}$	Total gas flow rate, dry basis corrected to standard conditions, dsm <sup>3</sup> /min (dscf/min)

### Sample calculation

#### Data

$C_s$	0,000036 g/dscf
$C_r$	0,000000 g/dscf
$Q_{std}$	175,63 dscf/min

#### Calculation

E	0,01 g/min
E	0,38 g/h

Calculation based on train 2 data.

## Total particulate emission rate ( $E_T$ )

### Equation used

ASTM 2515, equation 15

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

### Nomenclature

$E_T$	Total particulate emission, g
$C_S$	Concentration of particulate matter in stack gas or dilution tunnel gas, dry basis corrected to standard conditions, g/dscm <sup>3</sup> (g/dscf)
$C_r$	Concentration of particulate matter in room air, g/dscm <sup>3</sup> (g/dscf)
$Q_{std}$	Total gas flow rate, dry basis corrected to standard conditions, dsm <sup>3</sup> /min (dscf/min)
$\theta$	Total sampling time, min

### Sample calculation

#### Data

$C_S$	0,000036 g/dscf
$C_r$	0,000000 g/dscf
$Q_{std}$	175,63 dscf/min
$\theta$	354 min

#### Calculation

E 2,22 g  
Calculation based on train 2 data.



## Average gas velocity in dilution tunnel during each min interval, i, of the test run

### Equation used

ASTM 2515, equation 10

$$v_{si} = F_p K_p C_p \sqrt{\Delta p_i} \sqrt{\frac{T_{si}}{P_s M_s}}$$

### Nomenclature

	Average gas velocity in dilution tunnel during each min interval, i of the test run
$v_{si}$	m/sec (ft/sec)
$F_p$	Pitot tube correction factor
$K_p$	Pitot tube constant
	For the metric units: $34.97 \text{ m/sec} \left[ \frac{(\frac{g}{\text{mole}})(\text{mm Hg})}{(^{\circ}\text{K})(\text{mm H}_2\text{O})} \right]^{1/2}$
	For English units: $85.49 \text{ ft/sec} \left[ \frac{(\frac{\text{lb}}{\text{mole}})(\text{in Hg})}{(^{\circ}\text{R})(\text{in H}_2\text{O})} \right]^{1/2}$
$C_p$	Pitot tube coefficient (use 0.99 for standard pitot tube, 0.84 may be used for S-type tubes constructed according to Method 2 specifications)
$\Delta p_i$	interval, i, of the test run
$T_{si}$	Absolute average gas temperature in the dilution tunnel during the $i^{\text{th}}$ minutes
$P_s$	Absolute dilution tunnel static gas pressure, mm Hg (in. Hg), or $P_{\text{bar}} + P_g$
$M_s$	Molecular weight of dilution tunnel gas, wet basis, g/g-mole (lb/lb-mol) may be assumed to be 28.78

### Sample calculation

#### Data

<b>i=1</b>		<b>i=2</b>	
$F_p$	0,946	$F_p$	0,946
$K_p$	85,49	$K_p$	85,49
$C_p$	0,99	$C_p$	0,99
$\Delta p_i$	0,058 in H <sub>2</sub> O	$\Delta p_i$	0,059 in H <sub>2</sub> O
$T_{si}$	561,9 R	$T_{si}$	559,6 R
$P_s$	30,35 in Hg	$P_s$	30,35 in Hg
$M_s$	28,78 lb/lb-mol	$M_s$	28,78 lb/lb-mol

#### Calculation

<b>i=1</b>		<b>i=2</b>	
$v_{si}$	15,51 ft/sec	$v_{si}$	15,57 ft/sec

## Percent of proportional sampling rate (PR)

### Equation used

B415, equation 13.1

$$PR = \left( \frac{\theta V_{mi(std)} V_S T_m T_{Si}}{\theta_i V_m V_{Si} T_{mi} T_S} \right) \times 100$$

### Nomenclature

PR	Percent of proportional sampling rate (%)
$\theta$	Total sampling time, min
$\theta_i$	Time of interval, 1 min
$V_m$	Volume of gas sample measured by the DGM, dsm <sup>3</sup> (dscf)
$V_{mi(std)}$	Volume of gas sample measured by the digital mass flow controller during the i <sup>th</sup> 1 minutes interval, dsm <sup>3</sup> (dscf)
$V_S$	Average gas velocity in the dilution tunnel, ft/min
$V_{Si}$	Average gas velocity in the dilution tunnel during the i <sup>th</sup> 10 minutes interval, ft/min
$T_m$	Absolute average digital mass flow controller temperature, K (R)
$T_{mi}$	Absolute average digital mass flow controller temperature during the i <sup>th</sup> 1 minutes
$T_S$	Absolute average gas temperature in the dilution tunnel, K (R)
$T_{Si}$	Absolute average gas temperature in the dilution tunnel during the i <sup>th</sup> 1 minutes

### Sample calculation

#### Data

train =1			train =2		
$\theta$	354	min	$\theta$	354	min
$\theta_i$	1	min	$\theta_i$	1	min
$V_m$	61,09	dcf	$V_m$	61,67	dcf
$V_{mi(std)}$	0,168	cuft	$V_{mi(std)}$	0,1761	cuft
$V_S$	15,47	ft/sec	$V_S$	15,47	ft/sec
$V_{Si}$	15,519	ft/sec	$V_{Si}$	15,519	ft/sec
$T_m$	534,4	R	$T_m$	535,0	R
$T_{mi}$	534,16	R	$T_{mi}$	534,30	R
$T_S$	544,29	R	$T_S$	544,29	R
$T_{Si}$	561,9	R	$T_{Si}$	561,9	R

#### Calculation

train=1		train=2	
PR	100,3 %	PR	104,2 %

## Filter face velocity check

### Equation used

$$FV_{max} = \frac{V_{mL}}{1} \times \frac{1}{F_A}$$

### Nomenclature

$FV_{max}$	Maximum filter face velocity during the test run, m/min (ft/min)
$V_{mL}$	Largest 1 minute interval metered gas volume value recorded during the test run, dm <sup>3</sup> (dcf)
$F_A$	Filter area exposed to gas sample during train operation, m <sup>2</sup> (ft <sup>2</sup> )

### Sample calculation

#### Data

$V_{mL}$	0,175 dcf
$F_A$	0,0116 ft <sup>2</sup>

#### Calculation

$FV_{max}$	15,06 ft/min
------------	--------------

## Dual train precision

### Equation used

$$\frac{\text{Train 1} - \text{average train 1 and train 2}}{\text{average train 1 and train 2}} \times 100 \leq 7.5\%$$

### Nomenclature

Dual train precision	Deviation between emission's train 1 and 2
Train 1	Total emission for train 1
Train 2	Total emission for train 2

### Sample calculation

#### Data

Train 1	2,44 g
Train 2	2,22 g

#### Calculation

Dual train precision	4,82 %
----------------------	--------



## Analyzer drift checks

### Equation used

$$Drift = \frac{\Delta R}{span} \times 100$$

### Nomenclature

Drift	The change in analyzer response to calibration gas over the duration of the test run
$\Delta R$	The difference between the analyzer response at the end of the test run and the
Span	The upper limit of the instrument range, ppmv or %

### Sample calculation

#### Data

$\Delta R$	0,015 %
Span	5 %

#### Calculation

Drift	0,30 %
-------	--------

Calculated with CO concentration values.

## APPENDIX 12: Volume calculations

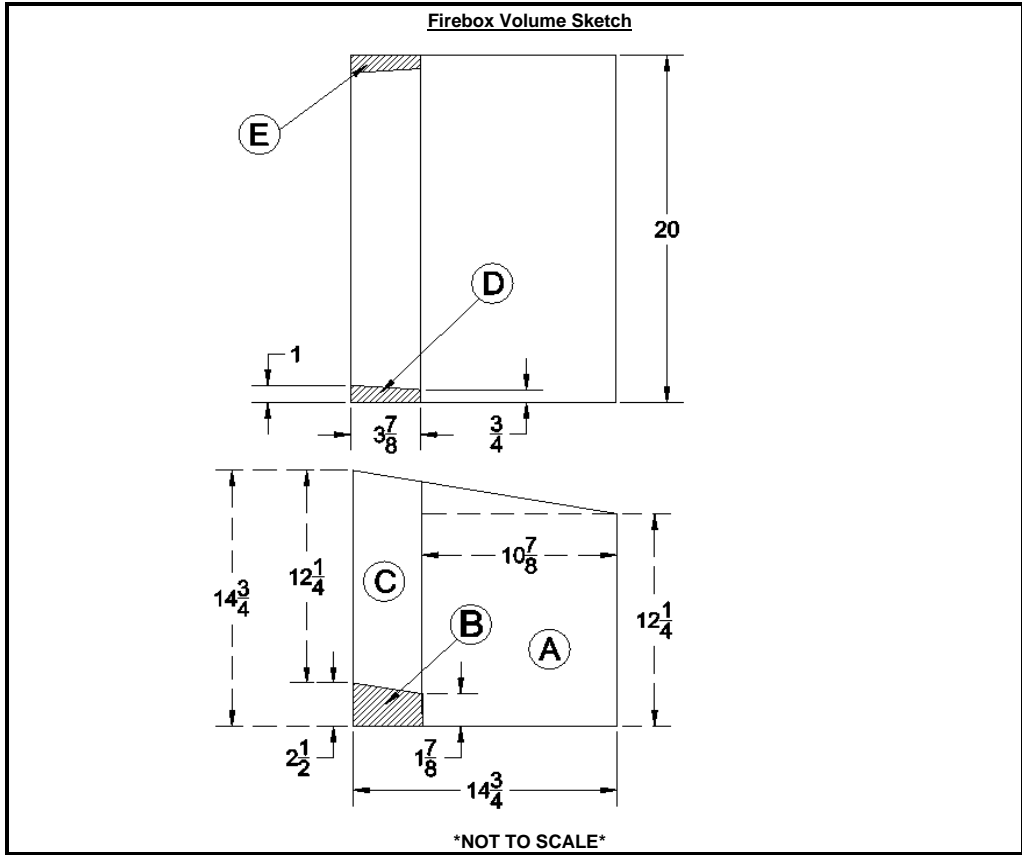


Model: GM60

### Firebox Volume and Fuel Load Calculation

Date: 7/31/17

Test Engineer: DBRYANT



Area	Add/Subtract (+/-)	Height (in)	Width (in)	Length (in)	Volume (cuft)
A	+	12.25	10.88	20	1.5426
B	-	2.5	3.88	20	-0.1123
C	+	14.25	3.88	20	0.6399
D	-	12.25	3.88	1	-0.0275
E	-	12.25	3.88	1	-0.0275
F					0.0000
G					0.0000
H					0.0000
I					0.0000
J					0.0000

Total Firebox Volume (cuft)	Test Fuel Load (lbs)		
	Lower (lbs)	Ideal (lbs)	Upper (lbs)
2.0152	12.70	14.11	15.52

<b>Crib Construction</b>	2 X 4 and 4 X 4	35% TO 65% WEIGHT 2 X 4
--------------------------	-----------------	-------------------------

<b>Firebox Length:</b>	20	in
<b>Door Opening Width</b>	16.75	in
<b>Nominal Test Fuel Piece Length (5/6 of Firebox Length):</b>	16.6666667	in

## APPENDIX 13: Operating instruction





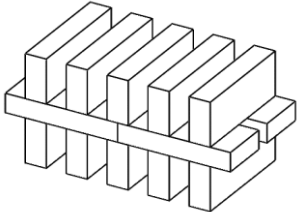
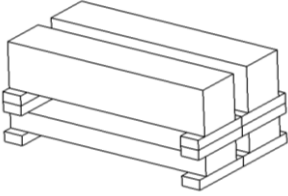
## Wood Stove Operating Instructions

Model: GM 60

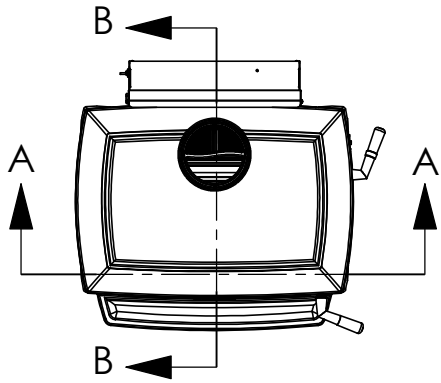
Date: 12/13/2017



Test Engineer: D. Bryant

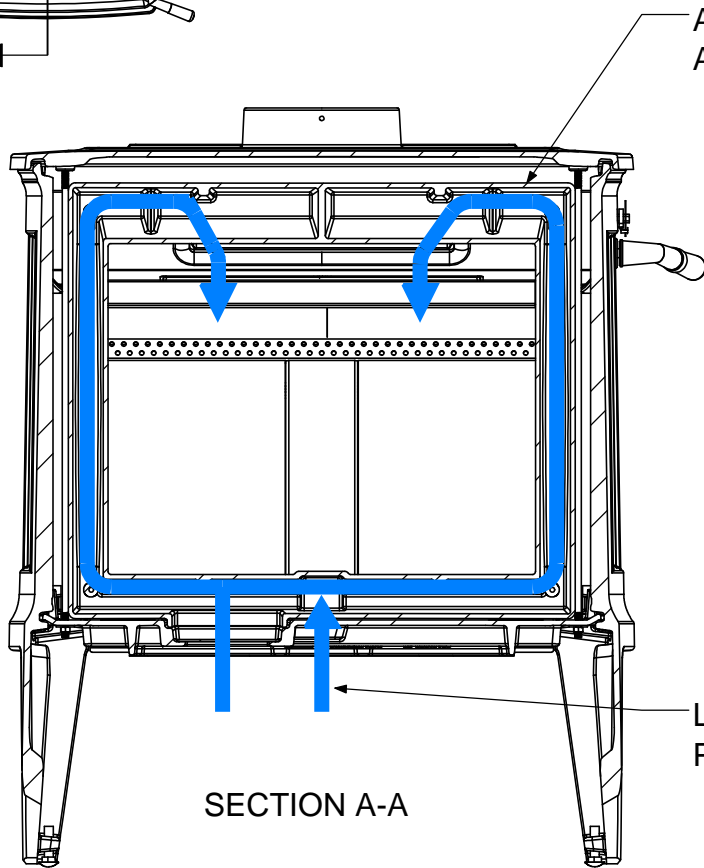
Burn Rate Category	Kindling	Pre-burn Load	Test Load	Pre-Burn Start	Air Setting	Fan Setting	Coal Bed	Test Start
<b>Low</b> 0.80-0.95 kg/hr typ.	*3.5 lbs of kindling *Burn to 0.8-1.0 lbs before adding pre-burn	*14 ea- 2"x4"x8" (Leave door cracked 5-10 min to insure ignition *Close bypass @10 lbs fuel weight	*2 ea - 2"x4" *2ea - 4" x 4" 15.5" to 16.5" long *12 ea - spacers *low-avg-high (lbs) 12.7 - 14.11 - 15.52	4.0 lbs up from top of coal bed range *~500 °F stove temp	.099" (CLOSED)	ON - Pre-Burn (low) OFF - First 30 minutes of test ON - Remainder of test (LOW)	Rake coal bed 1-2 minutes before test start. Ensure clear path for lower primary. Start test at low end of coal bed weight range	*350-400 °F stove temp *600 °F CAT temp *Close door and bypass after loading *Primary full open for first 5 minutes.
<b>Medium Low</b> 0.95-1.25 kg/hr typ.	*3.5 lbs of kindling *Burn to 0.8-1.0 lbs before adding pre-burn	*14 ea- 2"x4"x8" (Leave door cracked 5-10 min to insure ignition *Close bypass @10 lbs fuel weight	*2 ea - 2"x4" *2ea - 4" x 4" 15.5" to 16.5" long *12 ea - spacers *low-avg-high (lbs) 12.7 - 14.11 - 15.52	5.5 lbs up from top of coal bed range ~500 °F stove temp	0.188"	ON - Pre-Burn (low) ON - Test (low) Note: fan will start automatically from thermostat	Rake coal bed 1-2 minutes before test start. Ensure clear path for lower primary. Start test at low end of coal bed weight range	*380-450 °F stove temp *700 °F CAT temp *Close door and bypass after loading *Primary full open for first 5 minutes.
<b>Medium High</b> 1.26-1.75 kg/hr typ.	*3.5 lbs of kindling *Burn to 0.8-1.0 lbs before adding pre-burn	*14 ea- 2"x4"x8" (Leave door cracked 5-10 min to insure ignition *Close bypass @10 lbs fuel weight	*2 ea - 2"x4" *2ea - 4" x 4" 15.5" to 16.5" long *12 ea - spacers *low-avg-high (lbs) 12.7 - 14.11 - 15.52	7.0 lbs up from top of coal bed range ~500 °F stove temp	.438"	ON - Pre-Burn (low) ON - Test (low) Note: fan will start automatically from thermostat	Rake coal bed 1-2 minutes before test start. Ensure clear path for lower primary. Start test at low end of coal bed weight range	*450 °F stove temp *750 °F CAT temp *Close door and bypass after loading *Shut down primary after test load ignites (approx. 2 minutes)
<b>High</b> 1.76-2.25 kg/hr typ.	*3.5 lbs of kindling *Burn to 0.8-1.0 lbs before adding pre-burn	*14 ea- 2"x4"x8" (Leave door cracked 5-10 min to insure ignition *Close bypass @10 lbs fuel weight	*2 ea - 2"x4" *2ea - 4" x 4" 15.5" to 16.5" long *12 ea - spacers *low-avg-high (lbs) 12.7 - 14.11 - 15.52	Start Pre-Burn immediately after lighting kindling.	FULL OPEN	ON - Pre-Burn (low) ON - Test (low) Note: fan will start automatically from thermostat	Rake coal bed 1-2 minutes before test start. Ensure clear path for lower primary. Start test at low end of coal bed weight range	*500°F stove temp *800 °F CAT temp *Close door and bypass after loading *Primary stays at full open setting

Typical Pre-Burn Load	Typical Test Load	Additional Instructions
		

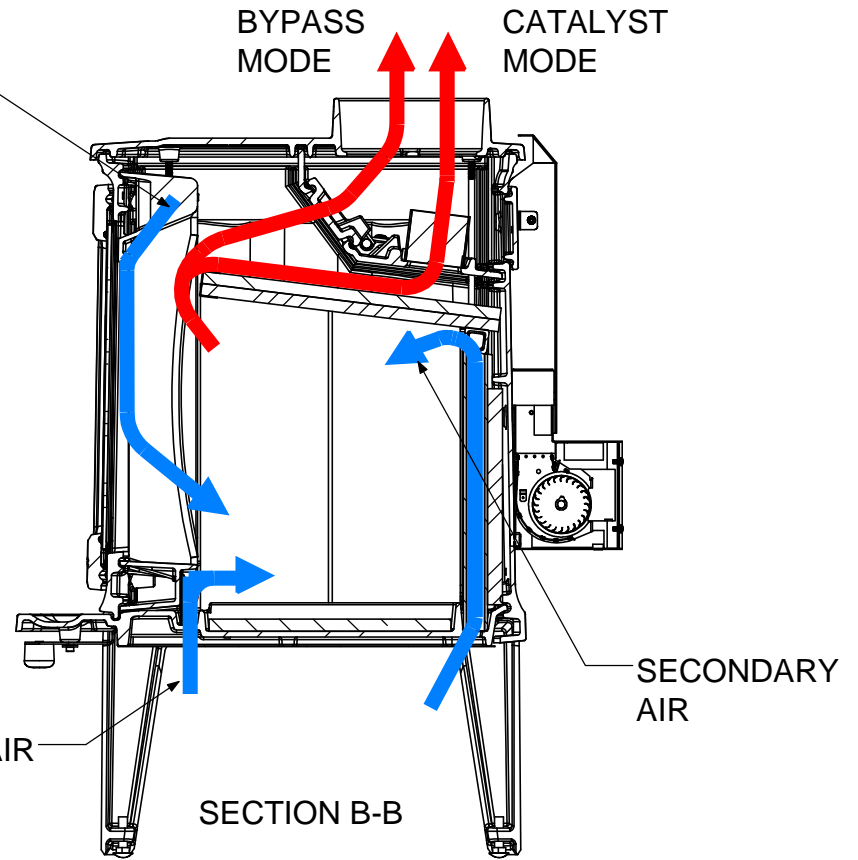
## APPENDIX 14: Drawing Air flow pattern



**INLET**   
**OUTLET** 



SECTION A-A



SECTION B-B



UNLESS OTHERWISE SPECIFIED:  
 TOLERANCES ARE:  
 FRACTIONS DECIMALS ANGLES  
 $\pm 1/64$  .XX $\pm$  .015  $\pm 1/4^\circ$   
 .XXX $\pm$ .005

- 1.) DIMENSIONS ARE IN INCHES / MM
  - 2.) ALL MACHINED SURFACES TO BE DE-BURRED AND SMOOTHED
- DO NOT SCALE DRAWING

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

APPROVALS	DATE
DRAWN DRB	
CHECKED	
RESP ENG	
MFG ENG	
QUAL ENG	



<b>GM60</b>	
<b>EPA AIR FLOW</b>	
SIZE A	HEARTHSTONE DWG. NO. <b>8660</b>
SCALE: 1:16	HERGOM DWG. NO.
SHEET 1	OF 1

This document submitted by HearthStone is the property of HearthStone and may contain information of a proprietary nature and shall not be copied or duplicated in whole or in part or used in whole or in part for any purpose other than that which is necessary for the preparation of bids or fabrication. Please return to HearthStone.

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED



OMB Control No. 2060-0161  
Approval expires 03/31/2019

OMB Control No. 2060-0693  
Approval expires 03/31/2019

EPA Form 6400-05

## Office of Enforcement and Compliance Assurance

### 30-DAY NOTIFICATION

#### 2015 CLEAN AIR ACT (CAA) STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW RESIDENTIAL HYDRONIC HEATERS AND FORCED-AIR FURNACES 40 CFR PART 60 SUBPARTS AAA AND QQQQ

The public reporting and recordkeeping burden for this collection of information is estimated to average 2 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Regulatory Support Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

**Disclaimer:** The statutory provisions and the EPA regulations described in this document contain legally binding requirements. This document is not a substitute for those provisions or regulations, nor is it a regulation itself. In the event of a discrepancy, please refer to 40 CFR PART 60 Subparts AAA AND QQQQ, sections 60.537 and 60.5479. If you have additional questions, please contact Rafael Sanchez at 202-564-7028 or via email at [sanchez.rafael@epa.gov](mailto:sanchez.rafael@epa.gov).

**Instructions:** The manufacturer of an affected wood/pellet heater/central heater model line must notify the Administrator of the date that certification testing is scheduled to begin by email to [WoodHeaterReports@epa.gov](mailto:WoodHeaterReports@epa.gov). This notice must be received by the EPA at least 30 days before the start of testing.

GENERAL INFORMATION						
Manufacturer's Name: <b>Hearthstone QHHP</b>						
Heater Type (Check one):	<input checked="" type="checkbox"/> Adjustable Burn Rate Wood Heater	<input type="checkbox"/> Pellet Stove	<input type="checkbox"/> Single Burn Rate Heater	<input type="checkbox"/> Hydronic Heater	<input type="checkbox"/> Forced Air Furnace	<input type="checkbox"/> Other:
Hydronic Heater Type (Check one):	<input type="checkbox"/> Full Storage	<input type="checkbox"/> Partial Storage	<input type="checkbox"/> Indoor	<input type="checkbox"/> Outdoor	<input type="checkbox"/> Other:	
Forced-Air Furnace Type (Check one):	<input type="checkbox"/> Small (less than 65,000 BTU/hr heat output)		<input type="checkbox"/> Large (greater than 65,000 BTU/hr heat output)			
Fuel Tested (Check one):	<input checked="" type="checkbox"/> Crib	<input type="checkbox"/> Pellet	<input type="checkbox"/> Cordwood	<input type="checkbox"/> Wood Chips	<input type="checkbox"/> Other:	
Model Name(s) (as will appear on test report): <b>Green Mountain 60</b>						
Model Number(s) (as will appear on test report): <b>8660</b>						
Equipped with a catalytic combustor? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No						





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Mailing Address: 317 Stafford Ave.		
Street Address: 317 Stafford Ave.		
City: Morrisville	State: VT	ZIP Code: 05661
Phone: 802-851-4044	Fax: NA	Web Site: <a href="http://www.hearthstonestoves.com/">http://www.hearthstonestoves.com/</a>
Address of Manufacturer: 317 Stafford Ave.		
City: Morrisville	State: VT	ZIP Code: 05661
<b>EPA APPROVED TEST LABORATORY</b>		
Name and Title of Authorized Representative: Danick Power		
Company: Services Polytests, Inc.		
Phone: 450-741-3636	E-mail: <a href="mailto:Dpower@polytests.com">Dpower@polytests.com</a>	Fax: NA



OMB Control No. 2060-0161  
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City: St-Jean-Sur Richelieu	State: Quebec, Canada	ZIP Code: J3B-7S7
<b>EPA APPROVED THIRD-PARTY CERTIFIER</b>		
Name and Title of Authorized Representative: John Steinert, President		
Company: Dirigo Laboratories, Inc.		
Phone: 503-650-0088	E-mail: <a href="mailto:jsteinert@dirigolab.com">jsteinert@dirigolab.com</a>	Fax: NA
City: Clackamas	State: OR	ZIP Code: 97015
<b>COMPLIANCE TEST INFORMATION</b>		
Test Method(s): EPA Method 28R, ASTM E2515-11, ASTM E2780, CSA B415.1-10		
Date(s) of Proposed Test: January 15 <sup>th</sup> , 2018 – January 19 <sup>th</sup> , 2018		



OMB Control No. 2060-0161  
Approval expires 03/31/2019

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EPA Form 6400-05

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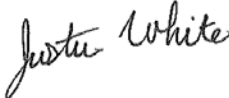
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**Instructions:** The manufacturer of an affected wood/pellet heater/central heater model line must notify the Administrator of the date that certification testing is scheduled to begin by email to [WoodHeaterReports@epa.gov](mailto:WoodHeaterReports@epa.gov). This notice must be received by the EPA at least 30 days before the start of testing.

<b>Testing Location (Name and Address):</b> Polytests Services Inc. 695 B rue Gaudette, St-Jean-sur-Richelieu Québec, Canada, J3B 7S7 450.741.3636	
<b>Contact Name:</b> Danick Power	<b>Title:</b> VP of Operations
<b>Phone Number:</b> 450 741-3636	<b>Email Address:</b> Dpower@polytests.com

Justin White, Product Development Manager

Print Name and Title of Authorized Official



Signature

November 13<sup>th</sup>, 2017

Date

Telephone Number: 802-851-4044

Email Address: [jwhite@hearthstonestoves.com](mailto:jwhite@hearthstonestoves.com)

Remarks:

v1







## Certificate of Conformity

Issued to:           Hearthstone QHHP  
                          317 Stafford Ave.  
                          Morrisville, VT 05661  
                          (802) 851-4044  
Model:               Green Mountain 60  
Effective Date:     March 16, 2018  
Report #             18-407

Certification tests were performed by Services Polytests, Inc. located at: 695-B Gaudette- St-jean-sur-Richelieu, QC, J3B 7S7 CANADA.

PFS TECO certifies conformity to the following per 40 CFR Part 60 §60.533 (f) (A):

- The test report is complete and accurate.
- The instrumentation used for the test was properly calibrated.
- The representative model tested meets the applicable emission limits.
- The tests have been conducted per the appropriate guidelines.
- The manufacturer's Quality Control Plan has been reviewed to ensure that all production units are similar in all material respects that would affect emissions to the tested/certified model and that the units in the model line will meet all (other) applicable requirements.

PFS TECO certifies that the emissions levels as measured in the test report are in compliance with the 2020 PM emission limit of  $\leq 2.0$  g/hr using crib wood.

The weighted average emissions for the Green Mountain 60 wood heater is **0.62 g/hr** with a weighted average efficiency of **79.2%**. Average CO emissions are **28.68 g/hr** or **0.49 g/min.**

Issued by:       PFS TECO  
                      11785 SE Highway 212  
                      Suite 305  
                      Clackamas, OR 97015

03/15/2018

John Steinert, General Manager

Date



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, DC 20460

OFFICE OF  
ENFORCEMENT AND  
COMPLIANCE ASSURANCE

September 14, 2020

Mr. Simon Booth  
Hearthstone QHHP, Inc.  
317 Stafford Avenue  
Morrisville, Vermont 05661

Re: Updated Certification Letter Number 121-18 for Green Mountain 60 8660, Hipster 20 AMB8260, and Shelburne 8372 Catalytic Wood Heater Models

Dear Mr. Booth:

The United States Environmental Protection Agency (EPA) is in receipt of your July 9, 2020, letter regarding the above-referenced certificate of compliance letter. This certificate currently includes the Green Mountain 60 8660 model. Hearthstone QHHP, Inc. (Hearthstone) is requesting that the above-referenced certificate be updated to add the Hipster 20 AMB8260, and Shelburne 8372 models. According to Hearthstone, the Hipster 20 AMB8260, and Shelburne 8372 models will be manufactured exactly the same as the current certified model except for cosmetic changes to the outer cast iron body of the heaters. Hearthstone affirms that the above-referenced design changes will not cause wood heaters within the model line to exceed applicable emission limits.

In accordance with the 2015 Wood Heater Rule, a manufacturer must recertify a model line whenever any change is made in the design that affects or is presumed to affect the particulate emission rate for that model (Sections §60.533(k)(1) and (k)(2)). However, pursuant to the Rule, EPA may waive the recertification requirement if the manufacturer presents adequate rationale, and EPA determines that the change may not reasonably be anticipated to cause heaters in the model line to exceed the applicable emission limits.

Based on a February 6, 2018, test report by Services Polytests Inc., a July 10, 2020, certificate of conformity by PFS TECO, and the information provided in your July 9, 2020, letter, EPA has determined that the proposed changes are unlikely to cause the model line to exceed the emission rate of 0.62 g/hr. An emission rate of 0.62 g/hr meets the 2020 New Source Performance Standard (NSPS) for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces at 40 CFR Part 60, Subpart AAA particulate matter emission limit of 2.0 g/hr. Therefore, pursuant to §60.533(k)(1), EPA is waiving certification testing for the Hipster 20 AMB8260, and Shelburne 8372 models. We have updated the above-referenced certificate number and the EPA Wood Heater Database to include the new model names. Please refer to the above-referenced certification letter number in all future correspondence.

This certification is valid for the above-referenced models and cannot be transferred to another model line without applying for certification. This certification allows Hearthstone to manufacture and sell the above-referenced models through April 18, 2023. Thereafter, Hearthstone may not manufacture, advertise for sale, offer for sale, or sell wood heaters under this certificate without applying for and being issued another compliance certification.

All wood heaters manufactured or sold under this certification must comply with EPA labeling requirements found at §60.536. These provisions require each wood heater to have a permanent label affixed to it that includes the month and year of manufacture, model name or number, serial number, certification test emission value, test method, standard met, and compliance certification statement.

In addition, Hearthstone must comply with all applicable requirements of the regulation, including:

1. Conducting a third-party certifier-approved quality assurance program which ensures that all units within a model line are similar to the wood heater submitted for certification testing in all respects that would affect emissions and are in compliance with the applicable emission limit, pursuant to §60.533(m);
2. Applying for recertification whenever any change is made to above-referenced models that affect or is presumed to affect the particulate matter emission rate for the model line, pursuant to §60.533(k)(1);
3. Submitting a report to the EPA every two years following issuance of a certificate of compliance for each model line. This report must include the sales for each model by state and certify that no changes in the design or manufacture of this model line have been made that require recertification under §60.533(k);
4. Retaining records and submitting reports as required at §60.537; and
5. Submitting wood heaters for audit testing if selected by the EPA under §60.533(n)(1)(i) and (2)(i).

Failure to comply with these requirements may result in a revocation of this certification and enforcement action, including penalties as specified under the Clean Air Act. If you have any questions concerning this letter, please contact Rafael Sanchez of my staff at (202) 564-7028 or via email at [sanchez.rafael@epa.gov](mailto:sanchez.rafael@epa.gov).

Sincerely,



Martha Segall  
Acting Director  
Monitoring, Assistance, and Media Programs Division  
Office of Compliance



**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)**  
**2015 Standards of Performance for New Residential Wood Heaters, New Residential**  
**Hydronic Heaters and Forced-Air Furnaces Application**  
**40 CFR PART 60 SUBPARTS AAA AND QQQQ**

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A. <i>Summary Results – Adjustable Wood Burning Heaters</i> .....	7
B. <i>Summary Results – Single Burn Rate Wood Burning Heaters</i> .....	<b>Erreur ! Signet non défini.</b>
C. <i>Summary Results – Pellet Heaters</i> .....	<b>Erreur ! Signet non défini.</b>
Hydronic Heaters.....	<b>Erreur ! Signet non défini.</b>
II. Test Method 28WHH for Measurement of Particulate Emissions and Heating Efficiency of Wood-Fired Hydronic Heating Appliances	<b>Erreur ! Signet non défini.</b>
Table 1A. Data Summary Part A .....	<b>Erreur ! Signet non défini.</b>
.....	<b>Erreur ! Signet non défini.</b>
Table 1B. Data Summary Part B.....	<b>Erreur ! Signet non défini.</b>
Table 1C: Additional (Hangtag) Information.....	<b>Erreur ! Signet non défini.</b>
Table 2. Annual Weighting.....	<b>Erreur ! Signet non défini.</b>
III. Test Method 28WHH for Certification of Cord Wood-Fired Hydronic Heating Appliances With Partial Thermal Storage...	<b>Erreur ! Signet non défini.</b>
Table 2A. Data Summary Part A .....	<b>Erreur ! Signet non défini.</b>
Table 2B. Data Summary Part B.....	<b>Erreur ! Signet non défini.</b>
Table 3C. Data Summary Part D.....	<b>Erreur ! Signet non défini.</b>
Forced-Air Furnaces.....	<b>Erreur ! Signet non défini.</b>
IV. Forced-Air Furnaces .....	<b>Erreur ! Signet non défini.</b>

**APPLICATION FOR A CERTIFICATE OF COMPLIANCE PURSUANT TO 40 CFR  
PART 60 SUBPARTS AAA AND QQQQ  
2015 STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW  
RESIDENTIAL HYDRONIC HEATERS AND FORCED-AIR FURNACES**

**GENERAL INFORMATION**

**Manufacturer's Name: Hearthstone QHHP**

<b>Heater Type (Circle One):</b>	Adjustable Burn Rate Wood Heater	Pellet Stove	Single Burn Rate Heater	Hydronic Heater	Forced Air Furnace	Other:
<b>Hydronic Heater Type (Circle One):</b>	Traditional	Full Storage	Partial Storage	Indoor/Outdoor	Other:	
<b>Forced-Air Furnace Type (Circle One):</b>	Small (less than 65,000 BTU/hr heat output)		Large (greater than 65,000 BTU/hr heat output)		Other:	

<b>Fuel Tested:</b>	Crib	Pellet	Cordwood	Wood Chips	Other:
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<b>Test Method(s):</b> Méthod 28, ASMTE2780	<b>Catalyst:</b> Yes
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**Model Name and Design Number (The model name and design number must clearly distinguish one model from another. The name and design number cannot include the EPA symbol or logo or name or derivatives such as "EPA):**  
Green Mountain 60, Model # 8660

<b>Physical Address (Street number and Address, not P.O. Box):</b> 317 Stafford Ave.	<b>Mailing Address:</b> Same
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<b>City:</b> Morrisville	<b>State:</b> Vermont	<b>ZIP Code:</b> 05661
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<b>Phone:</b> 802-851-4044	<b>Email:</b> <a href="mailto:jwhite@hearthstonestoves.com">jwhite@hearthstonestoves.com</a>	<b>Website:</b> <a href="http://www.hearthstonestoves.com">www.hearthstonestoves.com</a>
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**EPA Submission Date of 30 day Notice:** November 13<sup>th</sup> 2017

**MANUFACTURER'S AUTHORIZED REPRESENTATIVE INFORMATION**

**Name:** Justin White

**Position/Title:** Product Development Manager

**Address:** 317 Stafford Ave.

<b>City:</b> Morrisville	<b>State:</b> VT	<b>ZIP Code:</b> 05661
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<b>Phone:</b> 802-851-4044	<b>E-mail:</b> <a href="mailto:jwhite@hearthstonestoves.com">jwhite@hearthstonestoves.com</a>	<b>Website:</b> <a href="http://www.hearthstonestoves.com">www.hearthstonestoves.com</a>
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**Remarks:**

**APPLICATION FOR A CERTIFICATE OF COMPLIANCE PURSUANT TO 40 CFR  
PART 60 SUBPARTS AAA AND QQQQ  
2015 STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW  
RESIDENTIAL HYDRONIC HEATERS AND FORCED-AIR FURNACES**

**EPA-APPROVED TEST LABORATORY**

**Name of Test Laboratory:**  
Polytests Services inc.

**Name of Person Authorized or Responsible for Conducting Compliance Test:** Danick Power

**Position/Title:** VP operation

**Address:** 695-B Gaudette,

**City:** St-Jean-sur-Richelieu

**State:** Quebec, Canada

**ZIP Code:** J3B 7S7

**Phone:** 450 741-3636

**Email:** dpower@polytests.com

**Website:** www.polytests.com

**Remarks:**

**EPA-Approved Third Party Certifier**

**Name of Certifier Entity:** PFS TECO

**Name of Person Authorized or Responsible for Reviewing Test Report and/or Issuing Certification of Conformity:**  
John Steinert

**Position/Title:** General Manager – Portland Laboratory

**Address:** 11785 SE Highway 212 – Suite 305

**City:** Clackamas

**State:** OR

**ZIP Code:** 97015

**Phone:** 503-650-0088

**Email:**  
john.steinert@pfsteco.com

**Website:** www.pfsteco.com

**Remarks:**


**COMPLIANCE STATEMENTS AND ACKNOWLEDGEMENTS – SECTIONS 60.533(B) AND 60.5475(B)**

**INSTRUCTIONS: PLEASE READ THE BELOW STATEMENTS AND AFFIRMATIONS AND ADDRESS ACCORDINGLY.**

**FOR EMISSIONS DATA SUMMARY TABLES SEE ATTACHMENTS**

**1. Engineering Drawings Statement**

Engineering drawings and specifications of components that may affect emissions (including specifications for each component listed in paragraphs (k)(2), (3) and (4) of 60.533(b) and 60.5475(b). Manufacturers may use assembly or design drawings that have been prepared for other purposes, but must designate on the drawings the dimensions of each component listed in paragraph (k) of this section. Manufacturers must identify tolerances of components listed in paragraph (k)(2) of 60.533(b) and 60.5475(b) that are different from those specified in that paragraph, and show that such tolerances cannot reasonably be anticipated to cause wood heaters in the model line to exceed the applicable emission limits. The drawings must identify how the emission-critical parts, such as air tubes and catalyst, can be readily inspected and replaced.

[JW] Engineering drawings and specifications of components that may affect emissions are included with the CBI certification report. Dimensions and tolerances are in line with 60.533 (b), and our quality assurance plan and quality inspection sheets ensure on-going quality and conformance. Replacement instructions for emission-critical components are included in our operator's manual.

**2. Firebox Statement Requirement**

A statement whether the firebox or any firebox component (including the materials listed in paragraph (k)(3) of 60.533(b) and 60.5475(b) will be composed of material different from the material used for the firebox or firebox component in the wood heater on which certification testing was performed, a description of any such differences and demonstration that any such differences may not reasonably be anticipated to adversely affect emissions or efficiency.

[JW] All K-list items as described in 60.533 (b) on the certification test unit will be similar in all material respects to the production units, with exception to several cast iron ribs and features that were built with steel rather than cast iron. These features were constructed to have the same thickness, dimensional size, and placement as those on production units that will be fully cast iron. Because the material properties are very similar, these substitutions are considered to have a negligible effect on safety, performance, emissions, and function, per 60.533. These substitutions were pre-approved by the EPA on April 6<sup>th</sup>, 2017.

**3. CBI**

Clear identification of any claimed confidential business information (CBI). Submit such information under separate cover to the EPA CBI Office; Attn: Residential Wood Heater Compliance Program Lead, 1200 Pennsylvania Ave., NW, Room 7138, MS:2227A, Washington, DC 20460. **Note that all emissions data, including all information necessary to determine emission rates in the format of the standard, cannot be claimed as CBI.**

[JW] A CBI and Non-CBI report will be provided separately.



**4. Valid Certification Statement**

All documentation pertaining to a valid certification test, including the complete test report and, for all test runs: Raw data sheets, laboratory technician notes, calculations and test results. Documentation must include the items specified in the applicable test methods. Documentation must include discussion of each test run and its appropriateness and validity, and must include detailed discussion of all anomalies, whether all burn rate categories were achieved, any data not used in the calculations and, for any test runs not completed, the data collected during the test run and the reason(s) that the test run was not completed and why. The burn rate for the low burn rate category must be no greater than the rate that an operator can achieve in home use and no greater than is advertised by the manufacturer or retailer. The test report must include a summary table that clearly presents the individual and overall emission rates, efficiencies and heat outputs. Submit the test report and all associated required information, according to the procedures for electronic reporting specified in § 60.537(f) and 60.5475(f).

[JW] A valid certification test report with all required documentation as specified above has been submitted by Polytests.

**5. Warranties**

A copy of the warranties for the model line, which must include a statement that the warranties are void if the unit is used to burn materials for which the unit is not certified by the EPA and void if not operated according to the owner's manual.

[JW] The warranty is detailed in the Operator's manual, which is provided with Polytest's report.

**6. Q/A Statement**

A statement that the manufacturer will conduct a quality assurance program for the model line that satisfies the requirements of paragraph (m) of this section.

[JW] Hearthstone is contracted with PFS TECO as our third party certifier to review our QA/QC program, and to provide at least annual audits. Hearthstone's QA plan is included with the certification report.

**7. Laboratory Sealing of Unit**

A statement describing how the tested unit was sealed by the laboratory after the completion of certification testing and asserting that such unit will be stored by the manufacturer in the sealed state until 5 years after the certification test.

[JW] The unit has been sealed by Polytests and will be transferred back to Hearthstone. Hearthstone will store the unit in a sealed state for at least five years.

**8. Statements that the wood heaters manufactured under this certificate will be—**

- (i) Similar in all material respects that would affect emissions as defined in § 60.531 to the wood heater submitted for certification testing, and labeled as prescribed in § 60.536 and 60.5478.
- (ii) Accompanied by an owner's manual that meets the requirements in § 60.536 and 60.5478. In addition, a copy of the owner's manual must be submitted to the Administrator and be available to the public on the manufacturer's web site.

[JW] (i) The tested unit is the same in all material respects that would affect emissions to production units, and production units will be labeled in accordance with 60.536

(ii) All production units will include a copy of the owner's operation/installation manual that meets the requirements as specified in 60.536. A copy of the owner's manual has been provided with the report, and will be made available on Hearthstone's website.

**9. Third Party Certification Statement**

A statement that the manufacturer has entered into contracts with an approved laboratory and an approved third-party certifier that satisfy the requirements of paragraph (f) of this section.

[JW] Hearthstone is contracted with PFS TECO as our third party certifier.

**10. Approved laboratory/third party Statement**

A statement that the approved laboratory and approved third-party certifier are allowed to submit information on behalf of the manufacturer, including any claimed to be CBI.

**11. Manufacturer’s Website Certification Test Reports Availability Statement**

A statement that the manufacturer will place a copy of the certification test report and summary on the manufacturer’s web site available to the public within 30 days after the Administrator issues a certificate of compliance.

[JW] Polytests and PFS TECO are allowed to submit information related to EPA emissions testing performed by Polytests on behalf of Hearthstone, including any claimed CBI.

**12. Transferability Acknowledgement Statement**

A statement of acknowledgment that the certificate of compliance cannot be transferred to another manufacturer or model line without written approval by the Administrator.

[JW] Hearthstone acknowledges that the certificate of compliance cannot be transferred to another manufacturer or model line without written approval by the Administrator.

**13. Statement about Selling Wood Heaters without an EPA Certificate**

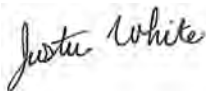
A statement acknowledging that it is unlawful to sell, distribute or offer to sell or distribute an affected wood heater without a valid certificate of compliance.

[JW] Hearthstone acknowledges that it is unlawful to sell, distribute or offer to sell or distribute an affected wood heater without a valid certificate of compliance.

**Print Name and Title: Justin White, Product Development Manager**

**Date: 2/7/18**

Signature of responsible representative of the manufacturer certifying the accuracy of the above statements:



The authorized or responsible party whose signature is above is certifying that the manufacturer has complied with and will continue to comply with all requirements of the 2015 NSPS for compliance certification and that the manufacturer remains responsible for compliance regardless of any error by the test laboratory or third-party certifier.

**Attachments**

**Instructions: Please complete the section applicable to your certification request. You may substitute your own data tables in lieu of the ones shown below provided that all the information is captured.**

**WOOD BURNING HEATERS**

**I. Test Method 28R for Certification and Auditing of Wood Heaters**

**A. SUMMARY RESULTS – ADJUSTABLE WOOD BURNING HEATERS**

<b>Category 1 &lt; 0.80 Kg/hr.</b>		<b>Category 2 .80 to 1.00 kg/hr.</b>		<b>Category 3 1.25 to 1.90 kg/hr.</b>		<b>Category 4 Maximum</b>	
Date	2018-01-15	Date	2018-01-16	Date	2018-01-18	Date	2018-01-22
Run Number	1	Run Number	2	Run Number	4	Run Number	5
Emission Rate g/Hr.	0.39	Emission Rate g/Hr.	0.20	Emission Rate g/Hr.	0.78	Emission Rate g/Hr.	2.15
Burn Rate KG/Hr.	0.834	Burn Rate KG/hr.	1.239	Burn Rate KG/hr.	1.604	Burn Rate KG/hr.	2.37
BTU/Hr. (HHV)	12 608	BTU/Hr. (HHV)	18 702	BTU/Hr. (HHV)	23 468	BTU/Hr. (HHV)	33 576
Overall Efficiency (%)	80.42	Overall Efficiency (%)	80.29	Overall Efficiency (%)	77.81	Overall Efficiency (%)	75.37
CO Emissions (g/MJ Output)	0.67	CO Emissions (g/MJ Output)	1.07	CO Emissions (g/MJ Output)	1.33	CO Emissions (g/MJ Output)	1.45
CO Emissions (g/kg Dry Fuel)	10.64	CO Emissions (g/kg Dry Fuel)	17.05	CO Emissions (g/kg Dry Fuel)	20.45	CO Emissions (g/kg Dry Fuel)	21.70
CO Emissions (g/min)	0.148	CO Emissions (g/min)	0.352	CO Emissions (g/min)	0.55	CO Emissions (g/min)	0.86
ASTM E2515 Emissions – First Hour (g/hr)	1.53	ASTM E2515 Emissions – First Hour (g/hr)	0.41	ASTM E2515 Emissions – First Hour (g/hr)	2.35	ASTM E2515 Emissions – First Hour (g/hr)	4.38

**Weighted particulate emission average of 4 test runs: 0.62 grams per hour.**

**Weighted average HHV efficiency of 4 test runs: 79.2%.**

**Average Co 0.478 gr/min**





# Certificate of Conformity

Issued to:           Hearthstone QHHP  
                          317 Stafford Ave.  
                          Morrisville, VT 05661  
                          (802) 851-4044  
Model:               Green Mountain 60  
Effective Date:     March 16, 2018  
Revised Date\*:     May 4, 2021  
Report #            18-407

*\*See revision schedule on page 2 for full list of revisions.*

Certification tests were performed by Services Polytests, Inc. located at: 695-B Gaudette- St-jean-sur-Richelieu, QC, J3B 7S7 CANADA.

PFS TECO certifies conformity to the following per 40 CFR Part 60 §60.533 (f) (A):

- The test report is complete and accurate.
- The instrumentation used for the test was properly calibrated.
- The representative model tested meets the applicable emission limits.
- The tests have been conducted per the appropriate guidelines.
- The manufacturer's Quality Control Plan has been reviewed to ensure that all production units are similar in all material respects that would affect emissions to the tested/certified model and that the units in the model line will meet all (other) applicable requirements.

PFS TECO certifies that the emissions levels as measured in the test report are in compliance with the 2020 PM emission limit of  $\leq 2.0$  g/hr using crib wood per EPA Method 28R. Efficiency tested per CSA B415.1-10.

The weighted average emissions for the Green Mountain 60 wood heater is **0.62 g/hr** with a weighted average efficiency of **79.2%**. Average CO emissions are **0.39 g/min.**

Issued by:       PFS TECO  
                      11785 SE Highway 212  
                      Suite 305  
                      Clackamas, OR 97015

John Steinert, Vice President Hearth Products Division



## Revision Summary

Date: March 16, 2018 – Original Issue

Date: May 4, 2021 – The Model Hipster 20 AMB8260 and Shelburne 8372 was added to the CoC and the follow revisions to the test report were reviewed:

Revision 1 (November 25, 2020):

- NCBI Report added Appendix 12: Volume Calculation
- CBI & NCBI Report added Appendix 13: operating instruction
- The section 3.4 p.13 updated for runs Anomalies, Validity and appropriateness detail.
- The section 3.4 p.13 updated to address the negative back filter weight.
- Updated Section 1.4 p.6 conditioning was done at medium hate draw.
- Appendix 9 updated for more detailed fuel load
- NCBI report updated to include Appendix 4 Pre-burn Data

Revision 2 (January 20th 2021):

- appendix 1 molecular weight updated to 29 for all runs
- Updated names on report to match the EPA certificate, WHA and CoC