



TEST REPORT

TEST OF A PELLET STOVE FOR EMISSIONS AND EFFICIENCY

PER: ASTM E2779-10 (section 9.4.1 integrate test run); ASTM E2515-11 as referred into 40 CFR Part 60 Subpart AAA, CSAB415.1-10 (for efficiency only)

Client:

AICO SPA (RAVELLI)

Via Consorzio Agrario, 3/D

Chiari, Italy

Model name:

RV 100 Classic

Attention: Rafael Sanchez

TESTED BY:

Services Polytests inc.

695-B Gaudette

St-jean-sur-Richelieu, QC, J3B 7S7

TEST DATES: May 25<sup>th</sup> 2016

REPORT DATE: June 1<sup>ST</sup> 2016

Revision 1: February 16<sup>th</sup> 2022

Revision 2: July 7<sup>th</sup> 2022

Revision 3: August 9<sup>th</sup> 2022

Project number: PI-20129

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## Revision List

### Revision 1 February 16<sup>th</sup> 2022

- Moisture in the tunnel assume change section 3.6
- Table 2.6 updated with deviation in g/Kg
- Appendix 1 molecular weight updated to 29 for all runs
- Appendix 1 updated with data and preburn data
- The section 3.4 p.11 updated for runs Anomalies, Validity and appropriateness detail.
- Updated Section 1.4 p.6 conditioning was done week of May 17<sup>th</sup> 2016.
- Additional letter for TYPOs about mixing baffle in the original report, appendix 8 updated.
- Table 2.1 additional emission number in gr/Mj
- Section 3.4 update : Pellet on ENplus program

### Revision 2: July 7<sup>th</sup> 2022

- Section 3.4 update : Pellet on ENplus program
- The section 3.4 p.11 updated for back filter negative weight addressed.
- Appendix 7 manual updated to meet requirement

### Revision 3: August 9<sup>th</sup> 2022

- include negative filter weights with calculations both corrected to zero and uncorrected in appendix 1.

## 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 (NA pellet stove)
- APPENDIX 13: Operating instruction
- APPENDIX 14: Drawing Air flow pattern
- APPENDIX 15: WHA/ CoC/ 30 day notice/ others

## 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 date: May 26<sup>th</sup> 2016
- Test methods used:
  - Particulate emissions: ASTM E2779-10 ; 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: Ravelli
- Product type: Pellet stove
- Combustion system: blower
- Unit tested: RV100 Classic

#### Particularities

- None

### 1.3 RESULTS

#### Emission results obtained

- Weighted average emission rate: 0.7grams/hour
- Efficiency 80.2%

Conformity: NSPS Phase 2020

### 1.4 PRETEST INFORMATION

Unit condition: The unit was received by carrier on May 2<sup>nd</sup> 2016. The 50hrs of aging is made in week of May 17<sup>th</sup> 2016.

- Venting system type: pellet venting conduit 3inch. diameter
- System height from floor: 15 feet
- Particularities: none

Break in period

- Duration: the unit was received from the manufacturer and ran for at least 50 hours at 50% of the maximum burn rate with adequate documentation of fuel additions and flue and unit temperatures during the week of May 17<sup>th</sup> 2016.
- Fuel: wood pellet model: Hotzpellets), ENplus program listed manufacturer

## 2 SUMMARY OF TEST RESULTS

### 2.1 EMISSIONS

Run Number	Date	Setting	Burn Rate	Run Time (Min.)	Heat Output (Btu/hr)	1st Hour Emissions (g/hr)	Integrated Total (g/hr)	CO Emissions (g/hr)	Heating Efficiency (% HHV)
1	May 26 <sup>th</sup> 2016	H	2.31	60	34 500	0.67	0.7	3.55	77.97
		M	1.12	120	17 400			3.76	80.8
		L	0.68	180	10 750			2.92	82.1
		Overall	1.1	360	16 900			2.72	80.2

- 0.045 gr/min overall Co emission rate
- 0.040 g/Mj emission / output

### 2.2 AVERAGE CALCULATION

NA : Pellet Stove tested as ASTM E2779 section 9.4.1 integrate test run

### 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	72	80	30,091	30,062	42,7	22,3	18	21

### 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 (%)
1	5,00	5,90	NA	15,36	NA	5,90

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

Average dilution tunnel measurements				Sample Data			
Run Number	Burn Rate (Min)	Volumetric Flow Rate (dscf/min)	Total Temperatures (°R)	Volume sampled (DSCF)		Particulate catch (mg)	
				1	2	1	2
1	360	168,46	553,23	63,738	61,959	4,60	4,50

### 2.6 DILUTION TUNNEL DUAL TRAIN PRECISION

Run Number	Sample Ratio		Total Emission (g)			
	Train 1	Train 2	Train 1	Train 2	% Deviation	Deviation g/Kg
1	951,47	978,79	4,22	4,25	0,39%	0,005

### 3 PROCESS DESCRIPTION

#### 3.1 DISCUSSION

The unit was received by carrier on May 2<sup>nd</sup> 2016. The 50hrs of aging is made in week of May 17<sup>th</sup> 2016.

#### 3.2 UNIT DIMENSIONS

##### Baffle

- Location: top of the combustion chamber
- Restriction: 7/8 X 11
- Dimensions: 4 1/8 X 10 7/8
- Material: Steel

##### Bricks

- Location: back and side of the combustion chamber
- Dimensions: 6 ¼ wide X 15 ½ height; Sides: 3 wide X 15 ½ height
- Material: Vermiculite

##### Flue gas exhaust

- Location: back of the unit at 9 ½ from the bottom
- Dimensions: 3 inches (inside diameter)
- Material: Steel

##### Overall unit dimension

- Overall dimension: 21 ½ depth X 21 ¾ wide X 44 height
- Firebox dimensions: 6 ½ depth X 11 wide X 13 ½ Height
- Burner dimension: 2 ¾ depth X 3 5/8 wide X 2 7/16 height

##### Convection fan

- Manufacturer: EBM-PAPST
- Model M2E 068-BF
- Spec.: certification file : E76226

##### Gasket

- Refer to appendix 6 for all details

##### Glass

- in the door: 11 7/8 wide X 18 1/8 Height
- material: Robax
- Thickness: 4mm



### 3.3 AIR SUPPLY SYSTEM

Description

Model RV 100 Classic		
power	rpm blower	Auger motor (2 rpm)
1	750	1.9 sec. ON / 5.2 sec. OFF
2	950	2.8 sec. ON / 4.3 sec. OFF
3	1250	3.5 sec. ON / 3.6 sec. OFF
4	1550	4.2 sec. ON / 2.9 sec. OFF
5	1900	5.8 sec. ON / 1.3 sec. OFF

### 3.4 OPERATION DURING TEST

Run #1

This run was performed May 25<sup>th</sup> 2016. It lasted 360 minutes and as ASTM E 2779 section 9.4.1 integrate test run obtained at 1.1kg/hr & emission at 0.7gr/hr. The pellet stove is preheated for 110 min. before the beginning of the test. For the first hour of the test the unit was set at power 5, then for the next 2 hours we set at power 2 to burn less than 50% of the maximum, and for the last portion of the test the pellet stove is set at power 1 for 3hours of minimum burn rate. Run have been found appropriate, no anomalies happened and have been validate and found compliant. Negative weight has been found on back filter du to sticking on gasket, these have been handled properly.

- 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

- Test fuel: wood pellet (model: Hotzpellets), ENplus program listed manufacturer
- Description: The pellet for each test and pre-burn period was sent to Twin ports testing inc for test fuel calorific analysis. This laboratory is ISO/IEC 17025 recognize. For the test fuel property refer to test fuel analysis in the appendix D Calibration data.
- Handling and storage: keep all bags in the same room (at 20C ambient and 50% humidity) all wrap together to ensure the stability of the moisture.

### 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 in the system ahead of the sampling section. The sampling section is a continuous section of 6-inch diameter pipe straight over its entire length. Tunnel velocity pressure is determined by a standard pitot tube located upstream from the beginning of the sampling section. Thermocouple is installed on the pitot tube to measure the dry bulb temperature. 2% MC is assumed, as allowed, to be 4%. Tunnel samplers are located downstream of the pitot tube and upstream from the end of this section. All detail of dilution tunnel setup can be found in appendix 8

### 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	26-05-2016
Technicien	M.M
Project #	PI-20129

### Description de l'unité

Manufacturier	RAVELLI	
Modèle	RV 100 CLASSIC	
Combustion system	Pellet	
Appliance type	pellet stove	
Firebox volume	na	cu ft.
Appliance weight empty	na	lbs
Appliance weight full	na	lbs

### Paramètres du test

Logging time	1	min
Manufacturer's rated heat output	na	BTU/h Donnée fournie par le manufacturier
Targeted category	1	
Targeted output	à définir	BTU/h
Cp steel	0,1	BTU/lb-°F

### Échantillonnage

Blank sampling rate	0,20	cuft/min
Internal probe diameter	0,18	in.
Calibration Factor (DGM #1):	0,996	Dimensionless
Equipment number (DGM #1):	EM-178	
Calibration Factor (DGM #2):	0,990	Dimensionless
Equipment number (DGM #2):	EM-179	
Calibration Factor (DGM #3):	1,000	Dimensionless
Equipment number (DGM #3):	EM-070	Dimensionless

### Tunnel

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

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### Fuel data

Fuel type	Dimension	
Fuel specie	Other	
HHV		20214,0 kJ/kg
%C		50,4
%H		6,1
%O		42,9
%Ash		0,4
HHV		8691,0 Btu/lb
LHV		8178,0 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

	Start	End
Barometer (kPa):	101,9	101,8
Barometer (in.Hg):	30,091059	30,061529
Dry Bulb (F):	70,7	80,24
Humidity (%):	42,7	22,3
Air velocity (ft/min)	18	21

DGM #1	Final: ##### cuft
	Initial: ##### cuft
DGM #2	Final: ##### cuft
	Initial: ##### cuft
DGM room	

	Final: 394948,260	Liter
	Initial: 393039,560	Liter
	Final: 345121,660	Liter
	Initial: 343272,350	Liter
	Final: 853,630	cuft
	Initial: 818,370	cuft

Numéro de la ligne dans "Raw data" à partir duquel les données du VRAI test commencent

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Autres données à rentrer: dans preload data, load data, traverse et filter set weight

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<b>Date</b>	26-05-2016
<b>Technicien</b>	M.M

## Preload data sheet

Test Load Weight:

Lower    Ideal    Upper

#####    #####    #VALEUR!

Load Volume: ##### cu. ft

Loading Density: #VALEUR! lbs./ft3

Number of Spaces: na

Load Density (wet): #VALEUR! lbs./ft3

Spacer weight (lbs): na

Dry Wood Density: #VALEUR!

Piece Size (in):			Weight lbs	Meter Moisture Content				Ave. MC x	Volume
Thick	Wide	x Length		Dry Uncorrected %				Weight	Cubic Inches
			5	5,9				29,5	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 MC								29,5	0,00

PreTest Load Weight: ##### lbs.

Dry Weight: #VALEUR! kg.

Dry: #####

Average Moisture Content: %

#####

Must be 18-28

Wet: #VALEUR!

must be 15,2-22

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## Tunnel Traverse Worksheet (for velocity calculations)

Static Pressure: 0,24 in. H2O  
 Barometer: 29,900 in. Hg

**Pour un tunnel de 12" et plus, prendre 6 lectures**

	TUNNEL VELOCITY	TUNNEL TEMP	SQUARE ROOT
	In. wc	°F	
A center			0,0000
B center			0,0000
A1			0,0000
A2			0,0000
A3			0,0000
A4			0,0000
A5			0,0000
A6			0,0000
B1			0,0000
B2			0,0000
B3			0,0000
B4			0,0000
B5			0,0000
B6			0,0000
AVERAGE	#DIV/0!	#DIV/0!	0,0000

PITOT CONSTANT=  
0,919

**Pour un tunnel moins de 12", prendre 4 lectures**

	TUNNEL VELOCITY	TUNNEL TEMP	SQUARE ROOT
	In. wc	°F	
A center	0,060	74,04	0,2449
B center	0,059	73,91	0,2429
A1	0,051	74,18	0,2258
A2	0,055	74,21	0,2345
A3	0,058	73,03	0,2408
A4	0,050	73	0,2236
B1	0,052	72,890	0,2280
B2	0,051	73,510	0,2258
B3	0,058	72,910	0,2408
B4	0,053	72,880	0,2302
AVERAGE	0,0547	73,4560	0,2338

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**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															
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	108,7444	0,1259	0,1280	11,1001	110,4323	0,1270	0,1260	10,1352	107,6440	0,1285	0,1281	10,4135	0,1258	2016-05-25	17:00
Before (6)	108,7445	0,1258	0,1279	11,1002	110,4324	0,1269	0,1259	10,1351	107,6441	0,1285	0,1280	10,4134	0,1257	2016-05-26	07:15
After (1)	108,7446	0,1260	0,1273	11,1038	110,4325	0,1302	0,1256	10,1377	107,6442	0,1323	0,1278	10,4160	0,1259	2016-05-26	16:30
After (2)	108,7446	0,1260	0,1273	11,1033	110,4325	0,1302	0,1256	10,1372	107,6442	0,1323	0,1278	10,4156	0,1259	2016-05-31	07:00
After (3)	108,7446	0,1260	0,1273	11,1013	110,4325	0,1302	0,1256	10,1362	107,6442	0,1323	0,1278	10,4144	0,1259	2016-06-01	08:00
After (4)	108,7446	0,1260	0,1273	11,1012	110,4325	0,1302	0,1256	10,1361	107,6442	0,1323	0,1278	10,4144	0,1259	2016-06-02	08:00
After (5)															
After (6)	108,7446	0,1260	0,1273	11,1012	110,4325	0,1302	0,1256	10,1361	107,6442	0,1323	0,1278	10,4144	0,1259	2016-06-02	08:00

Difference	0,0001	0,0002	-0,0006	0,0010	0,0001	0,0033	-0,0003	0,0010	0,0001	0,0038	-0,0002	0,0010	0,0002		
Total (mg)		0,7				4,8				4,7			0,2		
Total ajusté (mg)		<b>0,50</b>				<b>4,60</b>				<b>4,50</b>					

**Project nu.** PI-20129  
**Date** 26-05-2016  
**Technicien** M.M

# Demonstration Purpose Only

## Not the real Numbers

### negative mass adjusted to

# Zero

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															
Before (1)															
Before (2)															
Before (3)															
Before (4)															
Before (5)	108,7444	0,1259	0,1280	11,1001	110,4323	0,1270	0,1260	10,1352	107,6440	0,1285	0,1281	10,4135	0,1258	2016-05-25	17:00
Before (6)	108,7445	0,1258	0,1279	11,1002	110,4324	0,1269	0,1259	10,1351	107,6441	0,1285	0,1280	10,4134	0,1257	2016-05-26	07:15
After (1)	108,7446	0,1260	0,1273	11,1038	110,4325	0,1302	0,1256	10,1377	107,6442	0,1323	0,1278	10,4160	0,1259	2016-05-26	16:30
After (2)	108,7446	0,1260	0,1273	11,1033	110,4325	0,1302	0,1256	10,1372	107,6442	0,1323	0,1278	10,4156	0,1259	2016-05-31	07:00
After (3)	108,7446	0,1260	0,1273	11,1013	110,4325	0,1302	0,1256	10,1362	107,6442	0,1323	0,1278	10,4144	0,1259	2016-06-01	08:00
After (4)	108,7446	0,1260	0,1273	11,1012	110,4325	0,1302	0,1256	10,1361	107,6442	0,1323	0,1278	10,4144	0,1259	2016-06-02	08:00
After (5)															
After (6)	108,7446	0,1260	0,1279	11,1012	110,4325	0,1302	0,1259	10,1361	107,6442	0,1323	0,1280	10,4144	0,1259	2016-06-02	08:00

Difference	0,0001	0,0002	0,0000	0,0010	0,0001	0,0033	0,0000	0,0010	0,0001	0,0038	0,0000	0,0010	0,0002		
Total (mg)		1,3				5,7				4,9			0,2		
Total ajusté (mg)		<b>1,10</b>				<b>5,50</b>				<b>4,70</b>					

Project nu. PI-20129  
 Date 26-05-2016  
 Technicien M.M

SFBA EPA EMISSION RESULTS

RESULTS

**Average emission rate:** 0,7 g/hr  
 Burn Rate : 1,097 Dry kg/hr

**Test Duration:** 360 min

PRESSURE FACTOR: DGM 1 0,96659  
 DGM 2 0,97649  
 DGM 3 1,00522

BAROMETRIC PRESSURE  
 Average: 30,076294 in Hg  
 Start: 30,091059 in Hg  
 End: 30,061529 in Hg

TEMPERATURE FACTORS DGM 1 0,98207  
 DGM 2 0,98133  
 DGM 3 0,98519

DGM CONTROLLER VALUES

DGM 1 Final: 13947,466 Cuft  
 Initial: 13880,061 Cuft

VOLUMES SAMPLED DGM 1 63,738 SCft  
 DGM 2 61,959 SCft  
 DGM 3 34,919 SCft

DGM 2 Final: 12187,857 Cuft  
 Initial: 12122,549 Cuft

DGM #3 Final: 853,630 Cuft  
 Initial: 818,370 Cuft

TOTAL TUNNEL VOLUME : 60645

TEMPERATURES

DGM 1 537,638 °R  
 DGM 2 538,043 °R

SAMPLE RATIOS  
 Sample Train 1: 951,473  
 Sample Train 2: 978,791

CALIBRATION FACTORS

DGM 1 0,9961  
 DGM 2 0,9901  
 DGM #3 1,0000

Paticulate concentration  
 Sample Train 1 **0,000075** g/dscf  
 Sample Train 2 **0,000076** g/dscf  
 Room **0,000006** g/dscf

TUNNEL FLOW RATE: 168,459 Dscfm

TOTAL EMISSIONS  
 Sample Train 1 **4,22** g  
 Sample Train 2 **4,25** g

PARTICULATE CATCH  
 Total Sample Train 1: 4,80 mg  
 Total Sample Train 2: 4,70 mg  
 Total Sample Train 1 1st hour: 0,70 mg

EMISSION RATES  
 Sample Train 1 **0,70** g/hr  
 Sample Train 2 **0,71** g/hr

1st hour emission rate **0,67** g/hr

DEVIATION: 0,39%

Cs Train 1 Train 2  
 7,531E-05 7,58563E-05

DATA 2016-05-26 EPA PI 20129 RUN 1  
preburn

Temps  
acquisition  
minutes

Flue	Room	Tunnel	scale	Tunnel Velocity	
temp	temp	dry bulb		Pressure	
°F	°F	°F	lbs	in. Wc	
1	74,77	70,03	73,45	38,79	0,0614
2	89,29	69,94	74,49	38,69	0,0595
3	117,15	69,80	75,93	38,70	0,0592
4	141,21	69,79	77,44	38,59	0,0597
5	163,56	69,76	78,97	38,51	0,0595
6	181,72	69,77	80,00	38,40	0,0583
7	198,53	70,08	80,71	38,31	0,0588
8	210,44	70,15	81,06	38,22	0,0590
9	213,24	70,10	81,36	38,20	0,0597
10	202,83	69,79	80,45	38,20	0,0604
11	210,73	69,98	82,36	38,12	0,0585
12	234,95	70,00	86,13	38,11	0,0590
13	255,02	69,94	88,49	37,99	0,0583
14	272,58	69,98	90,62	37,90	0,0580
15	285,90	70,09	92,05	37,79	0,0590
16	295,20	69,86	93,21	37,71	0,0590
17	304,44	69,84	94,58	37,61	0,0568
18	312,49	70,01	95,23	37,51	0,0585
19	319,59	69,91	96,20	37,42	0,0590
20	371,67	70,15	102,23	15,66	0,0580
21	372,79	69,88	102,16	15,59	0,0568
22	375,02	70,32	102,31	15,56	0,0571
23	377,87	70,44	102,51	15,47	0,0573
24	378,65	70,07	102,85	15,38	0,0576
25	379,71	70,42	103,29	15,27	0,0576
26	382,70	70,35	103,04	15,17	0,0566
27	385,43	70,34	103,39	15,17	0,0576
28	385,00	70,62	103,33	15,08	0,0590
29	386,63	70,58	103,74	14,96	0,0576
30	388,48	70,38	103,79	14,86	0,0583
31	389,82	70,39	103,55	14,76	0,0576
32	390,65	70,27	103,76	14,67	0,0590
33	391,33	70,05	103,96	14,58	0,0583
34	392,81	70,26	104,26	14,47	0,0590
35	394,32	70,59	104,10	14,37	0,0583
36	395,92	70,58	104,21	14,39	0,0576
37	396,51	70,44	103,84	14,29	0,0565
38	397,54	70,47	104,41	14,16	0,0576
39	397,53	70,67	104,33	13,97	0,0571
40	398,71	70,94	104,46	13,98	0,0585
41	399,35	71,02	104,55	13,87	0,0573
42	399,64	71,13	104,69	13,77	0,0580
43	399,83	71,06	104,75	13,78	0,0558
44	401,00	70,97	105,55	13,68	0,0576
45	400,82	70,98	105,00	13,58	0,0573
46	400,23	71,08	105,29	13,48	0,0588
47	401,37	71,13	105,27	13,37	0,0570
48	402,59	71,19	105,32	13,26	0,0583
49	403,26	71,16	105,17	13,18	0,0583

DATA 2016-05-26 EPA PI 20129 RUN 1  
preburn

50	404,17	71,26	104,83	13,07	0,0585
51	404,44	70,94	105,10	13,00	0,0583
52	404,75	70,60	105,25	12,98	0,0576
53	405,87	70,86	105,51	12,88	0,0585
54	405,75	70,88	105,73	12,78	0,0576
55	406,08	70,98	105,40	12,67	0,0590
56	407,33	71,08	105,75	12,61	0,0576
57	407,89	71,39	105,48	12,47	0,0580
58	408,47	71,50	105,92	12,38	0,0583
59	412,15	71,47	107,42	12,38	0,0583
60	407,96	71,43	106,33	12,28	0,0585
61	407,66	71,41	106,28	12,18	0,0595
62	407,13	71,72	106,02	12,09	0,0588
63	408,11	71,75	106,01	11,99	0,0580
64	408,04	71,58	106,20	11,98	0,0584
65	407,68	71,65	105,93	11,87	0,0583
66	409,41	71,64	106,36	11,68	0,0583
67	410,21	71,55	106,15	11,67	0,0592
68	409,03	71,76	106,48	11,58	0,0573
69	408,85	71,93	106,44	11,48	0,0580
70	409,08	71,83	106,56	11,38	0,0592
71	408,97	71,71	106,38	11,29	0,0588
72	409,85	71,39	105,87	11,18	0,0573
73	410,50	71,54	106,20	11,19	0,0588
74	410,67	71,42	106,04	11,07	0,0573
75	410,41	71,65	106,28	10,97	0,0585
76	410,82	71,61	106,57	10,88	0,0592
77	410,04	71,62	106,52	10,78	0,0583
78	410,73	71,79	106,61	10,68	0,0580
79	410,56	71,85	106,75	10,58	0,0576
80	411,19	71,78	106,62	10,48	0,0576
81	410,38	71,75	106,55	10,39	0,0590
82	411,43	72,05	106,56	10,28	0,0568
83	411,84	71,86	106,62	10,18	0,0580
84	412,01	71,82	106,57	10,07	0,0583
85	413,22	71,75	106,97	10,00	0,0588
86	412,71	71,82	106,74	9,98	0,0585
87	413,59	71,93	106,97	9,88	0,0576
88	414,70	71,98	106,89	9,79	0,0573
89	415,15	72,16	107,20	9,68	0,0566
90	414,02	71,96	106,85	9,60	0,0576
91	414,16	71,87	106,58	9,47	0,0576
92	413,67	72,09	106,55	9,47	0,0576
93	413,46	72,14	106,66	9,28	0,0573
94	413,53	72,05	106,11	9,18	0,0568
95	413,64	71,51	105,90	9,27	0,0571
96	412,62	72,09	105,59	9,19	0,0576
97	413,01	72,06	105,12	8,99	0,0585
98	415,17	71,89	105,33	8,96	0,0585
99	414,72	71,88	105,05	8,89	0,0568
100	414,40	72,05	104,99	8,78	0,0585
101	414,22	72,14	105,53	8,68	0,0581

DATA 2016-05-26 EPA PI 20129 RUN 1  
preburn

102	413,50	72,13	105,50	8,58	0,0590
103	414,61	71,95	105,80	8,48	0,0570
104	415,17	72,24	106,39	8,39	0,0588
105	414,60	72,28	105,98	8,29	0,0580

*		*	*	*	*	*1	*2	*3	Mass flow 1	DGM 1	DGM 1	Filter 1	Mass flow 2	DGM 2	DGM 2	Filter 2	Tunnel Velo
Elapsed	Raw data row	Weight	CO	CO <sub>2</sub>	O <sub>2</sub>	Flue	Room	Tunnel	Reading	Inlet T	Outlet T	Temp	Reading	Inlet T	Outlet T	Temp	Pressure
Time		Remaining	CO	CO <sub>2</sub>	O <sub>2</sub>	Gas	Temp	Dry Bulb									in wc
min		lbs	%	%	%	°F	°F	°F	cuft/min	oF	oF	oF	cuft/min	oF	oF	oF	in wc
0,00	141,00	15,4	0,0	9,2	0,0	413,0	72,3	106,3	0,18	74,20	74,24	73,04	0,17	74,43	74,27	72,38	0,06
1,0	142,0	15,3	0,0	9,9	0,0	412,9	72,7	106,3	0,18	74,28	74,29	73,10	0,17	74,49	74,37	72,43	0,06
2,0	143,0	15,2	0,0	9,4	0,0	413,1	72,8	106,2	0,18	74,35	74,34	73,16	0,17	74,50	74,45	72,40	0,06
3,0	144,0	15,1	0,0	9,5	0,0	413,2	72,6	106,0	0,18	74,35	74,36	73,24	0,17	74,55	74,50	72,47	0,06
4,0	145,0	15,0	0,0	9,6	0,0	413,2	72,6	105,9	0,18	74,34	74,41	73,28	0,17	74,55	74,57	72,44	0,06
5,0	146,0	14,9	0,0	9,6	0,0	413,8	72,3	105,8	0,18	74,30	74,41	73,35	0,17	74,49	74,59	72,31	0,06
6,0	147,0	14,8	0,0	8,4	0,0	412,0	72,6	106,1	0,18	74,29	74,45	73,44	0,17	74,47	74,63	72,29	0,06
7,0	148,0	14,8	0,0	9,8	0,0	412,7	72,6	105,9	0,18	74,29	74,43	73,53	0,17	74,47	74,67	72,33	0,06
8,0	149,0	14,7	0,0	10,7	0,0	413,7	72,4	105,5	0,18	74,35	74,45	73,65	0,17	74,45	74,68	72,32	0,06
9,0	150,0	14,6	0,0	9,1	0,0	413,2	72,3	105,4	0,18	74,37	74,48	73,76	0,17	74,51	74,70	72,44	0,06
10,0	151,0	14,5	0,0	10,7	0,0	414,1	72,2	105,6	0,18	74,33	74,48	73,85	0,17	74,50	74,72	72,31	0,06
11,0	152,0	14,4	0,0	9,3	0,0	414,2	72,4	105,6	0,18	74,32	74,49	73,96	0,17	74,47	74,74	72,36	0,06
12,0	153,0	14,3	0,0	9,5	0,0	415,8	72,2	106,4	0,18	74,35	74,50	74,09	0,17	74,48	74,78	72,38	0,06
13,0	154,0	14,2	0,0	5,7	0,0	415,9	72,3	106,3	0,18	74,34	74,47	74,26	0,17	74,46	74,76	72,48	0,06
14,0	155,0	14,1	0,0	8,2	0,0	414,4	72,6	106,0	0,18	74,41	74,48	74,34	0,17	74,49	74,77	72,45	0,06
15,0	156,0	14,1	0,0	9,1	0,0	413,5	72,4	105,8	0,18	74,46	74,50	74,49	0,17	74,48	74,80	72,58	0,06
16,0	157,0	13,9	0,0	9,0	0,0	413,4	72,5	105,7	0,18	74,47	74,53	74,60	0,17	74,53	74,82	72,57	0,06
17,0	158,0	13,9	0,0	10,6	0,0	413,5	72,3	105,6	0,18	74,42	74,54	74,74	0,17	74,54	74,85	72,60	0,06
18,0	159,0	13,8	0,0	10,0	0,0	413,7	72,6	105,6	0,18	74,39	74,57	74,84	0,17	74,48	74,88	72,55	0,06
19,0	160,0	13,7	0,0	12,1	0,0	414,8	72,7	105,6	0,18	74,43	74,58	74,98	0,17	74,52	74,88	72,62	0,06
20,0	161,0	13,6	0,0	9,2	0,0	415,7	72,5	106,2	0,18	74,54	74,59	75,09	0,17	74,57	74,89	72,68	0,06
21,0	162,0	13,5	0,0	10,4	0,0	416,7	72,7	105,8	0,18	74,55	74,60	75,22	0,17	74,60	74,91	72,75	0,06
22,0	163,0	13,4	0,0	8,8	0,0	415,9	72,9	106,5	0,18	74,61	74,63	75,34	0,17	74,63	74,93	72,72	0,06
23,0	164,0	13,3	0,0	8,2	0,0	415,5	73,0	106,0	0,18	74,59	74,65	75,46	0,17	74,63	74,95	72,86	0,06
24,0	165,0	13,2	0,0	10,1	0,0	416,1	72,8	106,5	0,18	74,65	74,66	75,57	0,17	74,66	74,98	72,84	0,06
25,0	166,0	13,1	0,0	9,8	0,0	416,2	72,8	106,7	0,18	74,69	74,67	75,71	0,18	74,68	74,99	72,86	0,06
26,0	167,0	13,0	0,0	9,2	0,0	416,3	72,6	106,4	0,18	74,68	74,70	75,83	0,18	74,70	75,02	72,88	0,06
27,0	168,0	12,9	0,0	10,5	0,0	416,5	72,9	106,5	0,18	74,67	74,70	75,94	0,17	74,72	75,07	73,00	0,06
28,0	169,0	12,9	0,0	8,9	0,0	416,3	72,9	106,3	0,18	74,67	74,71	76,07	0,17	74,73	75,08	73,04	0,06
29,0	170,0	12,8	0,0	9,1	0,0	416,9	72,8	106,7	0,18	74,70	74,72	76,15	0,17	74,71	75,10	73,04	0,06
30,0	171,0	12,7	0,0	9,5	0,0	416,9	73,0	106,2	0,18	74,72	74,75	76,27	0,17	74,75	75,10	73,11	0,06
31,0	172,0	12,6	0,0	8,5	0,0	416,6	72,9	106,3	0,18	74,70	74,75	76,35	0,17	74,73	75,13	73,13	0,06
32,0	173,0	12,5	0,0	9,2	0,0	416,3	72,8	106,5	0,18	74,80	74,78	76,45	0,17	74,80	75,12	73,19	0,06
33,0	174,0	12,4	0,0	10,2	0,0	416,3	73,0	106,8	0,18	74,85	74,81	76,50	0,17	74,87	75,16	73,20	0,06
34,0	175,0	12,3	0,0	9,7	0,0	416,9	73,1	106,5	0,18	74,79	74,81	76,60	0,17	74,85	75,17	73,20	0,06
35,0	176,0	12,2	0,0	8,8	0,0	415,9	72,9	106,5	0,18	74,79	74,83	76,71	0,17	74,87	75,21	73,32	0,06
36,0	177,0	12,1	0,0	9,6	0,0	415,0	73,2	106,7	0,18	74,83	74,84	76,78	0,17	74,90	75,23	73,25	0,06
37,0	178,0	12,0	0,0	10,1	0,0	415,2	73,2	106,5	0,18	74,86	74,85	76,89	0,17	74,90	75,24	73,33	0,06
38,0	179,0	12,0	0,0	8,7	0,0	414,3	73,1	106,7	0,18	74,86	74,85	76,97	0,17	74,91	75,26	73,42	0,06
39,0	180,0	11,9	0,0	8,6	0,0	414,3	72,9	106,4	0,18	74,86	74,88	77,05	0,17	74,96	75,26	73,43	0,06
40,0	181,0	11,8	0,0	9,1	0,0	414,3	73,0	106,7	0,18	74,86	74,89	77,14	0,17	74,92	75,26	73,53	0,06
41,0	182,0	11,7	0,0	9,8	0,0	414,0	73,2	106,5	0,18	74,96	74,91	77,18	0,17	74,96	75,28	73,46	0,06
42,0	183,0	11,6	0,0	8,1	0,0	413,4	73,1	106,1	0,18	74,96	74,94	77,24	0,17	74,99	75,31	73,35	0,06
43,0	184,0	11,5	0,0	9,0	0,0	413,5	72,4	106,5	0,18	74,91	74,95	77,32	0,17	74,99	75,27	73,46	0,06
44,0	185,0	11,4	0,0	8,6	0,0	413,7	72,7	106,5	0,18	74,87	74,96	77,38	0,17	74,99	75,32	73,42	0,06
45,0	186,0	11,3	0,0	8,5	0,0	413,3	72,4	106,5	0,18	74,80	74,95	77,44	0,17	74,93	75,31	73,43	0,06
46,0	187,0	11,3	0,0	8,6	0,0	413,4	72,9	106,4	0,18	74,81	74,96	77,51	0,17	74,95	75,35	73,49	0,06
47,0	188,0	11,2	0,0	9,0	0,0	413,5	72,7	106,0	0,18	74,84	74,96	77,54	0,17	74,98	75,35	73,37	0,06
48,0	189,0	11,1	0,0	8,7	0,0	412,9	72,7	106,1	0,18	74,81	74,98	77,58	0,17	74,98	75,38	73,46	0,06
49,0	190,0	11,0	0,0	7,9	0,0	411,9	72,7	106,3	0,18	74,85	74,99	77,64	0,17	74,99	75,41	73,48	0,06
50,0	191,0	11,0	0,0	9,2	0,0	412,0	72,9	106,5	0,18	74,90	74,97	77,64	0,17	74,99	75,43	73,43	0,06
51,0	192,0	10,9	0,0	9,7	0,0	411,5	72,8	106,6	0,18	74,95	74,99	77,69	0,17	75,04	75,44	73,45	0,06
52,0	193,0	10,8	0,0	9,8	0,0	411,9	72,7	106,8	0,18	75,04	74,99	77,71	0,18	75,13	75,47	73,56	0,06
53,0	194,0	10,7	0,0	9,4	0,0	412,6	73,0	106,8	0,18	75,17	75,06	77,75	0,17	75,21	75,51	73,54	0,06
54,0	195,0	10,6	0,0	10,0	0,0	411,9	72,8	106,8	0,18	75,24	75,08	77,82	0,17	75,29	75,54	73,74	0,06
55,0	196,0	10,5	0,0	11,1	0,0	413,0	73,0	106,9	0,18	75,26	75,11	77,88	0,17	75,34	75,57	73,89	0,06
56,0	197,0	10,4	0,0	8,5	0,0	413,0	72,5	107,1	0,18	75,31	75,14	77,91	0,17	75,40	75,61	74,02	0,06
57,0	198,0	10,3	0,0	8,7	0,0	412,7	72,7	106,5	0,18	75,47	75,17	77,94	0,17	75,51	75,62	73,93	0,06
58,0	199,0	10,2	0,0	10,4	0,0	413,5	73,2	106,8	0,18	75,63	75,20	77,98	0,17	75,59	75,63	73,87	0,06
59,0	200,0	10,1	0,0	8,6	0,0	413,8	73,0	107,0	0,18	75,73	75,23	78,00	0,17	75,70	75,65	73,97	0,06
60,0	201,0	10,0	0,0	8,9	0,0	413,4	73,2	107,3	0,18	75,82	75,27	78,00	0,17	75,80	75,69	74,11	0,06
61,0	202,0	10,0	0,0	9,4	0,0	413,9	73,4	107,3	0,18	75,94	75,33	78,08	0,17	75,86	75,71	72,79	0,06
62,0	203,0	9,9	0,0	8,6	0,0	401,2	73,2	103,3	0,18	76,04	75,39	78,09	0,17	75,98	75,79	72,90	0,06
63,0	204,0	9,8	0,0	9,3	0,0	383,7	72,9	98,9	0,18	76,12	75,44	78,12	0,17	76,09	75,80	72,95	0,06
64,0	205,0	9,8	0,1	6,5	0,0	370,7	72,9	97,3	0,18	76,15	75,46	78,16	0,17	76,17	75,86	73,00	0,06
65,0	206,0	9,8	0,0	7,2	0,0	360,5	72,8	96,7	0,18	76,23	75,51	78,19	0,17	76,24	75,89	73,11	0,06
66,0	207,0	9,7	0,0	7,5	0,0	352,3	72,9	95,4	0,18	76,26	75,54	78,19	0,17	76,31	75,92	73,19	0,06
67,0	208,0	9,6	0,0	5,9	0,0	345,2	72,9	94,7	0,18	76,12	75,56	78,20	0,17				



71,0	212,0	9,5	0,0	6,0	0,0	325,2	73,6	92,9	0,18	76,08	75,61	78,19	0,17	76,32	76,03	73,72	0,06
72,0	213,0	9,4	0,0	7,2	0,0	320,5	73,6	92,1	0,18	76,24	75,65	78,21	0,17	76,43	76,10	73,85	0,06
73,0	214,0	9,4	0,0	5,5	0,0	327,4	73,9	95,5	0,18	76,34	75,71	78,23	0,17	76,54	76,16	73,97	0,06
74,0	215,0	9,3	0,0	6,5	0,0	320,7	73,8	92,6	0,18	76,44	75,73	78,24	0,17	76,63	76,23	74,11	0,06
75,0	216,0	9,3	0,0	7,9	0,0	315,6	73,7	92,3	0,18	76,57	75,79	78,23	0,17	76,73	76,30	74,21	0,06
76,0	217,0	9,2	0,0	6,7	0,0	310,1	73,9	91,6	0,18	76,65	75,84	78,24	0,17	76,80	76,35	74,33	0,06
77,0	218,0	9,2	0,0	6,8	0,0	306,4	73,6	91,5	0,18	76,71	75,90	78,25	0,17	76,91	76,43	74,47	0,06
78,0	219,0	9,2	0,0	6,7	0,0	304,5	73,6	90,9	0,18	76,78	75,94	78,20	0,17	76,93	76,49	74,53	0,06
79,0	220,0	9,1	0,0	5,6	0,0	302,5	73,6	90,8	0,18	76,76	75,96	78,16	0,17	76,96	76,55	74,66	0,06
80,0	221,0	9,1	0,0	8,1	0,0	300,1	73,7	90,9	0,18	76,78	76,01	78,14	0,17	77,01	76,60	74,76	0,06
81,0	222,0	9,0	0,0	6,7	0,0	297,4	73,7	91,0	0,18	76,88	76,05	78,10	0,17	77,07	76,66	74,83	0,06
82,0	223,0	9,0	0,0	6,2	0,0	295,8	73,8	91,0	0,18	76,97	76,11	78,10	0,17	77,19	76,71	74,93	0,06
83,0	224,0	8,9	0,0	4,9	0,0	293,7	73,9	90,7	0,18	77,04	76,13	78,05	0,17	77,24	76,73	75,01	0,06
84,0	225,0	8,9	0,0	5,8	0,0	291,1	74,1	90,6	0,18	77,14	76,17	78,04	0,17	77,32	76,76	75,11	0,06
85,0	226,0	8,9	0,0	8,3	0,0	289,6	74,4	90,8	0,18	77,15	76,20	78,03	0,17	77,33	76,82	75,18	0,06
86,0	227,0	8,8	0,0	5,9	0,0	288,6	74,2	90,5	0,18	77,23	76,24	78,02	0,17	77,45	76,89	75,29	0,06
87,0	228,0	8,8	0,0	5,6	0,0	286,5	74,4	90,4	0,18	77,30	76,28	78,00	0,17	77,57	76,95	75,34	0,06
88,0	229,0	8,7	0,0	6,9	0,0	284,2	74,3	90,2	0,18	77,34	76,35	77,99	0,17	77,67	76,98	75,43	0,06
89,0	230,0	8,7	0,0	7,5	0,0	281,8	74,0	90,2	0,18	77,46	76,40	77,98	0,17	77,75	77,03	75,48	0,06
90,0	231,0	8,6	0,0	8,1	0,0	282,1	74,2	90,4	0,18	77,55	76,47	77,95	0,17	77,84	77,10	75,56	0,06
91,0	232,0	8,6	0,0	6,4	0,0	280,9	74,5	90,1	0,18	77,71	76,53	77,94	0,17	77,93	77,11	75,63	0,06
92,0	233,0	8,6	0,0	4,2	0,0	278,6	74,5	90,2	0,18	77,83	76,61	77,89	0,17	78,03	77,16	75,68	0,06
93,0	234,0	8,5	0,0	9,0	0,0	278,6	74,5	90,3	0,18	77,85	76,68	77,90	0,17	78,08	77,23	75,76	0,06
94,0	235,0	8,5	0,0	7,7	0,0	276,8	74,6	89,9	0,18	77,87	76,72	77,85	0,17	78,09	77,27	75,83	0,06
95,0	236,0	8,4	0,0	6,4	0,0	276,5	74,8	90,1	0,18	77,98	76,79	77,85	0,17	78,22	77,33	75,91	0,06
96,0	237,0	8,4	0,0	5,9	0,0	275,0	74,8	90,0	0,18	78,04	76,86	77,83	0,17	78,26	77,42	75,98	0,06
97,0	238,0	8,3	0,0	7,6	0,0	274,1	74,6	90,2	0,18	78,05	76,90	77,85	0,17	78,33	77,47	76,07	0,06
98,0	239,0	8,3	0,0	7,5	0,0	274,4	74,3	90,1	0,18	78,04	76,93	77,85	0,17	78,35	77,52	76,15	0,06
99,0	240,0	8,2	0,0	6,0	0,0	273,8	74,7	90,1	0,18	78,07	77,01	77,83	0,17	78,44	77,61	76,18	0,06
100,0	241,0	8,2	0,0	5,5	0,0	273,5	74,3	89,9	0,18	78,12	77,07	77,84	0,17	78,44	77,64	76,19	0,06
101,0	242,0	8,2	0,0	8,0	0,0	271,8	74,1	90,0	0,18	78,14	77,12	77,78	0,17	78,47	77,65	76,24	0,06
102,0	243,0	8,1	0,0	7,6	0,0	271,3	74,2	90,2	0,18	78,06	77,12	77,75	0,17	78,41	77,67	76,30	0,06
103,0	244,0	8,1	0,1	4,6	0,0	271,7	74,2	90,4	0,18	78,02	77,18	77,72	0,17	78,43	77,70	76,32	0,06
104,0	245,0	8,0	0,0	7,8	0,0	271,2	74,5	90,3	0,18	77,95	77,20	77,67	0,17	78,38	77,74	76,36	0,06
105,0	246,0	8,0	0,0	8,1	0,0	270,4	74,6	90,3	0,18	77,89	77,24	77,65	0,17	78,39	77,75	76,41	0,06
106,0	247,0	7,9	0,0	6,3	0,0	269,1	74,6	90,2	0,18	77,84	77,26	77,69	0,17	78,35	77,81	76,46	0,06
107,0	248,0	7,9	0,0	6,5	0,0	270,3	74,8	90,1	0,18	77,84	77,27	77,69	0,17	78,30	77,84	76,52	0,06
108,0	249,0	7,8	0,0	6,7	0,0	269,6	74,6	90,2	0,18	77,83	77,29	77,68	0,17	78,29	77,86	76,56	0,06
109,0	250,0	7,8	0,0	6,6	0,0	268,8	74,3	90,0	0,18	77,77	77,32	77,69	0,17	78,28	77,90	76,58	0,06
110,0	251,0	7,7	0,0	7,5	0,0	268,5	74,2	89,8	0,18	77,75	77,35	77,66	0,17	78,27	77,93	76,59	0,06
111,0	252,0	7,7	0,0	6,4	0,0	269,3	73,3	89,6	0,18	77,83	77,36	77,63	0,17	78,29	77,93	76,64	0,06
112,0	253,0	7,6	0,0	6,0	0,0	268,8	73,2	89,3	0,18	77,64	77,36	77,64	0,17	78,15	77,94	76,62	0,06
113,0	254,0	7,6	0,0	7,2	0,0	268,9	73,4	89,7	0,18	77,48	77,36	77,60	0,17	78,05	77,93	76,61	0,06
114,0	255,0	7,6	0,0	6,0	0,0	267,6	73,7	89,5	0,18	77,35	77,37	77,60	0,17	77,96	77,96	76,62	0,06
115,0	256,0	7,6	0,0	6,8	0,0	266,7	74,1	89,3	0,18	77,30	77,38	77,59	0,17	77,91	77,98	76,62	0,06
116,0	257,0	7,5	0,0	6,0	0,0	266,4	74,0	89,8	0,18	77,46	77,40	77,58	0,17	78,01	77,98	76,63	0,06
117,0	258,0	7,4	0,0	5,9	0,0	265,6	74,0	89,6	0,18	77,43	77,43	77,56	0,17	77,97	78,00	76,65	0,06
118,0	259,0	7,4	0,0	6,2	0,0	266,1	74,2	89,8	0,18	77,41	77,46	77,56	0,17	77,97	78,03	76,66	0,06
119,0	260,0	7,4	0,0	8,1	0,0	266,0	74,2	89,6	0,18	77,49	77,49	77,52	0,17	78,02	78,07	76,69	0,06
120,0	261,0	7,3	0,0	6,4	0,0	265,1	74,2	89,5	0,18	77,44	77,50	77,53	0,17	77,95	78,08	76,72	0,06
121,0	262,0	7,3	0,0	5,6	0,0	264,5	74,2	89,5	0,18	77,45	77,53	77,53	0,17	77,92	78,10	76,74	0,06
122,0	263,0	7,3	0,0	6,9	0,0	264,6	74,2	89,9	0,18	77,52	77,56	77,52	0,17	77,98	78,16	76,76	0,06
123,0	264,0	7,3	0,0	6,5	0,0	264,4	74,6	89,5	0,18	77,62	77,59	77,52	0,17	78,05	78,20	76,78	0,06
124,0	265,0	7,1	0,0	7,0	0,0	264,9	74,2	89,4	0,18	77,59	77,62	77,53	0,17	78,03	78,20	76,78	0,06
125,0	266,0	7,1	0,0	6,3	0,0	264,4	74,2	89,6	0,18	77,62	77,63	77,49	0,17	78,05	78,20	76,78	0,06
126,0	267,0	7,1	0,0	7,2	0,0	263,7	74,5	89,8	0,18	77,63	77,66	77,48	0,17	78,06	78,23	76,80	0,06
127,0	268,0	7,0	0,0	5,2	0,0	262,9	74,7	90,0	0,18	77,67	77,73	77,50	0,17	78,10	78,29	76,86	0,06
128,0	269,0	7,0	0,0	7,8	0,0	262,9	74,8	89,9	0,18	77,72	77,74	77,50	0,17	78,15	78,32	76,88	0,06
129,0	270,0	6,9	0,0	7,3	0,0	262,6	74,9	89,9	0,18	77,80	77,79	77,54	0,17	78,24	78,35	76,90	0,06
130,0	271,0	6,9	0,0	7,6	0,0	262,6	75,0	89,7	0,18	77,88	77,83	77,53	0,17	78,30	78,38	76,93	0,06
131,0	272,0	6,8	0,0	9,0	0,0	262,5	74,8	89,6	0,18	77,93	77,85	77,53	0,17	78,36	78,44	76,92	0,06
132,0	273,0	6,8	0,0	7,1	0,0	263,3	74,4	89,8	0,18	77,92	77,89	77,54	0,17	78,39	78,47	76,96	0,06
133,0	274,0	6,8	0,0	7,0	0,0	265,6	74,5	90,3	0,18	77,84	77,91	77,56	0,17	78,36	78,47	76,95	0,06
134,0	275,0	6,7	0,1	3,9	0,0	277,1	74,4	90,9	0,18	77,83	77,93	77,56	0,17	78,38	78,48	76,97	0,06
135,0	276,0	6,7	0,0	6,7	0,0	271,7	74,3	90,3	0,18	77,77	77,94	77,55	0,17	78,32	78,50	76,96	0,06
136,0	277,0	6,6	0,0	4,7	0,0	268,1	74,6	90,4	0,18	77,71	77,97	77,56	0,17	78,30	78,53	77,01	0,06
137,0	278,0	6,6	0,0	4,5	0,0	264,8	74,8	90,2	0,18	77,70	77,99	77,61	0,17	78,28	78,55	77,06	0,06
138,0	279,0	6,5	0,0	7,8	0,0	264,7	75,2	90,1	0,18	77,79	78,01	77,61	0,17	78,28	78,56	77,06	0,06
139,0	280,0	6,5	0,0	6,8	0,0	263,3	74,9	90,2	0,18	77,96	78,05	77,61	0,17	78,40	78,58	77,09	0,06
140,0	281,0	6,4	0,0	7,6	0,0	262,8	75,0	90,1	0,18	78,01	78,10	77,63	0,17	78,42	78,63	77,14	0,06
141,0	282,0	6,4	0,0	6,4	0,0	263,3	74,9	89,7	0,18	78,11	78,13	77,63	0,17	78,51	78,65	77,17	0,06
142,0	283,0	6,4	0,0	6,6	0,0	262,5	75,0	89,7	0,18	78,12							

146,0	287,0	6,2	0,0	6,8	0,0	261,5	74,9	89,8	0,18	78,11	78,25	77,69	0,17	78,52	78,71	77,22	0,06
147,0	288,0	6,2	0,0	7,2	0,0	261,3	74,8	89,8	0,18	77,95	78,27	77,72	0,17	78,46	78,76	77,23	0,06
148,0	289,0	6,1	0,0	6,1	0,0	261,2	75,1	90,1	0,18	77,92	78,26	77,72	0,17	78,43	78,73	77,25	0,06
149,0	290,0	6,1	0,0	5,5	0,0	260,9	75,1	90,1	0,18	78,00	78,30	77,69	0,17	78,48	78,78	77,27	0,06
150,0	291,0	6,1	0,0	7,0	0,0	260,8	75,2	89,9	0,18	77,98	78,29	77,74	0,17	78,46	78,81	77,26	0,06
151,0	292,0	6,0	0,0	6,6	0,0	260,9	75,4	90,1	0,18	77,97	78,30	77,76	0,17	78,45	78,82	77,31	0,06
152,0	293,0	5,9	0,0	8,4	0,0	261,1	75,3	89,8	0,18	78,00	78,32	77,76	0,17	78,46	78,85	77,35	0,06
153,0	294,0	5,9	0,0	6,0	0,0	259,7	75,2	89,6	0,18	78,03	78,33	77,79	0,17	78,48	78,89	77,37	0,06
154,0	295,0	5,9	0,0	6,5	0,0	258,9	75,4	89,9	0,18	78,10	78,37	77,80	0,17	78,55	78,91	77,38	0,06
155,0	296,0	5,8	0,0	9,3	0,0	258,9	75,4	89,8	0,18	78,14	78,39	77,81	0,17	78,58	78,95	77,41	0,06
156,0	297,0	5,8	0,0	6,8	0,0	259,3	75,7	89,6	0,18	78,12	78,41	77,82	0,17	78,56	78,95	77,43	0,06
157,0	298,0	5,7	0,0	8,2	0,0	259,8	75,3	89,7	0,18	78,18	78,43	77,80	0,17	78,64	78,99	77,44	0,06
158,0	299,0	5,7	0,0	7,8	0,0	259,9	75,3	89,8	0,18	78,28	78,43	77,85	0,17	78,69	79,01	77,45	0,06
159,0	300,0	5,6	0,0	8,4	0,0	260,5	75,0	89,8	0,18	78,32	78,47	77,85	0,17	78,73	79,03	77,45	0,06
160,0	301,0	5,6	0,0	5,6	0,0	260,1	75,5	89,7	0,18	78,38	78,50	77,85	0,17	78,75	79,03	77,46	0,06
161,0	302,0	5,5	0,0	8,4	0,0	260,2	75,4	89,9	0,18	78,43	78,53	77,86	0,17	78,80	79,04	77,48	0,06
162,0	303,0	5,5	0,0	6,5	0,0	260,0	75,5	89,5	0,18	78,44	78,55	77,88	0,17	78,80	79,05	77,49	0,06
163,0	304,0	5,5	0,0	7,0	0,0	259,9	75,5	89,7	0,18	78,48	78,57	77,90	0,17	78,85	79,07	77,52	0,06
164,0	305,0	5,4	0,0	6,0	0,0	260,2	75,5	89,5	0,18	78,47	78,58	77,93	0,17	78,82	79,09	77,56	0,06
165,0	306,0	5,4	0,0	5,3	0,0	259,1	75,5	89,9	0,18	78,45	78,61	77,93	0,17	78,85	79,09	77,55	0,06
166,0	307,0	5,3	0,0	6,8	0,0	259,3	75,5	89,9	0,18	78,51	78,62	77,96	0,17	78,93	79,13	77,59	0,06
167,0	308,0	5,3	0,0	5,0	0,0	258,4	75,3	89,8	0,18	78,50	78,64	77,94	0,17	78,93	79,13	77,64	0,06
168,0	309,0	5,2	0,0	7,4	0,0	258,1	75,2	89,8	0,18	78,40	78,62	77,97	0,17	78,85	79,16	77,61	0,06
169,0	310,0	5,2	0,0	5,8	0,0	257,9	75,7	89,6	0,18	78,34	78,62	77,96	0,17	78,84	79,17	77,62	0,06
170,0	311,0	5,2	0,0	6,6	0,0	257,9	75,3	89,6	0,18	78,39	78,63	77,98	0,17	78,84	79,17	77,64	0,06
171,0	312,0	5,1	0,0	7,6	0,0	258,5	75,4	89,8	0,18	78,51	78,65	78,02	0,17	78,86	79,19	77,65	0,06
172,0	313,0	5,1	0,0	6,0	0,0	258,8	75,4	89,8	0,18	78,51	78,64	78,02	0,17	78,88	79,18	77,66	0,06
173,0	314,0	5,1	0,0	5,1	0,0	258,2	75,2	89,8	0,18	78,57	78,66	78,04	0,17	78,93	79,16	77,66	0,06
174,0	315,0	5,0	0,0	6,0	0,0	257,8	75,0	89,8	0,18	78,60	78,70	78,05	0,17	78,98	79,18	77,66	0,06
175,0	316,0	5,0	0,0	7,6	0,0	258,5	75,0	89,8	0,18	78,36	78,67	78,07	0,17	78,81	79,18	77,67	0,06
176,0	317,0	4,9	0,0	6,9	0,0	259,3	75,0	89,7	0,18	78,30	78,64	78,05	0,17	78,79	79,17	77,63	0,06
177,0	318,0	4,9	0,0	5,6	0,0	258,1	75,0	89,7	0,18	78,22	78,63	78,06	0,17	78,73	79,17	77,67	0,06
178,0	319,0	4,9	0,0	7,4	0,0	257,4	74,9	89,7	0,18	78,19	78,66	78,06	0,17	78,76	79,20	77,65	0,06
179,0	320,0	4,8	0,0	8,7	0,0	258,5	75,0	89,9	0,18	78,18	78,65	78,08	0,17	78,76	79,20	77,66	0,06
180,0	321,0	4,8	0,0	8,7	0,0	258,3	75,2	90,0	0,18	78,21	78,67	78,09	0,17	78,75	79,23	77,68	0,06
181,0	322,0	4,7	0,0	7,4	0,0	258,2	75,4	89,5	0,18	78,33	78,68	78,09	0,17	78,82	79,25	77,69	0,06
182,0	323,0	4,7	0,0	6,8	0,0	256,1	75,5	89,0	0,18	78,43	78,72	78,11	0,17	78,89	79,29	77,71	0,06
183,0	324,0	4,7	0,0	6,0	0,0	252,8	75,4	88,6	0,18	78,42	78,73	78,10	0,17	78,85	79,30	77,72	0,06
184,0	325,0	4,6	0,0	5,3	0,0	251,1	75,4	88,3	0,18	78,42	78,75	78,15	0,17	78,85	79,32	77,74	0,06
185,0	326,0	4,6	0,0	3,4	0,0	247,9	75,3	88,2	0,18	78,31	78,74	78,14	0,17	78,78	79,32	77,75	0,06
186,0	327,0	4,6	0,0	5,2	0,0	245,4	75,4	88,2	0,18	78,33	78,74	78,13	0,17	78,82	79,33	77,75	0,06
187,0	328,0	4,6	0,0	4,2	0,0	243,5	75,5	88,0	0,18	78,35	78,76	78,13	0,17	78,81	79,35	77,75	0,06
188,0	329,0	4,5	0,0	6,8	0,0	242,5	75,8	88,0	0,18	78,45	78,79	78,14	0,17	78,89	79,38	77,78	0,06
189,0	330,0	4,5	0,0	3,3	0,0	240,3	75,7	88,1	0,18	78,50	78,82	78,15	0,17	78,95	79,41	77,82	0,06
190,0	331,0	4,5	0,0	5,6	0,0	238,8	75,8	87,9	0,18	78,50	78,84	78,16	0,17	78,94	79,43	77,82	0,06
191,0	332,0	4,5	0,0	3,7	0,0	236,3	75,8	87,8	0,18	78,51	78,85	78,16	0,17	78,90	79,43	77,82	0,06
192,0	333,0	4,4	0,0	5,6	0,0	235,2	76,0	87,9	0,18	78,56	78,88	78,18	0,17	78,95	79,46	77,85	0,06
193,0	334,0	4,4	0,0	4,2	0,0	233,3	75,9	87,6	0,18	78,55	78,87	78,20	0,17	78,96	79,46	77,87	0,06
194,0	335,0	4,4	0,0	4,9	0,0	249,1	76,1	91,0	0,18	78,63	78,89	78,21	0,17	79,04	79,49	77,89	0,06
195,0	336,0	4,4	0,0	3,5	0,0	242,7	76,2	88,4	0,18	78,79	78,93	78,18	0,17	79,10	79,51	77,90	0,06
196,0	337,0	4,3	0,0	5,4	0,0	238,2	76,0	88,0	0,18	78,81	78,95	78,18	0,17	79,14	79,53	77,93	0,06
197,0	338,0	4,3	0,0	6,2	0,0	234,3	75,8	87,6	0,18	78,80	78,95	78,20	0,17	79,13	79,53	77,94	0,06
198,0	339,0	4,2	0,0	6,1	0,0	232,6	75,8	87,7	0,18	78,81	78,97	78,23	0,17	79,15	79,55	77,94	0,06
199,0	340,0	4,3	0,0	3,3	0,0	230,4	75,7	87,5	0,18	78,77	78,97	78,23	0,17	79,19	79,59	77,92	0,06
200,0	341,0	4,2	0,0	5,5	0,0	228,7	75,8	87,6	0,18	78,79	78,99	78,25	0,17	79,24	79,61	77,95	0,06
201,0	342,0	4,2	0,0	4,9	0,0	226,7	75,9	87,6	0,18	78,78	78,99	78,23	0,17	79,21	79,63	77,94	0,06
202,0	343,0	4,1	0,0	4,6	0,0	225,3	75,9	87,6	0,18	78,77	79,00	78,25	0,17	79,22	79,66	77,94	0,06
203,0	344,0	4,1	0,0	4,6	0,0	224,3	75,9	87,4	0,18	78,79	79,05	78,26	0,17	79,25	79,69	77,96	0,06
204,0	345,0	4,0	0,0	6,4	0,0	223,5	76,1	87,4	0,18	78,82	79,04	78,27	0,17	79,28	79,71	77,97	0,06
205,0	346,0	4,0	0,0	5,6	0,0	223,4	76,4	87,3	0,18	78,92	79,08	78,29	0,17	79,36	79,72	77,98	0,06
206,0	347,0	4,0	0,0	7,1	0,0	223,5	76,5	87,5	0,18	79,10	79,12	78,28	0,17	79,47	79,74	77,98	0,06
207,0	348,0	4,0	0,1	2,8	0,0	221,4	76,5	87,4	0,18	79,24	79,18	78,31	0,17	79,61	79,79	78,03	0,06
208,0	349,0	3,9	0,0	4,9	0,0	219,9	76,5	87,8	0,18	79,22	79,20	78,32	0,17	79,60	79,81	78,04	0,06
209,0	350,0	3,9	0,0	4,2	0,0	219,0	76,9	87,5	0,18	79,30	79,22	78,35	0,17	79,69	79,87	78,09	0,06
210,0	351,0	3,9	0,0	5,8	0,0	218,4	76,5	87,4	0,18	79,48	79,29	78,36	0,17	79,81	79,90	78,06	0,06
211,0	352,0	3,9	0,0	3,7	0,0	217,8	76,7	87,3	0,18	79,56	79,34	78,39	0,17	79,91	79,93	78,10	0,06
212,0	353,0	3,9	0,0	4,2	0,0	217,7	76,7	87,4	0,18	79,64	79,37	78,40	0,17	80,03	79,95	78,14	0,06
213,0	354,0	3,8	0,0	4,7	0,0	216,2	76,7	87,2	0,18	79,64	79,40	78,40	0,17	80,04	79,99	78,16	0,06
214,0	355,0	3,8	0,0	5,3	0,0	215,9	76,4	87,3	0,18	79,65	79,42	78,42	0,17	80,04	80,01	78,17	0,06
215,0	356,0	3,7	0,0	5,8	0,0	215,0	76,5	87,0	0,18	79,60	79,44	78,44	0,17	80,04	80,01	78,19	0,06
216,0	357,0	3,7	0,0	4,0	0,0	214,4	76,4	87,3	0,18	79,67	79,47	78,43	0,17	80,08	80,03	78,20	0,06
217,0	358,0	3,7	0,0	3,6	0,0	213,3	76,4										

221,0	362,0	3,6	0,0	6,9	0,0	212,3	77,1	87,6	0,18	79,92	79,61	78,47	0,17	80,20	80,09	78,29	0,06
222,0	363,0	3,6	0,0	4,6	0,0	212,1	77,4	87,7	0,18	79,92	79,62	78,51	0,17	80,24	80,12	78,31	0,06
223,0	364,0	3,5	0,0	5,3	0,0	211,7	77,2	87,7	0,18	79,92	79,66	78,57	0,17	80,26	80,15	78,35	0,06
224,0	365,0	3,5	0,0	3,5	0,0	210,4	77,1	87,5	0,18	79,99	79,70	78,56	0,17	80,34	80,21	78,37	0,06
225,0	366,0	3,5	0,0	4,3	0,0	210,1	77,1	87,5	0,18	80,14	79,77	78,60	0,17	80,50	80,25	78,39	0,06
226,0	367,0	3,5	0,0	3,8	0,0	208,7	77,1	87,2	0,18	80,11	79,81	78,60	0,17	80,49	80,28	78,42	0,06
227,0	368,0	3,5	0,0	5,6	0,0	207,6	77,1	87,4	0,18	80,05	79,81	78,61	0,17	80,49	80,29	78,42	0,06
228,0	369,0	3,4	0,0	4,6	0,0	207,3	77,2	87,5	0,18	80,14	79,86	78,66	0,17	80,55	80,33	78,45	0,06
229,0	370,0	3,4	0,0	6,0	0,0	207,9	77,2	87,6	0,18	80,10	79,87	78,68	0,17	80,53	80,36	78,46	0,06
230,0	371,0	3,4	0,0	5,5	0,0	207,3	77,2	87,3	0,18	80,14	79,89	78,67	0,17	80,54	80,36	78,48	0,06
231,0	372,0	3,4	0,0	4,3	0,0	206,6	76,8	87,1	0,18	80,17	79,90	78,68	0,17	80,58	80,39	78,52	0,06
232,0	373,0	3,3	0,0	3,8	0,0	205,6	77,2	87,0	0,18	80,21	79,94	78,68	0,17	80,65	80,40	78,50	0,06
233,0	374,0	3,3	0,0	5,3	0,0	206,3	77,1	87,2	0,18	80,22	79,97	78,72	0,17	80,70	80,43	78,51	0,06
234,0	375,0	3,3	0,0	3,9	0,0	205,1	77,4	87,5	0,18	80,26	80,01	78,73	0,17	80,72	80,48	78,53	0,06
235,0	376,0	3,3	0,0	4,9	0,0	204,2	77,3	87,4	0,18	80,28	80,05	78,75	0,17	80,73	80,51	78,57	0,06
236,0	377,0	3,2	0,0	4,5	0,0	203,5	77,3	87,4	0,18	80,25	80,05	78,74	0,17	80,74	80,52	78,55	0,06
237,0	378,0	3,2	0,0	6,1	0,0	204,2	77,1	87,5	0,18	80,19	80,07	78,79	0,17	80,68	80,56	78,58	0,06
238,0	379,0	3,1	0,0	6,1	0,0	204,9	77,3	87,4	0,18	80,21	80,11	78,82	0,17	80,70	80,56	78,58	0,06
239,0	380,0	3,1	0,0	6,2	0,0	204,9	77,4	87,4	0,18	80,33	80,15	78,82	0,17	80,75	80,57	78,62	0,06
240,0	381,0	3,1	0,0	5,2	0,0	204,2	77,5	87,1	0,18	80,42	80,17	78,86	0,17	80,78	80,59	78,63	0,06
241,0	382,0	3,1	0,0	5,8	0,0	204,1	77,5	87,2	0,18	80,51	80,21	78,84	0,17	80,87	80,60	78,64	0,06
242,0	383,0	3,0	0,0	5,0	0,0	203,4	77,3	87,5	0,18	80,63	80,26	78,90	0,17	80,97	80,67	78,69	0,06
243,0	384,0	3,1	0,0	4,4	0,0	202,8	77,4	87,3	0,18	80,53	80,28	78,89	0,17	80,92	80,68	78,69	0,06
244,0	385,0	3,0	0,0	5,0	0,0	202,9	77,7	87,1	0,18	80,36	80,29	78,88	0,17	80,82	80,69	78,70	0,06
245,0	386,0	3,0	0,0	6,3	0,0	202,6	77,6	87,3	0,18	80,38	80,32	78,92	0,17	80,85	80,70	78,72	0,06
246,0	387,0	2,9	0,0	4,3	0,0	202,4	77,6	87,3	0,18	80,31	80,33	78,95	0,17	80,83	80,76	78,73	0,06
247,0	388,0	2,9	0,0	5,8	0,0	202,2	77,5	87,3	0,18	80,34	80,35	78,95	0,17	80,86	80,80	78,75	0,06
248,0	389,0	2,9	0,0	4,5	0,0	201,6	77,6	87,4	0,18	80,47	80,38	78,99	0,17	80,97	80,84	78,78	0,06
249,0	390,0	2,9	0,0	5,7	0,0	202,1	77,7	87,2	0,18	80,48	80,42	79,00	0,17	81,01	80,87	78,81	0,06
250,0	391,0	2,8	0,0	3,0	0,0	200,8	77,6	87,2	0,18	80,54	80,46	79,02	0,17	81,07	80,91	78,81	0,06
251,0	392,0	2,8	0,0	5,8	0,0	201,4	77,6	87,3	0,18	80,63	80,51	79,02	0,17	81,14	80,94	78,84	0,06
252,0	393,0	2,8	0,0	6,2	0,0	200,9	77,8	87,2	0,18	80,64	80,53	79,05	0,17	81,18	80,98	78,85	0,06
253,0	394,0	2,8	0,0	4,8	0,0	200,5	77,7	86,9	0,18	80,66	80,56	79,05	0,17	81,15	80,99	78,86	0,06
254,0	395,0	2,7	0,0	5,4	0,0	202,2	77,7	87,4	0,18	80,63	80,58	79,06	0,17	81,12	80,98	78,86	0,06
255,0	396,0	2,7	0,0	3,9	0,0	217,6	77,6	88,4	0,18	80,64	80,60	79,06	0,17	81,17	81,02	78,88	0,06
256,0	397,0	2,6	0,0	3,6	0,0	211,6	77,8	87,9	0,18	80,57	80,63	79,07	0,17	81,12	81,03	78,86	0,06
257,0	398,0	2,7	0,0	6,1	0,0	208,7	77,8	88,0	0,18	80,62	80,65	79,10	0,17	81,15	81,08	78,89	0,06
258,0	399,0	2,6	0,0	4,3	0,0	206,3	77,7	87,9	0,18	80,60	80,67	79,11	0,17	81,16	81,11	78,93	0,06
259,0	400,0	2,6	0,0	5,1	0,0	205,3	77,9	87,9	0,18	80,61	80,67	79,10	0,17	81,14	81,13	78,95	0,06
260,0	401,0	2,6	0,0	3,8	0,0	203,9	78,0	87,8	0,18	80,61	80,70	79,11	0,17	81,14	81,17	78,96	0,06
261,0	402,0	2,6	0,0	4,2	0,0	203,3	78,1	87,8	0,18	80,66	80,73	79,17	0,17	81,18	81,21	79,00	0,06
262,0	403,0	2,5	0,0	5,4	0,0	203,0	78,2	87,8	0,18	80,77	80,79	79,18	0,17	81,28	81,24	79,01	0,06
263,0	404,0	2,5	0,0	5,4	0,0	203,0	78,1	87,9	0,18	80,77	80,81	79,21	0,17	81,26	81,29	79,04	0,06
264,0	405,0	2,5	0,0	5,6	0,0	202,9	78,3	88,0	0,18	80,77	80,83	79,22	0,17	81,25	81,29	79,01	0,06
265,0	406,0	2,4	0,0	5,1	0,0	202,5	78,4	88,2	0,18	80,86	80,86	79,26	0,17	81,31	81,33	79,09	0,06
266,0	407,0	2,4	0,0	4,1	0,0	201,6	78,6	88,1	0,18	80,97	80,89	79,30	0,17	81,36	81,35	79,12	0,06
267,0	408,0	2,4	0,0	3,3	0,0	201,0	78,4	88,1	0,18	81,03	80,93	79,33	0,17	81,44	81,37	79,14	0,06
268,0	409,0	2,4	0,0	5,5	0,0	201,3	78,5	87,8	0,18	80,97	80,94	79,34	0,17	81,39	81,38	79,19	0,06
269,0	410,0	2,3	0,0	5,3	0,0	201,8	78,3	87,9	0,18	80,99	80,96	79,37	0,17	81,44	81,39	79,20	0,06
270,0	411,0	2,3	0,0	4,8	0,0	201,1	78,1	87,6	0,18	81,05	81,00	79,39	0,17	81,50	81,42	79,19	0,06
271,0	412,0	2,3	0,0	5,0	0,0	200,4	78,3	87,5	0,18	81,09	81,04	79,41	0,17	81,54	81,44	79,22	0,06
272,0	413,0	2,3	0,0	6,2	0,0	199,9	78,2	87,6	0,18	81,18	81,04	79,43	0,17	81,59	81,44	79,26	0,06
273,0	414,0	2,3	0,0	3,8	0,0	198,8	78,5	87,7	0,18	81,10	81,09	79,43	0,17	81,54	81,47	79,26	0,06
274,0	415,0	2,2	0,0	5,3	0,0	199,0	78,5	87,8	0,18	81,15	81,10	79,49	0,17	81,59	81,51	79,28	0,06
275,0	416,0	2,2	0,0	6,6	0,0	200,0	78,5	88,0	0,18	81,22	81,12	79,49	0,17	81,62	81,56	79,31	0,06
276,0	417,0	2,2	0,0	3,6	0,0	198,9	78,7	88,0	0,18	81,26	81,15	79,52	0,17	81,69	81,60	79,33	0,06
277,0	418,0	2,2	0,0	4,2	0,0	198,6	78,7	88,2	0,18	81,28	81,17	79,57	0,17	81,68	81,63	79,39	0,06
278,0	419,0	2,1	0,0	5,5	0,0	198,7	79,0	88,2	0,18	81,39	81,22	79,59	0,17	81,77	81,66	79,39	0,06
279,0	420,0	2,1	0,0	4,0	0,0	198,4	78,8	88,1	0,18	81,41	81,27	79,59	0,17	81,83	81,70	79,40	0,06
280,0	421,0	2,1	0,0	4,8	0,0	197,8	78,5	88,1	0,18	81,39	81,29	79,62	0,17	81,82	81,72	79,44	0,06
281,0	422,0	2,1	0,0	4,0	0,0	197,2	78,5	87,9	0,18	81,34	81,31	79,66	0,17	81,79	81,73	79,47	0,06
282,0	423,0	2,0	0,0	5,1	0,0	196,6	78,5	88,0	0,18	81,29	81,33	79,67	0,17	81,79	81,75	79,52	0,06
283,0	424,0	2,0	0,0	3,9	0,0	196,5	78,3	87,8	0,18	81,30	81,34	79,69	0,17	81,81	81,77	79,51	0,06
284,0	425,0	2,0	0,0	6,4	0,0	197,7	78,5	87,7	0,18	81,30	81,38	79,69	0,17	81,84	81,81	79,52	0,06
285,0	426,0	2,0	0,0	3,6	0,0	196,5	78,3	87,7	0,18	81,26	81,41	79,69	0,17	81,82	81,82	79,54	0,06
286,0	427,0	1,9	0,0	5,4	0,0	196,7	78,5	87,7	0,18	81,20	81,41	79,71	0,17	81,77	81,86	79,54	0,06
287,0	428,0	1,9	0,0	5,5	0,0	198,8	78,4	88,0	0,18	81,17	81,42	79,73	0,17	81,74	81,87	79,54	0,06
288,0	429,0	1,9	0,0	5,1	0,0	198,6	78,5	87,6	0,18	81,12	81,42	79,72	0,17	81,69	81,89	79,55	0,06
289,0	430,0	1,8	0,0	4,6	0,0	197,9	78,4	87,6	0,18	81,20	81,42	79,72	0,17	81,73	81,89	79,57	0,06
290,0	431,0	1,8	0,0	4,6	0,0	197,5	78,3	87,6	0,18	81,21	81,44	79,74	0,17	81,78	81,92	79,58	0,06
291,0	432,0	1,8	0,0	3,5	0,0	196,6	78,4	87,5	0,18	81,19	81,47	79,75	0,17	81,74	81,91	79,58	0,06
292,0	433,0	1,8	0,0	6,4	0,0	198,8	78,4										

296,0	437,0	1,6	0,0	6,4	0,0	201,6	78,4	88,1	0,18	81,26	81,54	79,78	0,17	81,81	81,95	79,59	0,06
297,0	438,0	1,6	0,0	4,7	0,0	199,6	78,6	87,9	0,18	81,33	81,57	79,80	0,17	81,83	81,98	79,62	0,06
298,0	439,0	1,6	0,0	4,8	0,0	200,8	78,7	88,3	0,18	81,39	81,58	79,82	0,17	81,87	82,00	79,63	0,06
299,0	440,0	1,6	0,0	5,7	0,0	203,0	78,8	88,6	0,18	81,31	81,58	79,82	0,17	81,81	82,01	79,66	0,06
300,0	441,0	1,5	0,0	4,9	0,0	202,7	78,7	88,3	0,18	81,32	81,62	79,84	0,17	81,80	82,02	79,67	0,06
301,0	442,0	1,5	0,0	5,5	0,0	204,2	78,9	88,7	0,18	81,41	81,62	79,86	0,17	81,85	82,05	79,70	0,06
302,0	443,0	1,5	0,0	4,0	0,0	202,5	78,9	88,6	0,18	81,40	81,66	79,88	0,17	81,87	82,08	79,70	0,06
303,0	444,0	1,4	0,0	3,3	0,0	200,9	78,9	88,5	0,18	81,43	81,68	79,92	0,17	81,88	82,08	79,73	0,06
304,0	445,0	1,5	0,0	6,1	0,0	204,3	78,7	89,2	0,18	81,58	81,73	79,92	0,17	81,99	82,11	79,77	0,06
305,0	446,0	1,4	0,0	4,7	0,0	202,8	79,1	88,6	0,18	81,62	81,76	79,96	0,17	82,05	82,17	79,80	0,06
306,0	447,0	1,4	0,0	5,2	0,0	204,0	79,4	88,7	0,18	81,65	81,80	80,00	0,17	82,10	82,19	79,82	0,06
307,0	448,0	1,3	0,0	5,6	0,0	205,0	79,0	89,0	0,18	81,67	81,81	79,99	0,17	82,10	82,19	79,81	0,06
308,0	449,0	1,4	0,0	5,1	0,0	205,7	78,9	88,8	0,18	81,67	81,83	80,04	0,17	82,11	82,20	79,87	0,06
309,0	450,0	1,3	0,0	3,5	0,0	202,7	78,9	88,6	0,18	81,58	81,83	80,05	0,17	82,06	82,23	79,89	0,06
310,0	451,0	1,3	0,0	4,8	0,0	204,9	79,0	88,9	0,18	81,64	81,86	80,03	0,17	82,08	82,24	79,89	0,06
311,0	452,0	1,3	0,0	4,8	0,0	203,6	78,4	88,4	0,18	81,58	81,84	80,05	0,17	82,02	82,22	79,89	0,06
312,0	453,0	1,2	0,0	5,4	0,0	203,9	78,5	88,4	0,18	81,65	81,87	80,05	0,17	82,08	82,21	79,89	0,06
313,0	454,0	1,2	0,0	5,4	0,0	204,5	78,5	88,3	0,18	81,60	81,89	80,07	0,17	82,08	82,20	79,89	0,06
314,0	455,0	1,2	0,0	5,0	0,0	204,0	78,7	88,6	0,18	81,62	81,87	80,08	0,17	82,06	82,20	79,91	0,06
315,0	456,0	1,1	0,0	4,8	0,0	222,1	78,9	91,6	0,18	81,62	81,90	80,10	0,17	82,08	82,20	79,95	0,06
316,0	457,0	1,1	0,0	3,9	0,0	213,8	79,2	89,1	0,18	81,58	81,92	80,12	0,17	82,05	82,22	79,96	0,06
317,0	458,0	1,1	0,0	4,8	0,0	209,0	79,1	89,1	0,18	81,63	81,96	80,13	0,17	82,11	82,25	79,98	0,06
318,0	459,0	1,1	0,0	4,7	0,0	209,6	78,9	89,5	0,18	81,63	81,96	80,18	0,17	82,12	82,27	80,02	0,06
319,0	460,0	1,0	0,0	5,6	0,0	208,8	79,0	89,2	0,18	81,70	81,97	80,19	0,17	82,16	82,29	80,01	0,06
320,0	461,0	1,0	0,0	4,8	0,0	209,1	79,2	89,5	0,18	81,78	82,01	80,23	0,17	82,21	82,31	80,04	0,06
321,0	462,0	1,0	0,0	4,3	0,0	207,7	79,2	89,2	0,18	81,76	82,02	80,24	0,17	82,25	82,34	80,07	0,06
322,0	463,0	0,9	0,0	4,5	0,0	205,9	79,3	89,3	0,18	81,83	82,04	80,25	0,17	82,30	82,36	80,09	0,06
323,0	464,0	0,9	0,0	4,2	0,0	204,6	79,7	89,3	0,18	81,91	82,07	80,29	0,17	82,33	82,41	80,11	0,06
324,0	465,0	0,9	0,0	5,2	0,0	205,8	79,7	89,4	0,18	81,95	82,10	80,33	0,17	82,35	82,44	80,16	0,06
325,0	466,0	0,9	0,0	4,1	0,0	203,6	79,5	89,0	0,18	81,92	82,11	80,36	0,17	82,36	82,48	80,19	0,06
326,0	467,0	0,9	0,0	5,6	0,0	205,4	79,6	89,3	0,18	81,96	82,13	80,36	0,17	82,38	82,48	80,20	0,06
327,0	468,0	0,8	0,0	5,0	0,0	204,0	79,1	89,0	0,18	82,09	82,15	80,37	0,17	82,44	82,50	80,22	0,06
328,0	469,0	0,8	0,0	5,0	0,0	205,2	79,6	89,3	0,18	82,15	82,21	80,41	0,17	82,51	82,55	80,26	0,06
329,0	470,0	0,7	0,0	5,3	0,0	206,5	79,7	89,3	0,18	82,19	82,23	80,44	0,17	82,56	82,57	80,27	0,06
330,0	471,0	0,8	0,0	4,3	0,0	207,8	79,5	89,8	0,18	82,24	82,24	80,48	0,17	82,61	82,60	80,30	0,06
331,0	472,0	0,7	0,0	4,5	0,0	205,5	79,6	89,3	0,18	82,20	82,25	80,48	0,17	82,60	82,63	80,34	0,06
332,0	473,0	0,7	0,0	5,6	0,0	210,5	79,8	89,7	0,18	82,16	82,31	80,52	0,17	82,61	82,64	80,35	0,06
333,0	474,0	0,6	0,0	5,2	0,0	210,6	79,6	89,5	0,18	82,18	82,31	80,51	0,17	82,65	82,69	80,36	0,06
334,0	475,0	0,6	0,0	4,6	0,0	210,7	79,3	89,7	0,18	82,26	82,33	80,51	0,17	82,68	82,69	80,36	0,06
335,0	476,0	0,6	0,0	5,0	0,0	209,0	79,6	89,2	0,18	82,26	82,35	80,55	0,17	82,73	82,73	80,37	0,06
336,0	477,0	0,6	0,0	3,6	0,0	208,9	79,4	89,6	0,18	82,26	82,38	80,58	0,17	82,73	82,75	80,39	0,06
337,0	478,0	0,5	0,0	5,1	0,0	209,0	79,2	89,4	0,18	82,16	82,38	80,58	0,17	82,67	82,73	80,41	0,06
338,0	479,0	0,5	0,0	5,8	0,0	210,5	79,1	89,6	0,18	82,05	82,36	80,61	0,17	82,59	82,74	80,43	0,06
339,0	480,0	0,5	0,0	6,2	0,0	211,5	79,3	89,6	0,18	81,97	82,36	80,59	0,17	82,55	82,74	80,44	0,06
340,0	481,0	0,5	0,0	4,1	0,0	210,5	79,2	89,7	0,18	81,98	82,36	80,63	0,17	82,55	82,75	80,45	0,06
341,0	482,0	0,4	0,0	5,2	0,0	210,8	79,5	89,9	0,18	81,97	82,37	80,65	0,17	82,56	82,76	80,47	0,06
342,0	483,0	0,4	0,0	5,2	0,0	212,4	79,5	90,0	0,18	82,05	82,39	80,65	0,17	82,56	82,78	80,47	0,06
343,0	484,0	0,4	0,0	4,6	0,0	211,0	79,8	89,9	0,18	82,14	82,42	80,67	0,17	82,59	82,79	80,50	0,06
344,0	485,0	0,4	0,0	3,9	0,0	209,6	79,7	89,8	0,18	82,23	82,43	80,71	0,17	82,65	82,80	80,51	0,06
345,0	486,0	0,3	0,0	5,4	0,0	209,5	79,5	89,6	0,18	82,21	82,43	80,71	0,17	82,64	82,84	80,55	0,06
346,0	487,0	0,3	0,0	3,3	0,0	207,6	79,9	89,3	0,18	82,13	82,45	80,72	0,17	82,58	82,82	80,57	0,06
347,0	488,0	0,3	0,0	5,0	0,0	207,5	79,6	89,6	0,18	82,11	82,43	80,74	0,17	82,56	82,83	80,59	0,06
348,0	489,0	0,2	0,0	4,3	0,0	209,9	79,6	89,9	0,18	82,15	82,46	80,76	0,17	82,61	82,85	80,62	0,06
349,0	490,0	0,3	0,0	5,4	0,0	209,5	79,6	89,4	0,18	82,14	82,46	80,78	0,17	82,59	82,87	80,62	0,06
350,0	491,0	0,3	0,0	2,8	0,0	205,9	79,5	89,4	0,18	82,10	82,49	80,79	0,17	82,58	82,87	80,61	0,06
351,0	492,0	0,2	0,0	6,2	0,0	207,7	79,8	89,8	0,18	82,14	82,51	80,79	0,17	82,61	82,89	80,64	0,06
352,0	493,0	0,2	0,0	4,4	0,0	208,1	79,9	89,8	0,18	82,12	82,52	80,81	0,17	82,61	82,90	80,67	0,06
353,0	494,0	0,1	0,0	4,4	0,0	207,6	79,9	89,6	0,18	82,18	82,56	80,83	0,17	82,66	82,93	80,68	0,06
354,0	495,0	0,2	0,0	3,9	0,0	207,2	79,9	89,8	0,18	82,22	82,56	80,84	0,17	82,68	82,95	80,70	0,06
355,0	496,0	0,1	0,0	5,0	0,0	209,5	80,2	89,7	0,18	82,25	82,58	80,86	0,17	82,73	82,99	80,72	0,06
356,0	497,0	0,1	0,0	3,1	0,0	204,6	79,7	89,1	0,18	82,30	82,59	80,88	0,17	82,72	83,02	80,73	0,06
357,0	498,0	0,1	0,0	4,7	0,0	207,3	79,3	89,6	0,18	82,21	82,58	80,89	0,17	82,68	83,01	80,77	0,06
358,0	499,0	0,1	0,0	7,4	0,0	210,7	79,3	89,7	0,18	82,18	82,58	80,90	0,17	82,64	83,01	80,75	0,06
359,0	500,0	0,1	0,0	5,3	0,0	208,8	79,9	89,6	0,18	82,17	82,59	80,91	0,17	82,63	82,99	80,79	0,06
360,0	501,0	0,0	0,0	4,5	0,0	207,5	79,8	89,6	0,18	82,21	82,60	80,95	0,17	82,67	83,01	80,79	0,06

Manufacturer: RAVELLI  
 Model: RV 100 CLASSIC

Run: 1  
 Project #: PI-20129  
 Test Duration: 360 min

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 to 13.7.5.

	HHV	LHV
Eff	80,23%	85,79%
Comb Eff	99,50%	99,50%
HT Eff	80,63%	86,22%
Output	17 796	kJ/h
Burn Rate	1,10	kg/h
Grams CO	16	g
Input	22 182	kJ/h
MC wet	5,57	

Ultimate CO<sub>2</sub>  
 CO<sub>2-ut</sub> 20,28  
 F<sub>0</sub>  
 1,026

Averages			0,02	6,29	2,52	20,73	14,44	130,93	23,96
INPUT DATA				Oxygen Calculation			Input Data		
Elapsed Time	Weight Remaining (kg)	% CO [e]	% CO <sub>2</sub> [d]	Excess Air EA	Total O <sub>2</sub>	Calc. % O <sub>2</sub> [g]	Flue Gas (°C)	Room Temp (°C)	
0,00	6,97	0,01	9,16	121,2%	20,64	11,48	211,7	22,4	
1,00	6,93	0,01	9,89	104,9%	20,62	10,73	211,6	22,6	
2,00	6,89	0,01	9,39	115,7%	20,63	11,24	211,7	22,6	
3,00	6,84	0,01	9,50	113,1%	20,63	11,12	211,8	22,6	
4,00	6,78	0,01	9,59	111,2%	20,63	11,03	211,8	22,5	
5,00	6,74	0,01	9,64	110,2%	20,63	10,98	212,1	22,4	
6,00	6,70	0,01	8,38	141,6%	20,67	12,28	211,1	22,5	
7,00	6,70	0,01	9,83	106,0%	20,62	10,78	211,5	22,6	
8,00	6,66	0,01	10,73	88,7%	20,59	9,85	212,0	22,5	
9,00	6,61	0,01	9,11	122,4%	20,64	11,53	211,8	22,4	
10,00	6,56	0,02	10,68	89,6%	20,59	9,90	212,3	22,3	
11,00	6,52	0,01	9,29	118,0%	20,64	11,34	212,3	22,4	
12,00	6,48	0,01	9,53	112,5%	20,63	11,09	213,2	22,4	
13,00	6,42	0,02	5,74	252,0%	20,75	15,00	213,3	22,4	
14,00	6,38	0,01	8,17	147,9%	20,67	12,50	212,4	22,5	
15,00	6,38	0,01	9,12	122,1%	20,64	11,52	212,0	22,4	
16,00	6,31	0,01	9,02	124,5%	20,65	11,62	211,9	22,5	
17,00	6,30	0,01	10,59	91,3%	20,60	10,00	211,9	22,4	
18,00	6,25	0,01	10,03	102,0%	20,61	10,58	212,0	22,6	
19,00	6,20	0,03	12,08	67,5%	20,55	8,46	212,7	22,6	
20,00	6,16	0,01	9,19	120,4%	20,64	11,44	213,1	22,5	
21,00	6,11	0,02	10,38	95,1%	20,60	10,21	213,7	22,6	
22,00	6,06	0,01	8,76	131,1%	20,65	11,89	213,3	22,7	
23,00	6,02	0,01	8,23	146,0%	20,67	12,43	213,1	22,8	
24,00	5,98	0,01	10,08	101,0%	20,61	10,53	213,4	22,7	
25,00	5,93	0,01	9,82	106,3%	20,62	10,80	213,5	22,7	
26,00	5,89	0,01	9,21	120,0%	20,64	11,43	213,5	22,6	
27,00	5,84	0,01	10,50	93,0%	20,60	10,10	213,6	22,7	
28,00	5,84	0,01	8,92	127,0%	20,65	11,72	213,5	22,7	
29,00	5,80	0,02	9,14	121,5%	20,64	11,49	213,8	22,7	
30,00	5,74	0,01	9,47	113,9%	20,63	11,16	213,8	22,8	
31,00	5,71	0,01	8,46	139,3%	20,66	12,19	213,6	22,7	
32,00	5,65	0,01	9,16	121,2%	20,64	11,48	213,5	22,7	
33,00	5,61	0,01	10,17	99,3%	20,61	10,44	213,5	22,8	
34,00	5,57	0,01	9,74	108,0%	20,62	10,88	213,9	22,8	
35,00	5,52	0,01	8,84	129,0%	20,65	11,80	213,3	22,7	
36,00	5,48	0,01	9,60	110,9%	20,63	11,02	212,8	22,9	
37,00	5,43	0,01	10,12	100,2%	20,61	10,49	212,9	22,9	
38,00	5,43	0,01	8,74	131,7%	20,66	11,91	212,4	22,8	
39,00	5,39	0,01	8,58	135,9%	20,66	12,07	212,4	22,7	
40,00	5,34	0,01	9,09	122,9%	20,64	11,55	212,4	22,8	
41,00	5,29	0,01	9,80	106,6%	20,62	10,81	212,2	22,9	
42,00	5,25	0,01	8,07	150,9%	20,68	12,60	211,9	22,8	
43,00	5,21	0,01	9,01	124,9%	20,65	11,63	211,9	22,4	
44,00	5,16	0,01	8,60	135,6%	20,66	12,06	212,0	22,6	
45,00	5,12	0,01	8,48	138,8%	20,66	12,18	211,8	22,4	
46,00	5,12	0,01	8,58	136,1%	20,66	12,08	211,9	22,7	
47,00	5,07	0,01	8,96	126,1%	20,65	11,68	212,0	22,6	
48,00	5,02	0,01	8,68	133,4%	20,66	11,97	211,6	22,6	
49,00	4,98	0,01	7,90	156,2%	20,68	12,77	211,0	22,6	
50,00	4,97	0,01	9,21	120,0%	20,64	11,43	211,1	22,7	
51,00	4,93	0,01	9,73	108,1%	20,62	10,88	210,8	22,7	
52,00	4,89	0,01	9,79	107,0%	20,62	10,83	211,1	22,6	
53,00	4,84	0,01	9,44	114,6%	20,63	11,19	211,4	22,8	
54,00	4,80	0,01	9,95	103,5%	20,62	10,66	211,1	22,7	
55,00	4,76	0,03	11,14	81,5%	20,58	9,42	211,6	22,8	
56,00	4,71	0,01	8,55	136,9%	20,66	12,11	211,6	22,5	
57,00	4,66	0,01	8,71	132,5%	20,66	11,94	211,5	22,6	
58,00	4,61	0,01	10,35	95,7%	20,60	10,25	212,0	22,9	
59,00	4,57	0,01	8,61	135,1%	20,66	12,04	212,1	22,8	
60,00	4,53	0,01	8,94	126,7%	20,65	11,71	211,9	22,9	
61,00	4,53	0,01	9,37	116,2%	20,63	11,26	212,2	23,0	
62,00	4,48	0,01	8,56	136,6%	20,66	12,09	205,1	22,9	
63,00	4,44	0,01	9,32	117,3%	20,64	11,31	195,4	22,7	

64,00	4,44	0,06	6,46	211,1%	20,73	14,24	188,2	22,7
65,00	4,44	0,03	7,19	181,2%	20,71	13,51	182,5	22,7
66,00	4,39	0,02	7,51	169,5%	20,70	13,18	177,9	22,7
67,00	4,35	0,02	5,88	243,7%	20,75	14,86	174,0	22,7
68,00	4,35	0,01	6,77	199,2%	20,72	13,95	170,8	22,7
69,00	4,35	0,02	7,37	174,4%	20,70	13,32	167,5	22,7
70,00	4,30	0,03	7,16	182,0%	20,71	13,53	165,2	22,8
71,00	4,30	0,03	6,04	234,3%	20,74	14,69	162,9	23,1
72,00	4,25	0,02	7,20	180,9%	20,71	13,50	160,3	23,1
73,00	4,25	0,04	5,46	268,6%	20,76	15,28	164,1	23,3
74,00	4,21	0,03	6,46	212,5%	20,73	14,25	160,4	23,2
75,00	4,21	0,02	7,87	157,1%	20,68	12,80	157,6	23,2
76,00	4,17	0,01	6,69	202,7%	20,72	14,03	154,5	23,3
77,00	4,16	0,02	6,83	195,9%	20,72	13,87	152,5	23,1
78,00	4,17	0,02	6,65	203,8%	20,72	14,06	151,4	23,1
79,00	4,12	0,03	5,61	260,0%	20,76	15,14	150,3	23,1
80,00	4,12	0,01	8,12	149,4%	20,68	12,55	148,9	23,2
81,00	4,08	0,04	6,72	200,2%	20,72	13,98	147,5	23,2
82,00	4,08	0,02	6,19	226,2%	20,74	14,53	146,5	23,2
83,00	4,05	0,04	4,90	310,5%	20,78	15,86	145,4	23,3
84,00	4,04	0,02	5,79	249,3%	20,75	14,96	144,0	23,4
85,00	4,04	0,01	8,34	142,6%	20,67	12,32	143,1	23,5
86,00	3,98	0,03	5,87	244,0%	20,75	14,87	142,5	23,4
87,00	3,98	0,02	5,59	261,7%	20,76	15,16	141,4	23,6
88,00	3,94	0,02	6,88	193,7%	20,72	13,82	140,1	23,5
89,00	3,94	0,01	7,52	169,4%	20,70	13,17	138,8	23,3
90,00	3,89	0,01	8,12	149,5%	20,68	12,55	138,9	23,4
91,00	3,89	0,03	6,43	214,2%	20,73	14,29	138,3	23,6
92,00	3,89	0,03	4,21	378,1%	20,80	16,57	137,0	23,6
93,00	3,85	0,01	8,96	126,0%	20,65	11,68	137,0	23,6
94,00	3,85	0,01	7,66	164,2%	20,69	13,02	136,0	23,7
95,00	3,81	0,02	6,42	215,0%	20,73	14,30	135,8	23,8
96,00	3,81	0,02	5,93	241,0%	20,75	14,81	135,0	23,8
97,00	3,76	0,01	7,64	165,1%	20,69	13,05	134,5	23,7
98,00	3,76	0,01	7,49	170,2%	20,70	13,20	134,7	23,5
99,00	3,71	0,03	5,98	237,3%	20,74	14,75	134,3	23,7
100,00	3,71	0,04	5,55	263,0%	20,76	15,19	134,1	23,5
101,00	3,72	0,01	8,02	152,5%	20,68	12,65	133,2	23,4
102,00	3,67	0,02	7,56	167,7%	20,69	13,13	132,9	23,5
103,00	3,67	0,06	4,63	332,8%	20,79	16,13	132,2	23,4
104,00	3,62	0,02	7,82	158,5%	20,68	12,85	132,9	23,6
105,00	3,62	0,02	8,13	148,6%	20,67	12,53	132,4	23,7
106,00	3,58	0,02	6,34	218,9%	20,73	14,38	131,7	23,7
107,00	3,57	0,01	6,52	210,3%	20,73	14,20	132,4	23,8
108,00	3,53	0,01	6,75	200,0%	20,72	13,97	132,0	23,7
109,00	3,53	0,01	6,56	208,6%	20,73	14,16	131,6	23,5
110,00	3,49	0,02	7,51	169,6%	20,70	13,18	131,4	23,5
111,00	3,49	0,02	6,41	215,3%	20,73	14,31	131,9	23,0
112,00	3,44	0,02	6,01	236,8%	20,74	14,73	131,5	22,9
113,00	3,44	0,01	7,17	182,6%	20,71	13,53	131,6	23,0
114,00	3,44	0,01	6,02	236,5%	20,74	14,72	130,9	23,1
115,00	3,44	0,02	6,81	196,7%	20,72	13,89	130,4	23,4
116,00	3,40	0,02	6,02	235,9%	20,74	14,71	130,2	23,3
117,00	3,37	0,02	5,94	240,3%	20,75	14,80	129,8	23,3
118,00	3,35	0,02	6,21	225,4%	20,74	14,51	130,0	23,4
119,00	3,35	0,01	8,13	149,1%	20,68	12,54	130,0	23,5
120,00	3,31	0,01	6,36	218,4%	20,73	14,37	129,5	23,4
121,00	3,31	0,02	5,59	261,4%	20,76	15,16	129,2	23,5
122,00	3,31	0,01	6,85	195,6%	20,72	13,86	129,2	23,4
123,00	3,31	0,01	6,52	210,3%	20,73	14,20	129,1	23,6
124,00	3,21	0,01	6,97	190,6%	20,71	13,74	129,4	23,4
125,00	3,21	0,01	6,33	219,9%	20,73	14,40	129,1	23,5
126,00	3,21	0,01	7,21	180,9%	20,71	13,49	128,7	23,6
127,00	3,17	0,04	5,20	287,4%	20,77	15,55	128,3	23,7
128,00	3,17	0,01	7,82	159,0%	20,69	12,86	128,3	23,8
129,00	3,12	0,02	7,34	175,4%	20,70	13,35	128,1	23,8
130,00	3,13	0,02	7,57	167,1%	20,69	13,11	128,1	23,9
131,00	3,08	0,01	9,00	125,1%	20,65	11,64	128,1	23,8
132,00	3,08	0,01	7,06	186,6%	20,71	13,64	128,5	23,6
133,00	3,08	0,02	7,02	188,4%	20,71	13,69	129,8	23,6
134,00	3,03	0,06	3,94	407,2%	20,81	16,84	136,2	23,5
135,00	3,04	0,01	6,74	200,5%	20,72	13,98	133,1	23,5
136,00	2,99	0,02	4,72	327,0%	20,79	16,05	131,1	23,7
137,00	2,99	0,03	4,52	345,9%	20,79	16,26	129,3	23,8
138,00	2,95	0,01	7,76	161,0%	20,69	12,92	129,3	24,0
139,00	2,95	0,02	6,79	198,0%	20,72	13,92	128,5	23,8
140,00	2,93	0,01	7,59	166,7%	20,69	13,09	128,2	23,9
141,00	2,89	0,02	6,36	218,0%	20,73	14,37	128,5	23,9
142,00	2,89	0,01	6,64	205,1%	20,72	14,08	128,1	23,9
143,00	2,85	0,02	6,91	192,5%	20,71	13,79	128,1	23,9
144,00	2,85	0,01	7,47	170,8%	20,70	13,22	128,1	23,9
145,00	2,85	0,02	5,95	239,8%	20,75	14,79	127,7	23,8
146,00	2,81	0,01	6,84	196,3%	20,72	13,88	127,5	23,9
147,00	2,81	0,01	7,21	180,9%	20,71	13,49	127,4	23,8
148,00	2,76	0,02	6,07	233,4%	20,74	14,67	127,3	23,9

149,00	2,76	0,01	5,47	269,7%	20,76	15,28	127,2	24,0
150,00	2,76	0,01	6,98	190,0%	20,71	13,72	127,1	24,0
151,00	2,72	0,01	6,59	207,4%	20,73	14,13	127,1	24,1
152,00	2,67	0,01	8,45	139,9%	20,66	12,21	127,3	24,1
153,00	2,67	0,01	5,96	239,6%	20,75	14,78	126,5	24,0
154,00	2,67	0,02	6,51	210,5%	20,73	14,21	126,1	24,1
155,00	2,63	0,02	9,29	117,9%	20,64	11,34	126,1	24,1
156,00	2,63	0,02	6,84	195,9%	20,72	13,87	126,3	24,3
157,00	2,59	0,02	8,15	148,3%	20,67	12,51	126,5	24,1
158,00	2,59	0,01	7,76	161,1%	20,69	12,93	126,6	24,0
159,00	2,53	0,01	8,38	141,6%	20,67	12,28	127,0	23,9
160,00	2,53	0,02	5,64	258,1%	20,76	15,10	126,7	24,1
161,00	2,49	0,02	8,45	139,6%	20,66	12,21	126,8	24,1
162,00	2,49	0,01	6,49	211,8%	20,73	14,23	126,7	24,1
163,00	2,49	0,01	7,03	188,0%	20,71	13,67	126,6	24,2
164,00	2,45	0,02	6,04	234,7%	20,74	14,69	126,8	24,2
165,00	2,45	0,02	5,28	282,4%	20,77	15,47	126,2	24,2
166,00	2,40	0,02	6,78	198,4%	20,72	13,93	126,3	24,2
167,00	2,40	0,01	5,04	301,4%	20,78	15,73	125,8	24,1
168,00	2,35	0,01	7,39	174,1%	20,70	13,31	125,6	24,0
169,00	2,36	0,02	5,77	250,0%	20,75	14,97	125,5	24,3
170,00	2,36	0,01	6,64	204,9%	20,72	14,08	125,5	24,0
171,00	2,31	0,01	7,60	166,5%	20,69	13,09	125,9	24,1
172,00	2,31	0,02	6,05	234,0%	20,74	14,68	126,0	24,1
173,00	2,31	0,03	5,09	296,4%	20,77	15,67	125,7	24,0
174,00	2,27	0,02	5,96	239,6%	20,75	14,78	125,5	23,9
175,00	2,27	0,01	7,55	168,1%	20,69	13,14	125,9	23,9
176,00	2,21	0,02	6,87	194,5%	20,72	13,84	126,3	23,9
177,00	2,21	0,01	5,57	263,6%	20,76	15,19	125,6	23,9
178,00	2,22	0,02	7,39	173,5%	20,70	13,29	125,2	23,8
179,00	2,17	0,02	8,70	132,8%	20,66	11,95	125,9	23,9
180,00	2,17	0,01	8,70	132,9%	20,66	11,96	125,7	24,0
181,00	2,12	0,01	7,38	174,2%	20,70	13,31	125,7	24,1
182,00	2,12	0,02	6,76	199,1%	20,72	13,95	124,5	24,2
183,00	2,12	0,01	6,03	235,6%	20,74	14,71	122,7	24,1
184,00	2,08	0,01	5,25	285,4%	20,77	15,51	121,7	24,1
185,00	2,08	0,04	3,38	492,4%	20,83	17,43	120,0	24,1
186,00	2,08	0,01	5,17	291,6%	20,77	15,60	118,5	24,1
187,00	2,08	0,02	4,22	378,3%	20,80	16,57	117,5	24,2
188,00	2,04	0,01	6,77	198,9%	20,72	13,94	117,0	24,3
189,00	2,04	0,02	3,30	510,5%	20,83	17,52	115,7	24,3
190,00	2,04	0,01	5,59	262,4%	20,76	15,17	114,9	24,3
191,00	2,04	0,02	3,74	440,0%	20,82	17,07	113,5	24,3
192,00	2,00	0,02	5,56	263,8%	20,76	15,19	112,9	24,4
193,00	1,99	0,02	4,23	377,2%	20,80	16,56	111,8	24,4
194,00	1,99	0,01	4,90	313,1%	20,78	15,88	120,6	24,5
195,00	2,00	0,05	3,55	464,3%	20,82	17,25	117,1	24,6
196,00	1,95	0,01	5,43	272,7%	20,76	15,33	114,6	24,4
197,00	1,95	0,01	6,16	228,5%	20,74	14,57	112,4	24,3
198,00	1,91	0,01	6,12	230,4%	20,74	14,61	111,4	24,3
199,00	1,95	0,03	3,33	502,8%	20,83	17,48	110,2	24,3
200,00	1,90	0,02	5,45	270,2%	20,76	15,30	109,3	24,3
201,00	1,91	0,01	4,89	314,3%	20,78	15,89	108,2	24,4
202,00	1,85	0,01	4,58	341,4%	20,79	16,20	107,4	24,4
203,00	1,85	0,02	4,60	339,2%	20,79	16,18	106,9	24,4
204,00	1,81	0,01	6,40	216,6%	20,73	14,33	106,4	24,5
205,00	1,84	0,01	5,63	259,4%	20,76	15,12	106,3	24,7
206,00	1,81	0,01	7,10	185,3%	20,71	13,60	106,4	24,7
207,00	1,81	0,06	2,81	606,4%	20,85	18,01	105,2	24,7
208,00	1,77	0,02	4,95	308,2%	20,78	15,82	104,4	24,7
209,00	1,76	0,01	4,22	378,6%	20,80	16,57	103,9	24,9
210,00	1,77	0,01	5,80	249,0%	20,75	14,95	103,6	24,7
211,00	1,76	0,02	3,71	444,4%	20,82	17,10	103,2	24,8
212,00	1,76	0,01	4,21	380,0%	20,80	16,58	103,2	24,8
213,00	1,72	0,01	4,69	331,9%	20,79	16,10	102,3	24,8
214,00	1,72	0,01	5,33	280,2%	20,77	15,44	102,2	24,7
215,00	1,68	0,01	5,80	249,4%	20,75	14,95	101,7	24,7
216,00	1,68	0,02	4,00	404,1%	20,81	16,80	101,3	24,6
217,00	1,67	0,03	3,58	462,9%	20,82	17,23	100,7	24,7
218,00	1,68	0,01	6,37	217,7%	20,73	14,36	100,4	24,9
219,00	1,68	0,01	4,31	369,9%	20,80	16,49	100,1	25,0
220,00	1,68	0,02	5,01	303,6%	20,78	15,76	100,4	24,9
221,00	1,63	0,01	6,90	193,6%	20,72	13,81	100,2	25,1
222,00	1,63	0,01	4,62	337,5%	20,79	16,16	100,0	25,2
223,00	1,59	0,01	5,26	284,8%	20,77	15,50	99,8	25,1
224,00	1,59	0,02	3,54	469,5%	20,82	17,27	99,1	25,1
225,00	1,59	0,01	4,26	375,1%	20,80	16,54	98,9	25,0
226,00	1,59	0,01	3,83	428,0%	20,82	16,98	98,1	25,0
227,00	1,57	0,01	5,65	258,5%	20,76	15,10	97,6	25,0
228,00	1,54	0,01	4,62	337,6%	20,79	16,16	97,4	25,1
229,00	1,54	0,01	6,00	237,8%	20,74	14,74	97,7	25,1
230,00	1,54	0,01	5,52	266,5%	20,76	15,23	97,4	25,1
231,00	1,55	0,02	4,25	374,8%	20,80	16,54	97,0	24,9
232,00	1,49	0,02	3,77	434,5%	20,82	17,03	96,5	25,1
233,00	1,49	0,01	5,31	281,1%	20,77	15,45	96,8	25,1

234,00	1,49	0,02	3,91	416,4%	20,81	16,90	96,2	25,2
235,00	1,49	0,01	4,95	309,0%	20,78	15,83	95,7	25,2
236,00	1,44	0,01	4,51	348,6%	20,79	16,28	95,3	25,2
237,00	1,44	0,01	6,06	234,1%	20,74	14,68	95,7	25,1
238,00	1,40	0,01	6,10	232,1%	20,74	14,64	96,1	25,2
239,00	1,40	0,01	6,16	228,4%	20,74	14,57	96,1	25,2
240,00	1,40	0,01	5,20	289,7%	20,77	15,57	95,7	25,3
241,00	1,40	0,01	5,75	251,7%	20,75	14,99	95,6	25,3
242,00	1,36	0,02	4,97	306,7%	20,78	15,80	95,2	25,2
243,00	1,40	0,01	4,40	359,7%	20,80	16,39	94,9	25,2
244,00	1,36	0,01	4,97	307,8%	20,78	15,81	94,9	25,4
245,00	1,36	0,01	6,33	219,6%	20,73	14,40	94,8	25,3
246,00	1,32	0,02	4,34	365,3%	20,80	16,45	94,7	25,4
247,00	1,31	0,01	5,82	247,7%	20,75	14,92	94,6	25,3
248,00	1,32	0,01	4,48	351,7%	20,79	16,31	94,2	25,3
249,00	1,31	0,01	5,70	254,7%	20,75	15,04	94,5	25,4
250,00	1,27	0,02	3,05	560,6%	20,84	17,78	93,8	25,3
251,00	1,27	0,01	5,84	246,4%	20,75	14,90	94,1	25,3
252,00	1,27	0,01	6,23	224,8%	20,74	14,50	93,8	25,4
253,00	1,27	0,01	4,76	324,6%	20,78	16,01	93,6	25,4
254,00	1,23	0,01	5,39	275,7%	20,76	15,37	94,5	25,4
255,00	1,23	0,03	3,85	421,9%	20,81	16,94	103,1	25,3
256,00	1,18	0,03	3,64	452,9%	20,82	17,17	99,8	25,4
257,00	1,23	0,03	6,13	229,5%	20,74	14,60	98,2	25,4
258,00	1,18	0,03	4,31	367,7%	20,80	16,48	96,8	25,4
259,00	1,18	0,02	5,13	293,9%	20,77	15,63	96,3	25,5
260,00	1,18	0,02	3,85	424,5%	20,81	16,96	95,5	25,6
261,00	1,18	0,01	4,22	379,3%	20,80	16,58	95,2	25,6
262,00	1,13	0,01	5,39	275,3%	20,76	15,37	95,0	25,7
263,00	1,13	0,01	5,43	273,0%	20,76	15,33	95,0	25,6
264,00	1,13	0,02	5,62	259,5%	20,76	15,12	94,9	25,7
265,00	1,09	0,01	5,07	299,5%	20,77	15,70	94,7	25,8
266,00	1,11	0,02	4,09	394,1%	20,81	16,71	94,2	25,9
267,00	1,08	0,02	3,30	510,8%	20,83	17,52	93,9	25,8
268,00	1,09	0,01	5,47	269,6%	20,76	15,28	94,1	25,8
269,00	1,04	0,01	5,30	281,8%	20,77	15,46	94,4	25,7
270,00	1,04	0,01	4,77	323,9%	20,78	16,01	94,0	25,6
271,00	1,04	0,01	4,96	308,2%	20,78	15,82	93,6	25,7
272,00	1,04	0,01	6,24	224,3%	20,74	14,49	93,3	25,7
273,00	1,04	0,02	3,83	426,3%	20,81	16,97	92,7	25,8
274,00	0,99	0,01	5,26	284,8%	20,77	15,50	92,8	25,8
275,00	1,00	0,01	6,55	209,0%	20,73	14,17	93,3	25,8
276,00	1,00	0,02	3,57	465,2%	20,82	17,24	92,7	25,9
277,00	1,00	0,02	4,21	379,7%	20,80	16,58	92,6	25,9
278,00	0,95	0,01	5,54	265,3%	20,76	15,21	92,6	26,1
279,00	0,95	0,02	4,03	401,3%	20,81	16,77	92,4	26,0
280,00	0,95	0,02	4,82	318,8%	20,78	15,95	92,1	25,8
281,00	0,95	0,02	3,99	405,1%	20,81	16,81	91,8	25,8
282,00	0,91	0,02	5,12	295,1%	20,77	15,65	91,5	25,9
283,00	0,91	0,03	3,86	422,3%	20,81	16,94	91,4	25,7
284,00	0,91	0,01	6,42	215,3%	20,73	14,30	92,1	25,8
285,00	0,91	0,03	3,65	452,4%	20,82	17,16	91,4	25,7
286,00	0,86	0,01	5,38	276,2%	20,76	15,38	91,5	25,8
287,00	0,86	0,01	5,51	267,5%	20,76	15,25	92,7	25,8
288,00	0,86	0,01	5,07	299,1%	20,77	15,70	92,5	25,9
289,00	0,82	0,01	4,59	340,2%	20,79	16,19	92,2	25,8
290,00	0,82	0,01	4,57	342,9%	20,79	16,22	91,9	25,7
291,00	0,82	0,02	3,50	475,9%	20,83	17,31	91,4	25,8
292,00	0,82	0,01	6,38	217,3%	20,73	14,35	92,6	25,8
293,00	0,82	0,01	4,20	380,8%	20,80	16,59	92,2	25,7
294,00	0,77	0,01	6,64	205,0%	20,72	14,08	93,6	25,8
295,00	0,77	0,01	5,02	303,2%	20,78	15,75	94,5	25,8
296,00	0,72	0,01	6,41	215,8%	20,73	14,32	94,2	25,8
297,00	0,72	0,01	4,67	332,6%	20,79	16,11	93,1	25,9
298,00	0,72	0,01	4,83	319,2%	20,78	15,95	93,8	26,0
299,00	0,72	0,01	5,66	257,9%	20,76	15,09	95,0	26,0
300,00	0,68	0,02	4,94	308,9%	20,78	15,83	94,8	25,9
301,00	0,68	0,02	5,46	270,3%	20,76	15,29	95,7	26,0
302,00	0,68	0,02	4,00	404,2%	20,81	16,80	94,7	26,0
303,00	0,63	0,02	3,26	518,2%	20,83	17,56	93,8	26,1
304,00	0,68	0,02	6,08	232,7%	20,74	14,65	95,7	26,0
305,00	0,64	0,02	4,71	328,8%	20,79	16,07	94,9	26,2
306,00	0,64	0,01	5,23	286,7%	20,77	15,53	95,5	26,3
307,00	0,59	0,01	5,65	258,3%	20,76	15,10	96,1	26,1
308,00	0,63	0,01	5,08	297,9%	20,77	15,68	96,5	26,0
309,00	0,59	0,02	3,46	482,6%	20,83	17,36	94,8	26,1
310,00	0,59	0,01	4,75	325,7%	20,79	16,03	96,0	26,1
311,00	0,59	0,02	4,77	323,4%	20,78	16,00	95,4	25,8
312,00	0,55	0,02	5,41	273,2%	20,76	15,34	95,5	25,9
313,00	0,55	0,02	5,42	272,7%	20,76	15,33	95,8	25,8
314,00	0,55	0,01	4,95	308,4%	20,78	15,82	95,6	25,9
315,00	0,50	0,01	4,78	323,0%	20,78	16,00	105,6	26,1
316,00	0,50	0,03	3,90	416,5%	20,81	16,90	101,0	26,2
317,00	0,50	0,02	4,81	320,0%	20,78	15,96	98,4	26,2
318,00	0,50	0,01	4,71	329,6%	20,79	16,07	98,6	26,1



319,00	0,45	0,01	5,56	264,1%	20,76	15,19	98,2	26,1
320,00	0,45	0,02	4,85	316,4%	20,78	15,92	98,4	26,2
321,00	0,45	0,02	4,29	371,1%	20,80	16,50	97,6	26,2
322,00	0,40	0,02	4,50	348,8%	20,79	16,28	96,6	26,3
323,00	0,41	0,01	4,24	376,3%	20,80	16,55	95,9	26,5
324,00	0,40	0,01	5,23	286,9%	20,77	15,53	96,6	26,5
325,00	0,40	0,02	4,12	390,2%	20,81	16,68	95,4	26,4
326,00	0,41	0,01	5,56	264,1%	20,76	15,20	96,3	26,4
327,00	0,36	0,01	4,98	306,1%	20,78	15,79	95,5	26,1
328,00	0,36	0,02	4,98	305,8%	20,78	15,79	96,2	26,5
329,00	0,34	0,01	5,32	280,5%	20,77	15,44	97,0	26,5
330,00	0,36	0,02	4,27	372,5%	20,80	16,52	97,7	26,4
331,00	0,32	0,02	4,49	349,9%	20,79	16,30	96,4	26,4
332,00	0,32	0,01	5,64	258,6%	20,76	15,11	99,2	26,5
333,00	0,27	0,01	5,17	291,5%	20,77	15,60	99,2	26,5
334,00	0,27	0,01	4,61	338,8%	20,79	16,17	99,3	26,3
335,00	0,27	0,01	4,95	308,1%	20,78	15,82	98,3	26,5
336,00	0,27	0,02	3,59	462,2%	20,82	17,23	98,3	26,4
337,00	0,23	0,02	5,10	296,4%	20,77	15,67	98,3	26,2
338,00	0,23	0,02	5,80	248,3%	20,75	14,94	99,2	26,2
339,00	0,23	0,02	6,20	226,3%	20,74	14,53	99,7	26,3
340,00	0,23	0,02	4,06	397,4%	20,81	16,74	99,2	26,2
341,00	0,18	0,02	5,24	285,5%	20,77	15,52	99,3	26,4
342,00	0,18	0,02	5,23	286,4%	20,77	15,53	100,2	26,4
343,00	0,18	0,02	4,56	342,7%	20,79	16,22	99,5	26,6
344,00	0,19	0,02	3,90	417,7%	20,81	16,90	98,7	26,5
345,00	0,14	0,01	5,41	273,8%	20,76	15,34	98,6	26,4
346,00	0,14	0,02	3,29	512,9%	20,83	17,53	97,6	26,6
347,00	0,14	0,01	5,01	304,0%	20,78	15,76	97,5	26,4
348,00	0,09	0,01	4,32	368,2%	20,80	16,47	98,8	26,4
349,00	0,14	0,01	5,36	277,1%	20,77	15,39	98,6	26,4
350,00	0,13	0,04	2,78	618,0%	20,85	18,04	96,6	26,4
351,00	0,09	0,01	6,19	227,1%	20,74	14,54	97,6	26,5
352,00	0,08	0,02	4,39	359,7%	20,80	16,40	97,8	26,6
353,00	0,04	0,01	4,38	361,8%	20,80	16,41	97,5	26,6
354,00	0,09	0,02	3,86	422,7%	20,81	16,94	97,3	26,6
355,00	0,04	0,01	4,95	308,4%	20,78	15,82	98,6	26,8
356,00	0,04	0,02	3,14	541,9%	20,84	17,69	95,9	26,5
357,00	0,04	0,02	4,74	325,6%	20,78	16,03	97,4	26,3
358,00	0,03	0,02	7,39	173,7%	20,70	13,30	99,3	26,3
359,00	0,03	0,02	5,33	279,0%	20,77	15,42	98,2	26,6
360,00	0,00	0,01	4,47	352,5%	20,79	16,32	97,5	26,5

Manufacturer: RAVELLI  
 Model: RV 100 CLASSIC

Run: 1  
 Project #: PI-20129  
 Test Duration: 59 min

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 to 13.7.5.

	HHV	LHV
Eff	77,97%	83,38%
Comb Eff	99,50%	99,50%
HT Eff	78,37%	83,80%
Output	36 376	kJ/h
Burn Rate	2,31	kg/h
Grams CO	3	g
Input	46 651	kJ/h
MC wet	5,57	

Ultimate CO<sub>2</sub>  
 CO<sub>2-ult</sub> 20,28  
 F<sub>0</sub>  
 1,028

Averages		0,01	9,32	1,20	20,64	11,31	212,35	22,63
INPUT DATA				Oxygen Calculation			Input Data	
Elapsed Time	Weight Remaining (kg)	% CO [e]	% CO <sub>2</sub> [d]	Excess Air EA	Total O <sub>2</sub>	Calc. % O <sub>2</sub> [g]	Flue Gas (°C)	Room Temp (°C)
0,00	2,40	0,01	9,16	121,2%	20,64	11,48	211,7	22,4
1,00	2,36	0,01	9,89	104,9%	20,62	10,73	211,6	22,6
2,00	2,32	0,01	9,39	115,7%	20,63	11,24	211,7	22,6
3,00	2,27	0,01	9,50	113,1%	20,63	11,12	211,8	22,6
4,00	2,22	0,01	9,59	111,2%	20,63	11,03	211,8	22,5
5,00	2,17	0,01	9,64	110,2%	20,63	10,98	212,1	22,4
6,00	2,13	0,01	8,38	141,6%	20,67	12,28	211,1	22,5
7,00	2,13	0,01	9,83	106,0%	20,62	10,78	211,5	22,6
8,00	2,09	0,01	10,73	88,7%	20,59	9,85	212,0	22,5
9,00	2,04	0,01	9,11	122,4%	20,64	11,53	211,8	22,4
10,00	1,99	0,02	10,68	89,6%	20,59	9,90	212,3	22,3
11,00	1,95	0,01	9,29	118,0%	20,64	11,34	212,3	22,4
12,00	1,91	0,01	9,53	112,5%	20,63	11,09	213,2	22,4
13,00	1,85	0,02	5,74	252,0%	20,75	15,00	213,3	22,4
14,00	1,81	0,01	8,17	147,9%	20,67	12,50	212,4	22,5
15,00	1,81	0,01	9,12	122,1%	20,64	11,52	212,0	22,4
16,00	1,74	0,01	9,02	124,5%	20,65	11,62	211,9	22,5
17,00	1,73	0,01	10,59	91,3%	20,60	10,00	211,9	22,4
18,00	1,68	0,01	10,03	102,0%	20,61	10,58	212,0	22,6
19,00	1,63	0,03	12,08	67,5%	20,55	8,46	212,7	22,6
20,00	1,59	0,01	9,19	120,4%	20,64	11,44	213,1	22,5
21,00	1,55	0,02	10,38	95,1%	20,60	10,21	213,7	22,6
22,00	1,49	0,01	8,76	131,1%	20,65	11,89	213,3	22,7
23,00	1,45	0,01	8,23	146,0%	20,67	12,43	213,1	22,8
24,00	1,41	0,01	10,08	101,0%	20,61	10,53	213,4	22,7
25,00	1,36	0,01	9,82	106,3%	20,62	10,80	213,5	22,7
26,00	1,32	0,01	9,21	120,0%	20,64	11,43	213,5	22,6
27,00	1,27	0,01	10,50	93,0%	20,60	10,10	213,6	22,7
28,00	1,27	0,01	8,92	127,0%	20,65	11,72	213,5	22,7
29,00	1,23	0,02	9,14	121,5%	20,64	11,49	213,8	22,7
30,00	1,18	0,01	9,47	113,9%	20,63	11,16	213,8	22,8
31,00	1,14	0,01	8,46	139,3%	20,66	12,19	213,6	22,7
32,00	1,08	0,01	9,16	121,2%	20,64	11,48	213,5	22,7
33,00	1,04	0,01	10,17	99,3%	20,61	10,44	213,5	22,8
34,00	1,00	0,01	9,74	108,0%	20,62	10,88	213,9	22,8
35,00	0,96	0,01	8,84	129,0%	20,65	11,80	213,3	22,7
36,00	0,91	0,01	9,60	110,9%	20,63	11,02	212,8	22,9
37,00	0,86	0,01	10,12	100,2%	20,61	10,49	212,9	22,9
38,00	0,86	0,01	8,74	131,7%	20,66	11,91	212,4	22,8
39,00	0,82	0,01	8,58	135,9%	20,66	12,07	212,4	22,7
40,00	0,77	0,01	9,09	122,9%	20,64	11,55	212,4	22,8
41,00	0,72	0,01	9,80	106,6%	20,62	10,81	212,2	22,9
42,00	0,68	0,01	8,07	150,9%	20,68	12,60	211,9	22,8
43,00	0,64	0,01	9,01	124,9%	20,65	11,63	211,9	22,4
44,00	0,59	0,01	8,60	135,6%	20,66	12,06	212,0	22,6
45,00	0,55	0,01	8,48	138,8%	20,66	12,18	211,8	22,4
46,00	0,55	0,01	8,58	136,1%	20,66	12,08	211,9	22,7
47,00	0,51	0,01	8,96	126,1%	20,65	11,68	212,0	22,6
48,00	0,45	0,01	8,68	133,4%	20,66	11,97	211,6	22,6
49,00	0,41	0,01	7,90	156,2%	20,68	12,77	211,0	22,6
50,00	0,40	0,01	9,21	120,0%	20,64	11,43	211,1	22,7
51,00	0,36	0,01	9,73	108,1%	20,62	10,88	210,8	22,7
52,00	0,32	0,01	9,79	107,0%	20,62	10,83	211,1	22,6
53,00	0,27	0,01	9,44	114,6%	20,63	11,19	211,4	22,8
54,00	0,23	0,01	9,95	103,5%	20,62	10,66	211,1	22,7
55,00	0,19	0,03	11,14	81,5%	20,58	9,42	211,6	22,8
56,00	0,14	0,01	8,55	136,9%	20,66	12,11	211,6	22,5
57,00	0,09	0,01	8,71	132,5%	20,66	11,94	211,5	22,6
58,00	0,04	0,01	10,35	95,7%	20,60	10,25	212,0	22,9
59,00	0,00	0,01	8,61	135,1%	20,66	12,04	212,1	22,8

Manufacturer: RAVELLI  
Model: RV 100 CLASSIC

Run: 1  
Project #: PI-20129  
Test Duration: 180 min

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

	HHV	LHV
Eff	82,11%	87,80%
Comb Eff	99,50%	99,50%
HT Eff	82,52%	88,25%
Output	11 338	kJ/h
Burn Rate	0,68	kg/h
Grams CO	9	g
Input	13 809	kJ/h
MC wet	5,57	

Ultimate CO<sub>2</sub>  
CO<sub>2-ut</sub> 20,28  
F<sub>0</sub>  
1,024

Averages		0,02	4,94	3,26	20,78	15,83	99,28	25,55
INPUT DATA		Oxygen Calculation			Input Data			
Elapsed Time	Weight Remaining (kg)	% CO [e]	% CO <sub>2</sub> [d]	Excess Air EA	Total O <sub>2</sub>	Calc. % O <sub>2</sub> [g]	Flue Gas (°C)	Room Temp (°C)
0,00	2,17	0,01	8,70	132,9%	20,66	11,96	125,7	24,0
1,00	2,12	0,01	7,38	174,2%	20,70	13,31	125,7	24,1
2,00	2,12	0,02	6,76	199,1%	20,72	13,95	124,5	24,2
3,00	2,12	0,01	6,03	235,6%	20,74	14,71	122,7	24,1
4,00	2,08	0,01	5,25	285,4%	20,77	15,51	121,7	24,1
5,00	2,08	0,04	3,38	492,4%	20,83	17,43	120,0	24,1
6,00	2,08	0,01	5,17	291,6%	20,77	15,60	118,5	24,1
7,00	2,08	0,02	4,22	378,3%	20,80	16,57	117,5	24,2
8,00	2,04	0,01	6,77	198,9%	20,72	13,94	117,0	24,3
9,00	2,04	0,02	3,30	510,5%	20,83	17,52	115,7	24,3
10,00	2,04	0,01	5,59	262,4%	20,76	15,17	114,9	24,3
11,00	2,04	0,02	3,74	440,0%	20,82	17,07	113,5	24,3
12,00	2,00	0,02	5,56	263,8%	20,76	15,19	112,9	24,4
13,00	1,99	0,02	4,23	377,2%	20,80	16,56	111,8	24,4
14,00	1,99	0,01	4,90	313,1%	20,78	15,88	120,6	24,5
15,00	2,00	0,05	3,55	464,3%	20,82	17,25	117,1	24,6
16,00	1,95	0,01	5,43	272,7%	20,76	15,33	114,6	24,4
17,00	1,95	0,01	6,16	228,5%	20,74	14,57	112,4	24,3
18,00	1,91	0,01	6,12	230,4%	20,74	14,61	111,4	24,3
19,00	1,95	0,03	3,33	502,8%	20,83	17,48	110,2	24,3
20,00	1,90	0,02	5,45	270,2%	20,76	15,30	109,3	24,3
21,00	1,91	0,01	4,89	314,3%	20,78	15,89	108,2	24,4
22,00	1,85	0,01	4,58	341,4%	20,79	16,20	107,4	24,4
23,00	1,85	0,02	4,60	339,2%	20,79	16,18	106,9	24,4
24,00	1,81	0,01	6,40	216,6%	20,73	14,33	106,4	24,5
25,00	1,84	0,01	5,63	259,4%	20,76	15,12	106,3	24,7
26,00	1,81	0,01	7,10	185,3%	20,71	13,60	106,4	24,7
27,00	1,81	0,06	2,81	606,4%	20,85	18,01	105,2	24,7
28,00	1,77	0,02	4,95	308,2%	20,78	15,82	104,4	24,7
29,00	1,76	0,01	4,22	378,6%	20,80	16,57	103,9	24,9
30,00	1,77	0,01	5,80	249,0%	20,75	14,95	103,6	24,7
31,00	1,76	0,02	3,71	444,4%	20,82	17,10	103,2	24,8
32,00	1,76	0,01	4,21	380,0%	20,80	16,58	103,2	24,8
33,00	1,72	0,01	4,69	331,9%	20,79	16,10	102,3	24,8
34,00	1,72	0,01	5,33	280,2%	20,77	15,44	102,2	24,7
35,00	1,68	0,01	5,80	249,4%	20,75	14,95	101,7	24,7
36,00	1,68	0,02	4,00	404,1%	20,81	16,80	101,3	24,6
37,00	1,67	0,03	3,58	462,9%	20,82	17,23	100,7	24,7
38,00	1,68	0,01	6,37	217,7%	20,73	14,36	100,4	24,9
39,00	1,68	0,01	4,31	369,9%	20,80	16,49	100,1	25,0
40,00	1,68	0,02	5,01	303,6%	20,78	15,76	100,4	24,9
41,00	1,63	0,01	6,90	193,6%	20,72	13,81	100,2	25,1
42,00	1,63	0,01	4,62	337,5%	20,79	16,16	100,0	25,2
43,00	1,59	0,01	5,26	284,8%	20,77	15,50	99,8	25,1
44,00	1,59	0,02	3,54	469,5%	20,82	17,27	99,1	25,1
45,00	1,59	0,01	4,26	375,1%	20,80	16,54	98,9	25,0
46,00	1,59	0,01	3,83	428,0%	20,82	16,98	98,1	25,0
47,00	1,57	0,01	5,65	258,5%	20,76	15,10	97,6	25,0
48,00	1,54	0,01	4,62	337,6%	20,79	16,16	97,4	25,1
49,00	1,54	0,01	6,00	237,8%	20,74	14,74	97,7	25,1
50,00	1,54	0,01	5,52	266,5%	20,76	15,23	97,4	25,1
51,00	1,55	0,02	4,25	374,8%	20,80	16,54	97,0	24,9
52,00	1,49	0,02	3,77	434,5%	20,82	17,03	96,5	25,1
53,00	1,49	0,01	5,31	281,1%	20,77	15,45	96,8	25,1
54,00	1,49	0,02	3,91	416,4%	20,81	16,90	96,2	25,2
55,00	1,49	0,01	4,95	309,0%	20,78	15,83	95,7	25,2
56,00	1,44	0,01	4,51	348,6%	20,79	16,28	95,3	25,2
57,00	1,44	0,01	6,06	234,1%	20,74	14,68	95,7	25,1
58,00	1,40	0,01	6,10	232,1%	20,74	14,64	96,1	25,2
59,00	1,40	0,01	6,16	228,4%	20,74	14,57	96,1	25,2
60,00	1,40	0,01	5,20	289,7%	20,77	15,57	95,7	25,3
61,00	1,40	0,01	5,75	251,7%	20,75	14,99	95,6	25,3
62,00	1,36	0,02	4,97	306,7%	20,78	15,80	95,2	25,2
63,00	1,40	0,01	4,40	359,7%	20,80	16,39	94,9	25,2
64,00	1,36	0,01	4,97	307,8%	20,78	15,81	94,9	25,4
65,00	1,36	0,01	6,33	219,6%	20,73	14,40	94,8	25,3
66,00	1,32	0,02	4,34	365,3%	20,80	16,45	94,7	25,4
67,00	1,31	0,01	5,82	247,7%	20,75	14,92	94,6	25,3
68,00	1,32	0,01	4,48	351,7%	20,79	16,31	94,2	25,3
69,00	1,31	0,01	5,70	254,7%	20,75	15,04	94,5	25,4
70,00	1,27	0,02	3,05	560,6%	20,84	17,78	93,8	25,3
71,00	1,27	0,01	5,84	246,4%	20,75	14,90	94,1	25,3
72,00	1,27	0,01	6,23	224,8%	20,74	14,50	93,8	25,4
73,00	1,27	0,01	4,76	324,6%	20,78	16,01	93,6	25,4
74,00	1,23	0,01	5,39	275,7%	20,76	15,37	94,5	25,4
75,00	1,23	0,03	3,85	421,9%	20,81	16,94	103,1	25,3
76,00	1,18	0,03	3,64	452,9%	20,82	17,17	99,8	25,4
77,00	1,23	0,03	6,13	229,5%	20,74	14,60	98,2	25,4
78,00	1,18	0,03	4,31	367,7%	20,80	16,48	96,8	25,4
79,00	1,18	0,02	5,13	293,9%	20,77	15,63	96,3	25,5
80,00	1,18	0,02	3,85	424,5%	20,81	16,96	95,5	25,6
81,00	1,18	0,01	4,22	379,3%	20,80	16,58	95,2	25,6
82,00	1,13	0,01	5,39	275,3%	20,76	15,37	95,0	25,7
83,00	1,13	0,01	5,43	273,0%	20,76	15,33	95,0	25,6
84,00	1,13	0,02	5,62	259,5%	20,76	15,12	94,9	25,7
85,00	1,09	0,01	5,07	299,5%	20,77	15,70	94,7	25,8
86,00	1,11	0,02	4,09	394,1%	20,81	16,71	94,2	25,9
87,00	1,08	0,02	3,30	510,8%	20,83	17,52	93,9	25,8

88,00	1,09	0,01	5,47	269,6%	20,76	15,28	94,1	25,8
89,00	1,04	0,01	5,30	281,8%	20,77	15,46	94,4	25,7
90,00	1,04	0,01	4,77	323,9%	20,78	16,01	94,0	25,6
91,00	1,04	0,01	4,96	308,2%	20,78	15,82	93,6	25,7
92,00	1,04	0,01	6,24	224,3%	20,74	14,49	93,3	25,7
93,00	1,04	0,02	3,83	426,3%	20,81	16,97	92,7	25,8
94,00	0,99	0,01	5,26	284,8%	20,77	15,50	92,8	25,8
95,00	1,00	0,01	6,55	209,0%	20,73	14,17	93,3	25,8
96,00	1,00	0,02	3,57	465,2%	20,82	17,24	92,7	25,9
97,00	1,00	0,02	4,21	379,7%	20,80	16,58	92,6	25,9
98,00	0,95	0,01	5,54	265,3%	20,76	15,21	92,6	26,1
99,00	0,95	0,02	4,03	401,3%	20,81	16,77	92,4	26,0
100,00	0,95	0,02	4,82	318,8%	20,78	15,95	92,1	25,8
101,00	0,95	0,02	3,99	405,1%	20,81	16,81	91,8	25,8
102,00	0,91	0,02	5,12	295,1%	20,77	15,65	91,5	25,9
103,00	0,91	0,03	3,86	422,3%	20,81	16,94	91,4	25,7
104,00	0,91	0,01	6,42	215,3%	20,73	14,30	92,1	25,8
105,00	0,91	0,03	3,65	452,4%	20,82	17,16	91,4	25,7
106,00	0,86	0,01	5,38	276,2%	20,76	15,38	91,5	25,8
107,00	0,86	0,01	5,51	267,5%	20,76	15,25	92,7	25,8
108,00	0,86	0,01	5,07	299,1%	20,77	15,70	92,5	25,9
109,00	0,82	0,01	4,59	340,2%	20,79	16,19	92,2	25,8
110,00	0,82	0,01	4,57	342,9%	20,79	16,22	91,9	25,7
111,00	0,82	0,02	3,50	475,9%	20,83	17,31	91,4	25,8
112,00	0,82	0,01	6,38	217,3%	20,73	14,35	92,6	25,8
113,00	0,82	0,01	4,20	380,8%	20,80	16,59	92,2	25,7
114,00	0,77	0,01	6,64	205,0%	20,72	14,08	93,6	25,8
115,00	0,77	0,01	5,02	303,2%	20,78	15,75	94,5	25,8
116,00	0,72	0,01	6,41	215,8%	20,73	14,32	94,2	25,8
117,00	0,72	0,01	4,67	332,6%	20,79	16,11	93,1	25,9
118,00	0,72	0,01	4,83	319,2%	20,78	15,95	93,8	26,0
119,00	0,72	0,01	5,66	257,9%	20,76	15,09	95,0	26,0
120,00	0,68	0,02	4,94	308,9%	20,78	15,83	94,8	25,9
121,00	0,68	0,02	5,46	270,3%	20,76	15,29	95,7	26,0
122,00	0,68	0,02	4,00	404,2%	20,81	16,80	94,7	26,0
123,00	0,63	0,02	3,26	518,2%	20,83	17,56	93,8	26,1
124,00	0,68	0,02	6,08	232,7%	20,74	14,65	95,7	26,0
125,00	0,64	0,02	4,71	328,8%	20,79	16,07	94,9	26,2
126,00	0,64	0,01	5,23	286,7%	20,77	15,53	95,5	26,3
127,00	0,59	0,01	5,65	258,3%	20,76	15,10	96,1	26,1
128,00	0,63	0,01	5,08	297,9%	20,77	15,68	96,5	26,0
129,00	0,59	0,02	3,46	482,6%	20,83	17,36	94,8	26,1
130,00	0,59	0,01	4,75	325,7%	20,79	16,03	96,0	26,1
131,00	0,59	0,02	4,77	323,4%	20,78	16,00	95,4	25,8
132,00	0,55	0,02	5,41	273,2%	20,76	15,34	95,5	25,9
133,00	0,55	0,02	5,42	272,7%	20,76	15,33	95,8	25,8
134,00	0,55	0,01	4,95	308,4%	20,78	15,82	95,6	25,9
135,00	0,50	0,01	4,78	323,0%	20,78	16,00	105,6	26,1
136,00	0,50	0,03	3,90	416,5%	20,81	16,90	101,0	26,2
137,00	0,50	0,02	4,81	320,0%	20,78	15,96	98,4	26,2
138,00	0,50	0,01	4,71	329,6%	20,79	16,07	98,6	26,1
139,00	0,45	0,01	5,56	264,1%	20,76	15,19	98,2	26,1
140,00	0,45	0,02	4,85	316,4%	20,78	15,92	98,4	26,2
141,00	0,45	0,02	4,29	371,1%	20,80	16,50	97,6	26,2
142,00	0,40	0,02	4,50	348,8%	20,79	16,28	96,6	26,3
143,00	0,41	0,01	4,24	376,3%	20,80	16,55	95,9	26,5
144,00	0,40	0,01	5,23	286,9%	20,77	15,53	96,6	26,5
145,00	0,40	0,02	4,12	390,2%	20,81	16,68	95,4	26,4
146,00	0,41	0,01	5,56	264,1%	20,76	15,20	96,3	26,4
147,00	0,36	0,01	4,98	306,1%	20,78	15,79	95,5	26,1
148,00	0,36	0,02	4,98	305,8%	20,78	15,79	96,2	26,5
149,00	0,34	0,01	5,32	280,5%	20,77	15,44	97,0	26,5
150,00	0,36	0,02	4,27	372,5%	20,80	16,52	97,7	26,4
151,00	0,32	0,02	4,49	349,9%	20,79	16,30	96,4	26,4
152,00	0,32	0,01	5,64	258,6%	20,76	15,11	99,2	26,5
153,00	0,27	0,01	5,17	291,5%	20,77	15,60	99,2	26,5
154,00	0,27	0,01	4,61	338,8%	20,79	16,17	99,3	26,3
155,00	0,27	0,01	4,95	308,1%	20,78	15,82	98,3	26,5
156,00	0,27	0,02	3,59	462,2%	20,82	17,23	98,3	26,4
157,00	0,23	0,02	5,10	296,4%	20,77	15,67	98,3	26,2
158,00	0,23	0,02	5,80	248,3%	20,75	14,94	99,2	26,2
159,00	0,23	0,02	6,20	226,3%	20,74	14,53	99,7	26,3
160,00	0,23	0,02	4,06	397,4%	20,81	16,74	99,2	26,2
161,00	0,18	0,02	5,24	285,5%	20,77	15,52	99,3	26,4
162,00	0,18	0,02	5,23	286,4%	20,77	15,53	100,2	26,4
163,00	0,18	0,02	4,56	342,7%	20,79	16,22	99,5	26,6
164,00	0,19	0,02	3,90	417,7%	20,81	16,90	98,7	26,5
165,00	0,14	0,01	5,41	273,8%	20,76	15,34	98,6	26,4
166,00	0,14	0,02	3,29	512,9%	20,83	17,53	97,6	26,6
167,00	0,14	0,01	5,01	304,0%	20,78	15,76	97,5	26,4
168,00	0,09	0,01	4,32	368,2%	20,80	16,47	98,8	26,4
169,00	0,14	0,01	5,36	277,1%	20,77	15,39	98,6	26,4
170,00	0,13	0,04	2,78	618,0%	20,85	18,04	96,6	26,4
171,00	0,09	0,01	6,19	227,1%	20,74	14,54	97,6	26,5
172,00	0,08	0,02	4,39	359,7%	20,80	16,40	97,8	26,6
173,00	0,04	0,01	4,38	361,8%	20,80	16,41	97,5	26,6
174,00	0,09	0,02	3,86	422,7%	20,81	16,94	97,3	26,6
175,00	0,04	0,01	4,95	308,4%	20,78	15,82	98,6	26,8
176,00	0,04	0,02	3,14	541,9%	20,84	17,69	95,9	26,5
177,00	0,04	0,02	4,74	325,6%	20,78	16,03	97,4	26,3
178,00	0,03	0,02	7,39	173,7%	20,70	13,30	99,3	26,3
179,00	0,03	0,02	5,33	279,0%	20,77	15,42	98,2	26,6
180,00	0,00	0,01	4,47	352,5%	20,79	16,32	97,5	26,5

Manufacturer: RAVELLI  
 Model: RV 100 CLASSIC

Run: 1  
 Project #: PI-20129  
 Test Duration: 119 min

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 to 13.7.5.

	min	
	HHV	LHV
Eff	80,83%	86,44%
Comb Eff	99,50%	99,50%
HT Eff	81,24%	86,87%
Output	18 322	kJ/h
Burn Rate	1,12	kg/h
Grams CO	7	g
Input	22 667	kJ/h
MC wet	5,57	

Ultimate CO<sub>2</sub>  
 CO<sub>2-ult</sub> 20,28  
 F<sub>0</sub>  
 1,027

Averages		0,02	6,80	2,06	20,72	13,91	137,95	23,59
INPUT DATA				Oxygen Calculation			Input Data	
Elapsed Time	Weight Remaining (kg)	% CO [e]	% CO <sub>2</sub> [d]	Excess Air EA	Total O <sub>2</sub>	Calc. % O <sub>2</sub> [g]	Flue Gas (°C)	Room Temp (°C)
0,00	2,36	0,01	8,94	126,7%	20,65	11,71	211,9	22,9
1,00	2,36	0,01	9,37	116,2%	20,63	11,26	212,2	23,0
2,00	2,31	0,01	8,56	136,6%	20,66	12,09	205,1	22,9
3,00	2,27	0,01	9,32	117,3%	20,64	11,31	195,4	22,7
4,00	2,27	0,06	6,46	211,1%	20,73	14,24	188,2	22,7
5,00	2,27	0,03	7,19	181,2%	20,71	13,51	182,5	22,7
6,00	2,22	0,02	7,51	169,5%	20,70	13,18	177,9	22,7
7,00	2,18	0,02	5,88	243,7%	20,75	14,86	174,0	22,7
8,00	2,18	0,01	6,77	199,2%	20,72	13,95	170,8	22,7
9,00	2,18	0,02	7,37	174,4%	20,70	13,32	167,5	22,7
10,00	2,13	0,03	7,16	182,0%	20,71	13,53	165,2	22,8
11,00	2,13	0,03	6,04	234,3%	20,74	14,69	162,9	23,1
12,00	2,08	0,02	7,20	180,9%	20,71	13,50	160,3	23,1
13,00	2,08	0,04	5,46	268,6%	20,76	15,28	164,1	23,3
14,00	2,04	0,03	6,46	212,5%	20,73	14,25	160,4	23,2
15,00	2,04	0,02	7,87	157,1%	20,68	12,80	157,6	23,2
16,00	2,00	0,01	6,69	202,7%	20,72	14,03	154,5	23,3
17,00	1,99	0,02	6,83	195,9%	20,72	13,87	152,5	23,1
18,00	2,00	0,02	6,65	203,8%	20,72	14,06	151,4	23,1
19,00	1,95	0,03	5,61	260,0%	20,76	15,14	150,3	23,1
20,00	1,95	0,01	8,12	149,4%	20,68	12,55	148,9	23,2
21,00	1,91	0,04	6,72	200,2%	20,72	13,98	147,5	23,2
22,00	1,91	0,02	6,19	226,2%	20,74	14,53	146,5	23,2
23,00	1,88	0,04	4,90	310,5%	20,78	15,86	145,4	23,3
24,00	1,87	0,02	5,79	249,3%	20,75	14,96	144,0	23,4
25,00	1,87	0,01	8,34	142,6%	20,67	12,32	143,1	23,5
26,00	1,81	0,03	5,87	244,0%	20,75	14,87	142,5	23,4
27,00	1,81	0,02	5,59	261,7%	20,76	15,16	141,4	23,6
28,00	1,77	0,02	6,88	193,7%	20,72	13,82	140,1	23,5
29,00	1,77	0,01	7,52	169,4%	20,70	13,17	138,8	23,3
30,00	1,72	0,01	8,12	149,5%	20,68	12,55	138,9	23,4
31,00	1,72	0,03	6,43	214,2%	20,73	14,29	138,3	23,6
32,00	1,72	0,03	4,21	378,1%	20,80	16,57	137,0	23,6
33,00	1,68	0,01	8,96	126,0%	20,65	11,68	137,0	23,6
34,00	1,68	0,01	7,66	164,2%	20,69	13,02	136,0	23,7
35,00	1,64	0,02	6,42	215,0%	20,73	14,30	135,8	23,8
36,00	1,64	0,02	5,93	241,0%	20,75	14,81	135,0	23,8
37,00	1,59	0,01	7,64	165,1%	20,69	13,05	134,5	23,7
38,00	1,59	0,01	7,49	170,2%	20,70	13,20	134,7	23,5
39,00	1,54	0,03	5,98	237,3%	20,74	14,75	134,3	23,7
40,00	1,54	0,04	5,55	263,0%	20,76	15,19	134,1	23,5
41,00	1,55	0,01	8,02	152,5%	20,68	12,65	133,2	23,4
42,00	1,50	0,02	7,56	167,7%	20,69	13,13	132,9	23,5
43,00	1,50	0,06	4,63	332,8%	20,79	16,13	133,2	23,4
44,00	1,45	0,02	7,82	158,5%	20,68	12,85	132,9	23,6
45,00	1,45	0,02	8,13	148,6%	20,67	12,53	132,4	23,7
46,00	1,41	0,02	6,34	218,9%	20,73	14,38	131,7	23,7
47,00	1,40	0,01	6,52	210,3%	20,73	14,20	132,4	23,8
48,00	1,36	0,01	6,75	200,0%	20,72	13,97	132,0	23,7
49,00	1,36	0,01	6,56	208,6%	20,73	14,16	131,6	23,5
50,00	1,32	0,02	7,51	169,6%	20,70	13,18	131,4	23,5
51,00	1,32	0,02	6,41	215,3%	20,73	14,31	131,9	23,0
52,00	1,27	0,02	6,01	236,8%	20,74	14,73	131,5	22,9
53,00	1,27	0,01	7,17	182,6%	20,71	13,53	131,6	23,0
54,00	1,27	0,01	6,02	236,5%	20,74	14,72	130,9	23,1
55,00	1,27	0,02	6,81	196,7%	20,72	13,89	130,4	23,4
56,00	1,23	0,02	6,02	235,9%	20,74	14,71	130,2	23,3
57,00	1,20	0,02	5,94	240,3%	20,75	14,80	129,8	23,3
58,00	1,18	0,02	6,21	225,4%	20,74	14,51	130,0	23,4
59,00	1,18	0,01	8,13	149,1%	20,68	12,54	130,0	23,5
60,00	1,14	0,01	6,36	218,4%	20,73	14,37	129,5	23,4
61,00	1,14	0,02	5,59	261,4%	20,76	15,16	129,2	23,5

62,00	1,14	0,01	6,85	195,6%	20,72	13,86	129,2	23,4
63,00	1,14	0,01	6,52	210,3%	20,73	14,20	129,1	23,6
64,00	1,04	0,01	6,97	190,6%	20,71	13,74	129,4	23,4
65,00	1,04	0,01	6,33	219,9%	20,73	14,40	129,1	23,5
66,00	1,04	0,01	7,21	180,9%	20,71	13,49	128,7	23,6
67,00	1,00	0,04	5,20	287,4%	20,77	15,55	128,3	23,7
68,00	1,00	0,01	7,82	159,0%	20,69	12,86	128,3	23,8
69,00	0,95	0,02	7,34	175,4%	20,70	13,35	128,1	23,8
70,00	0,96	0,02	7,57	167,1%	20,69	13,11	128,1	23,9
71,00	0,91	0,01	9,00	125,1%	20,65	11,64	128,1	23,8
72,00	0,91	0,01	7,06	186,6%	20,71	13,64	128,5	23,6
73,00	0,91	0,02	7,02	188,4%	20,71	13,69	129,8	23,6
74,00	0,86	0,06	3,94	407,2%	20,81	16,84	136,2	23,5
75,00	0,87	0,01	6,74	200,5%	20,72	13,98	133,1	23,5
76,00	0,82	0,02	4,72	327,0%	20,79	16,05	131,1	23,7
77,00	0,82	0,03	4,52	345,9%	20,79	16,26	129,3	23,8
78,00	0,78	0,01	7,76	161,0%	20,69	12,92	129,3	24,0
79,00	0,78	0,02	6,79	198,0%	20,72	13,92	128,5	23,8
80,00	0,76	0,01	7,59	166,7%	20,69	13,09	128,2	23,9
81,00	0,72	0,02	6,36	218,0%	20,73	14,37	128,5	23,9
82,00	0,72	0,01	6,64	205,1%	20,72	14,08	128,1	23,9
83,00	0,68	0,02	6,91	192,5%	20,71	13,79	128,1	23,9
84,00	0,68	0,01	7,47	170,8%	20,70	13,22	128,1	23,9
85,00	0,68	0,02	5,95	239,8%	20,75	14,79	127,7	23,8
86,00	0,64	0,01	6,84	196,3%	20,72	13,88	127,5	23,9
87,00	0,64	0,01	7,21	180,9%	20,71	13,49	127,4	23,8
88,00	0,59	0,02	6,07	233,4%	20,74	14,67	127,3	23,9
89,00	0,59	0,01	5,47	269,7%	20,76	15,28	127,2	24,0
90,00	0,59	0,01	6,98	190,0%	20,71	13,72	127,1	24,0
91,00	0,55	0,01	6,59	207,4%	20,73	14,13	127,1	24,1
92,00	0,50	0,01	8,45	139,9%	20,66	12,21	127,3	24,1
93,00	0,50	0,01	5,96	239,6%	20,75	14,78	126,5	24,0
94,00	0,50	0,02	6,51	210,5%	20,73	14,21	126,1	24,1
95,00	0,46	0,02	9,29	117,9%	20,64	11,34	126,1	24,1
96,00	0,46	0,02	6,84	195,9%	20,72	13,87	126,3	24,3
97,00	0,42	0,02	8,15	148,3%	20,67	12,51	126,5	24,1
98,00	0,42	0,01	7,76	161,1%	20,69	12,93	126,6	24,0
99,00	0,36	0,01	8,38	141,6%	20,67	12,28	127,0	23,9
100,00	0,36	0,02	5,64	258,1%	20,76	15,10	126,7	24,1
101,00	0,32	0,02	8,45	139,6%	20,66	12,21	126,8	24,1
102,00	0,32	0,01	6,49	211,8%	20,73	14,23	126,7	24,1
103,00	0,32	0,01	7,03	188,0%	20,71	13,67	126,6	24,2
104,00	0,28	0,02	6,04	234,7%	20,74	14,69	126,8	24,2
105,00	0,28	0,02	5,28	282,4%	20,77	15,47	126,2	24,2
106,00	0,23	0,02	6,78	198,4%	20,72	13,93	126,3	24,2
107,00	0,23	0,01	5,04	301,4%	20,78	15,73	125,8	24,1
108,00	0,18	0,01	7,39	174,1%	20,70	13,31	125,6	24,0
109,00	0,19	0,02	5,77	250,0%	20,75	14,97	125,5	24,3
110,00	0,19	0,01	6,64	204,9%	20,72	14,08	125,5	24,0
111,00	0,14	0,01	7,60	166,5%	20,69	13,09	125,9	24,1
112,00	0,14	0,02	6,05	234,0%	20,74	14,68	126,0	24,1
113,00	0,14	0,03	5,09	296,4%	20,77	15,67	125,7	24,0
114,00	0,10	0,02	5,96	239,6%	20,75	14,78	125,5	23,9
115,00	0,10	0,01	7,55	168,1%	20,69	13,14	125,9	23,9
116,00	0,04	0,02	6,87	194,5%	20,72	13,84	126,3	23,9
117,00	0,04	0,01	5,57	263,6%	20,76	15,19	125,6	23,9
118,00	0,05	0,02	7,39	173,5%	20,70	13,29	125,2	23,8
119,00	0,00	0,02	8,70	132,8%	20,66	11,95	125,9	23,9

Date: 2016-05-26 Manufacturer: Avell Model: RV 100 classic  
Project #: p-20129 Run: 1 Tech: MM Reviewer: NO

Preheat at Power 5 for 1 Hour  
Start test at Power 5 for 60 min  
Set power 2 for medium for 120 min  
Set power 1 for minimum burn rate  
for 180 minutes

TEST LOAD CONFIGURATION

Date: \_\_\_\_\_ Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_  
Project #: \_\_\_\_\_ Run: \_\_\_\_\_ Tech: \_\_\_\_\_ Reviewer: \_\_\_\_\_

Side view	Front view	Top view
	NA DP	[Faint handwritten notes]



Date: \_\_\_\_\_ Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_  
 Project #: \_\_\_\_\_ Run: \_\_\_\_\_ Tech: \_\_\_\_\_ Reviewer: JP

	ADDITION		SUBSTRACTION	
	ft3	Volume	ft3	Volume
V measure				
V ashlip			NA	
%				
V usable				
Usable Firebox: _____				
Test load weight: _____		Minimum: _____		Maximum: _____
Déviation: _____				

**PRE / POST CHECKS**

Date: 2016-05-26 Manufacturer: NAVELL Model: LV100 classic  
 Project #: PI 20129 Run: 1 Tech: MM Reviewer: DP

Moisture Meter Calibration Check:

Equipment #	Time	12%	22%
N.A	-	-	-

Pre-Test

Post-Test

**Facility Conditions:**

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

18 (max50 Fpm)	21 (max50 Fpm)
----------------	----------------

Smoke Capture Check.....

ok	ok
----	----

Picture.....

4 sides ok	ok
------------	----

**Wood Heater Conditions:**

Date Wood Heater Stack Cleaned.....

2016-05-25
------------

Date Dilution Tunnel Cleaned.....

2016-05-25
------------

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
21	38	50
04	77	79
74	78	80
11	11	12
ok	ok	ok

Filter Front.....

Filter Back.....

Filter Thermocouple.....

Filter (<90°F).....

### SAMPLING EQUIPMENT CHECK OUT

Date: 2016-05-26 Manufacturer: R. Duvell Model: NV 100 class  
 Project #: 01 20129 Run: 1 Tech: MM Reviewer: DP

#### 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)	393038.58	394948.88	393038.88	394948.94	393270.95	395122.30
Initial 1minute DGM (Liter)	393038.56	394948.88	393038.88	394948.94	393270.92	395122.30
Change © (Liter)	0.02	0	0	0	0.03	0
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.)	0.6	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: 2016-05-26 Manufacturer: RAV-11; Model: NV100 classic  
 Project #: pt 20129 Run: 1 Tech: MM Reviewer: DP

Scale Type	Audit		Measured Weight
	Equipment #	Weight	
Platform	EM-090	4.4 lbs, Class F	4.4 lbs
Wood	EM-090	4.4 lbs, Class F	4.4 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: 2016-05-26 Manufacturer: RAVelli Model: RV100 class 10  
 Project #: PI 20129 Run: 1 Tech: MM Reviewer: DP

FOR TUNNELS < 12 in

Barometric pressure ( $P_{bar}$ ) 101.9 (KPa.) Static pressure ( $P_q$ ) 0.24 (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	0.060	82.74, 04 m.r.
B - Centroid	3.00	3.50	4	0.059	73.91
A-1	0.40	0.50	0.50	0.051	74.18
A-2	1.50	1.75	2	0.055	74.21
A-3	4.50	5.25	6	0.058	73.03
A-4	5.60	6.5	7.5	0.050	73.00
B-1	0.40	0.50	0.50	0.052	72.89
B-2	1.50	1.75	2	0.051	73.51
B-3	4.50	5.25	6	0.058	72.91
B-4	5.60	6.5	7.5	0.053	72.88
				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: 2016-05-26 Manufacturer: RAVelli Model: NV100 classic  
 Project #: PI 20129 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	2,954	2,971	1,00	1,00
Tolerance CO		+/- 0.02		+/- 0.15		+/- 0.05
CO <sub>2</sub>	0	0	17,90	17,87	9,76	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

## Post Test (Record Only)

	Zero	Span	Cal.	Zero Drift	Limit	Span Drift	Limit	Cal. Drift	Limit mm	OK?	Not OK*
CO	0,005	2,960	1,01	0,005	0.02	0,006	0.15	0,01	0.05	✓	
CO <sub>2</sub>	0	17,88	9,73	0	0.02	0,02	0.5	0,04	0.5	✓	
O <sub>2</sub>	na	na	na		na		na	mm	na	✓	

Date: 2011-05-26 Manufacturer: NAV=11: Model: RV100 C/la 56.0  
 Project #: pl 10/29 Run: 1 Tech: MM Reviewer: DP

**RAW DRY GAS METER READINGS**

	System 1	System 2	Blanck
Final (Liter)	394948,26	345121,66	853,63
Initial (Liter)	393039,56	343272,35	818,37

**AMBIENT CONDITIONS**

	Before	After
Barometer (kPa):	101,9	101,8
Dry Bulb (F):	70,7	80,24
Humidity (%):	42,7	22,3

**Flow Meter**

	Before	After
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: \_\_\_\_\_ Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_

Project #: \_\_\_\_\_ Run: \_\_\_\_\_ Tech: \_\_\_\_\_ Reviewer: DP

**FUEL DESCRIPTION:**

Type of wood: \_\_\_\_\_

**PRE-TEST LOAD**

Piece Size			Weight	Meter Moisture Content (% dry)*			
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.				
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.				
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.				

*NA*

TEST LOAD WEIGHT: \_\_\_\_\_ lbs



# FUEL DATA

Date: \_\_\_\_\_ Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_

Project #: \_\_\_\_\_ Run: \_\_\_\_\_ Tech: \_\_\_\_\_ Reviewer: SP

## FUEL DESCRIPTION:

Type of wood :

## TEST LOAD

Piece Size			Weight	Meter Moisture Content (% dry)*			
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.				
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.				
x	x	in.	lbs.				
x	x	in.	lbs.				
x	x	in.	lbs.				
x	x	in.	lbs.				
x	x	in.	lbs.				
x	x	in.	lbs.				

*NA*

TEST LOAD WEIGHT: \_\_\_\_\_ lbs Min 20%: \_\_\_\_\_ Max 25%: \_\_\_\_\_

Date: 2016-05-25

Manufacturer: A-Avelli

Model: RV 100 Classic

Project #: PI 20127 Run: 1

Tech: MR

Reviewer: DP

Pre-test Weight Record		SYSTEM 1 - 1 <sup>st</sup> hour						SYSTEM 1			
Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank	
		21	04	74	6	38	77	78	10	90	
2016-05-25	17:00	108, 7444	0, 1259	0, 1280	11, 1001	110, 4323	0, 1270	0, 1260	10, 1352	0, 1258	
2016-05-26	7:15	108, 7445	0, 1258	0, 1279	11, 1002	110, 4324	0, 1269	0, 1259	10, 1351	0, 1257	

Post-test Weight Record		SYSTEM 1 - 1 <sup>st</sup> hour						SYSTEM 1			
Date	Time	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	Blank	
		21	04	74	6	38	77	78	10	90	
2016-05-26	16:30	108, 7446	0, 1260	0, 1273	11, 1038	110, 4325	0, 1302	0, 1256	10, 1377	0, 1259	
2016-05-31	7:00	108, 7446	0, 1260	0, 1273	11, 1033	110, 4325	0, 1302	0, 1256	10, 1372	0, 1259	
2016-06-01	8:00	108, 7446	0, 1260	0, 1273	11, 1013	110, 4325	0, 1302	0, 1256	10, 1362	0, 1259	
2016-06-02	8:00	108, 7446	0, 1260	0, 1273	11, 1012	110, 4325	0, 1302	0, 1256	10, 1361	0, 1259	



# DILUTION TUNNEL PARTICULATE SAMPLER DATA

Date: 2016-05-25 1  
Project #: PI 20129 Run: 1

Manufacturer: RAvell  
Tech: MS Reviewer: DD

Model: PM 100 classic

SYSTEM 2					
Pre-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time				
2016-05-25	19:00	107640	01285	01281	10, 4135
2016-05-26	7:15	107641	01285	01280	10, 4134

SYSTEM 2					
Post-test Weight Record	Probe & Housing Number	Front Filter Number	Back Filter Number	gaskets	
Date	Time				
2016-05-26	16:30	1076442	01323	01278	10, 4160
2016-05-31	7:00	1076442	01323	01278	10, 4156
2016-06-01	8:00	1076442	01323	01278	10, 4144
2016-06-02	8:00	1076442	01323	01278	10, 4144

## APPENDIX 2: Proportionality results

					Average
					0,245
Average	Average	#1	#2		
100,02	100,62	System 1	System 2		SQRT
Proportional Rates		Vol.Std.	Vol.Std.		Delta-P
PR1	PR2			Time	
%	%	(ft3)	(ft3)	min	(in H2O)2
		0,176	0,172	0	0,2433036
102,87	103,63	0,176	0,171	1	0,2433034
103,32	104,13	0,176	0,172	2	0,2424048
103,96	104,66	0,176	0,171	3	0,2407881
103,68	104,32	0,176	0,171	4	0,2414197
104,09	104,96	0,176	0,171	5	0,2399438
103,01	103,92	0,176	0,171	6	0,2430238
104,68	105,16	0,176	0,171	7	0,2388863
103,75	104,63	0,176	0,171	8	0,2407877
104,93	105,61	0,176	0,172	9	0,2388842
103,40	103,97	0,177	0,172	10	0,2424682
104,28	104,66	0,176	0,171	11	0,2399435
103,54	104,06	0,176	0,171	12	0,24142
104,75	105,50	0,176	0,171	13	0,2382473
102,27	103,00	0,176	0,171	14	0,2443442
104,26	104,91	0,176	0,171	15	0,2399438
103,95	104,75	0,176	0,171	16	0,2407884
103,88	104,91	0,176	0,172	17	0,2407882
102,96	103,76	0,176	0,172	18	0,2432117
105,09	105,95	0,176	0,172	19	0,237821
103,27	103,93	0,176	0,171	20	0,24184
103,29	104,03	0,176	0,171	21	0,24184
102,97	103,63	0,176	0,171	22	0,2432199
104,44	105,31	0,176	0,171	23	0,2393106
104,85	105,60	0,176	0,171	24	0,2383514
103,59	104,59	0,176	0,171	25	0,2418406
103,56	104,73	0,176	0,172	26	0,2414202
103,27	104,03	0,176	0,171	27	0,2418397
104,69	105,68	0,176	0,171	28	0,2382462
103,01	103,85	0,176	0,171	29	0,2424688
103,83	104,46	0,176	0,171	30	0,2407885
103,40	104,18	0,176	0,171	31	0,2418398
103,46	104,26	0,176	0,171	32	0,2418399
103,34	104,30	0,176	0,171	33	0,2418395
105,81	106,49	0,176	0,171	34	0,2363232
103,52	104,17	0,176	0,171	35	0,2414207
102,98	103,91	0,176	0,171	36	0,2424683
104,05	104,92	0,176	0,171	37	0,2399442
102,66	103,48	0,176	0,171	38	0,2433047
104,25	105,20	0,176	0,171	39	0,2399445
103,57	104,14	0,176	0,171	40	0,2418399
104,13	104,84	0,176	0,171	41	0,2399454
104,36	105,21	0,176	0,171	42	0,2393091
104,31	105,12	0,176	0,171	43	0,2393092
103,94	104,95	0,176	0,171	44	0,2399445
103,41	104,37	0,176	0,171	45	0,2414216
104,24	105,06	0,176	0,171	46	0,239944

104,72	105,59	0,176	0,171	47	0,2388851
105,33	106,16	0,176	0,171	48	0,2373946
104,66	105,54	0,176	0,171	49	0,2388856
104,30	104,90	0,176	0,171	50	0,2393101
103,47	104,29	0,176	0,171	51	0,2414214
102,92	104,07	0,176	0,171	52	0,2428761
102,86	103,61	0,176	0,171	53	0,2428886
102,83	103,61	0,176	0,171	54	0,2428886
104,26	105,07	0,176	0,171	55	0,2399461
102,98	103,66	0,176	0,171	56	0,2424703
104,26	105,15	0,176	0,171	57	0,2388902
103,32	104,40	0,175	0,171	58	0,2414236
102,73	103,66	0,176	0,171	59	0,2428903
102,48	103,04	0,176	0,171	60	0,2439326
104,74	105,44	0,176	0,171	61	0,2388885
101,60	102,15	0,176	0,171	62	0,2449708
100,37	101,42	0,176	0,171	63	0,2468281
101,69	102,57	0,176	0,171	64	0,2433082
101,08	101,78	0,176	0,171	65	0,2443494
100,86	102,04	0,175	0,171	66	0,2443501
100,36	101,43	0,175	0,171	67	0,2457999
99,32	100,17	0,176	0,171	68	0,2484695
100,69	101,27	0,176	0,171	69	0,2453874
99,76	100,42	0,176	0,171	70	0,2468304
99,94	100,66	0,176	0,171	71	0,2468308
100,26	100,66	0,176	0,170	72	0,2453884
100,69	101,38	0,175	0,170	73	0,244974
99,56	100,48	0,175	0,171	74	0,2468308
99,36	100,27	0,175	0,171	75	0,2474481
99,69	100,58	0,175	0,171	76	0,2468324
99,99	100,77	0,175	0,171	77	0,2458028
100,34	101,02	0,175	0,171	78	0,244975
100,01	100,80	0,175	0,171	79	0,2453906
99,02	99,51	0,175	0,170	80	0,2478603
100,01	100,69	0,175	0,170	81	0,2453909
99,15	100,06	0,175	0,170	82	0,2474496
98,72	99,66	0,175	0,171	83	0,2484741
99,61	100,29	0,175	0,171	84	0,2468351
99,93	100,53	0,175	0,171	85	0,245805
99,93	100,45	0,175	0,170	86	0,2458057
98,85	99,56	0,175	0,170	87	0,2478624
98,93	99,86	0,175	0,170	88	0,2474521
99,78	100,49	0,175	0,170	89	0,245812
98,72	99,57	0,175	0,170	90	0,2484762
99,09	99,78	0,175	0,170	91	0,2474526
98,59	99,33	0,175	0,170	92	0,2488857
99,25	99,87	0,175	0,170	93	0,2470555
99,09	99,95	0,175	0,170	94	0,2468374
98,81	99,89	0,175	0,170	95	0,2474541
98,86	99,73	0,175	0,170	96	0,2474282
99,59	100,29	0,175	0,170	97	0,2458081
98,89	99,86	0,175	0,170	98	0,2474708
98,68	99,31	0,175	0,170	99	0,2478645
99,56	100,26	0,175	0,170	100	0,2458089

98,27	99,14	0,175	0,170	101	0,2484788
98,96	99,71	0,174	0,170	102	0,246839
98,70	99,61	0,174	0,170	103	0,2474546
98,42	99,09	0,175	0,170	104	0,2484785
98,75	99,82	0,175	0,170	105	0,2474551
99,62	100,06	0,175	0,170	106	0,2458089
99,64	100,44	0,175	0,170	107	0,2458089
99,68	100,29	0,175	0,170	108	0,2453957
99,76	100,44	0,175	0,170	109	0,2449816
100,54	101,14	0,175	0,170	110	0,2433188
99,54	100,55	0,175	0,170	111	0,2453966
100,39	101,39	0,175	0,170	112	0,2433186
100,05	100,85	0,175	0,170	113	0,2443588
100,27	100,97	0,175	0,170	114	0,2439435
100,57	101,32	0,175	0,170	115	0,2433177
100,14	100,38	0,175	0,170	116	0,2439433
100,17	100,82	0,175	0,169	117	0,243943
99,61	100,44	0,175	0,170	118	0,24498
99,93	100,48	0,175	0,170	119	0,2449805
99,82	100,82	0,175	0,170	120	0,24498
100,96	101,38	0,175	0,170	121	0,2424825
99,71	100,28	0,175	0,170	122	0,2458076
100,37	100,59	0,175	0,170	123	0,2439424
99,87	100,67	0,175	0,170	124	0,2443576
98,45	99,26	0,174	0,170	125	0,2474524
100,68	101,18	0,174	0,170	126	0,2429001
99,61	100,45	0,175	0,170	127	0,2453941
100,08	100,95	0,175	0,170	128	0,2439419
100,30	100,90	0,175	0,170	129	0,2440453
100,44	101,08	0,175	0,170	130	0,2433162
100,54	100,95	0,175	0,169	131	0,2428994
100,00	100,75	0,174	0,169	132	0,2439418
99,98	100,74	0,174	0,170	133	0,2439422
99,96	100,75	0,174	0,170	134	0,244357
99,65	100,37	0,175	0,170	135	0,2453936
100,45	101,17	0,175	0,170	136	0,2433163
100,17	100,79	0,175	0,170	137	0,2439416
99,88	100,35	0,175	0,170	138	0,2449779
99,83	100,62	0,175	0,170	139	0,2449628
99,90	100,57	0,175	0,170	140	0,2443527
99,17	99,96	0,174	0,170	141	0,245806
99,89	100,58	0,174	0,170	142	0,2443565
98,92	99,67	0,174	0,170	143	0,2468363
99,37	99,95	0,175	0,170	144	0,2458332
98,68	99,36	0,175	0,170	145	0,2474521
99,39	100,15	0,174	0,170	146	0,2453936
100,69	101,20	0,174	0,169	147	0,2424805
98,85	99,85	0,174	0,170	148	0,2468361
98,66	99,38	0,174	0,170	149	0,2474525
100,02	100,69	0,174	0,170	150	0,2439416
99,32	100,04	0,174	0,170	151	0,2458062
99,94	100,27	0,174	0,169	152	0,2444077
99,20	99,78	0,174	0,169	153	0,2458058
99,39	100,28	0,174	0,169	154	0,2449783

99,19	99,89	0,174	0,169	155	0,2458055
99,41	100,56	0,174	0,170	156	0,2449787
99,67	100,45	0,174	0,170	157	0,2443567
100,23	101,00	0,174	0,169	158	0,2433158
98,81	99,52	0,174	0,170	159	0,2468359
99,34	100,39	0,174	0,170	160	0,2453929
99,45	100,24	0,174	0,169	161	0,2443565
99,54	100,69	0,174	0,169	162	0,2443559
99,31	100,67	0,174	0,170	163	0,2449781
99,49	100,24	0,174	0,170	164	0,2449782
98,66	99,36	0,174	0,169	165	0,2468357
99,49	100,07	0,174	0,169	166	0,2449784
99,79	100,44	0,174	0,169	167	0,2443563
99,86	100,46	0,174	0,169	168	0,2439406
99,17	100,27	0,174	0,169	169	0,2449782
98,78	99,96	0,174	0,170	170	0,2458055
99,23	100,44	0,174	0,170	171	0,2449779
98,63	99,33	0,174	0,169	172	0,2468357
99,75	100,83	0,174	0,169	173	0,2439422
100,00	100,71	0,174	0,169	174	0,2433158
99,07	100,02	0,174	0,169	175	0,2453926
99,46	100,44	0,174	0,169	176	0,2443561
99,26	100,39	0,174	0,170	177	0,2449409
101,28	102,41	0,174	0,170	178	0,2399572
98,88	99,86	0,174	0,169	179	0,2458061
99,68	100,27	0,174	0,169	180	0,2443568
99,32	100,25	0,174	0,169	181	0,2449789
98,31	99,00	0,174	0,169	182	0,2468336
98,89	99,81	0,174	0,169	183	0,2453931
98,76	100,01	0,174	0,169	184	0,2453933
99,24	100,23	0,174	0,169	185	0,2443567
98,81	100,02	0,174	0,169	186	0,2453935
99,48	100,39	0,174	0,170	187	0,2443568
99,47	100,45	0,174	0,170	188	0,2443569
99,15	99,81	0,174	0,169	189	0,2449787
98,75	99,45	0,174	0,169	190	0,245806
98,21	99,00	0,174	0,169	191	0,2468362
98,72	99,67	0,174	0,169	192	0,245807
98,73	99,66	0,174	0,169	193	0,2453933
99,55	100,83	0,173	0,169	194	0,2439417
99,48	100,21	0,173	0,169	195	0,2439412
99,01	99,87	0,174	0,169	196	0,2449793
98,65	99,59	0,174	0,169	197	0,2458059
98,13	99,18	0,174	0,169	198	0,2468369
99,16	100,37	0,173	0,169	199	0,2440809
98,81	100,20	0,173	0,170	200	0,2449795
98,66	99,87	0,173	0,170	201	0,2453935
98,28	99,03	0,174	0,169	202	0,2468368
98,14	99,07	0,174	0,169	203	0,2468371
97,65	98,47	0,173	0,169	204	0,2474528
97,88	99,29	0,173	0,169	205	0,2468371
99,54	100,58	0,173	0,169	206	0,2433176
98,61	99,84	0,173	0,169	207	0,24498
98,86	99,82	0,173	0,169	208	0,2453945



98,20	99,00	0,174	0,169	209	0,246825
99,27	99,91	0,174	0,169	210	0,2443583
98,78	99,30	0,174	0,169	211	0,2453954
97,91	98,40	0,174	0,168	212	0,2474538
97,97	98,95	0,173	0,169	213	0,246838
98,50	99,74	0,173	0,169	214	0,2449865
98,49	99,48	0,173	0,169	215	0,2453954
98,59	99,59	0,173	0,169	216	0,2453953
98,02	98,96	0,173	0,169	217	0,2468383
98,92	99,59	0,173	0,169	218	0,2449814
98,41	99,17	0,173	0,169	219	0,2458085
99,00	100,06	0,173	0,169	220	0,2443592
98,58	99,66	0,173	0,169	221	0,2453957
98,27	99,53	0,173	0,169	222	0,2458086
97,68	98,69	0,173	0,169	223	0,2474546
98,98	100,42	0,173	0,169	224	0,2440738
98,54	99,36	0,173	0,169	225	0,2453963
98,45	99,17	0,173	0,168	226	0,2453963
99,23	100,04	0,173	0,169	227	0,243944
98,01	99,12	0,173	0,169	228	0,2468393
97,67	98,80	0,173	0,169	229	0,2474552
97,78	99,28	0,173	0,169	230	0,2468396
98,64	99,50	0,173	0,169	231	0,2449826
98,53	99,32	0,173	0,169	232	0,2453958
97,97	98,69	0,173	0,169	233	0,2468396
98,15	98,61	0,173	0,168	234	0,2466681
97,76	98,91	0,173	0,169	235	0,2468398
97,63	98,64	0,173	0,169	236	0,2474555
98,18	99,12	0,173	0,169	237	0,2458092
98,38	99,78	0,173	0,169	238	0,245397
99,84	99,75	0,174	0,169	239	0,2449826
99,42	99,23	0,175	0,169	240	0,2453978
99,53	99,62	0,174	0,168	241	0,2443599
99,59	99,90	0,174	0,168	242	0,243945
99,15	99,68	0,174	0,169	243	0,2453967
98,56	98,68	0,174	0,169	244	0,2468397
99,65	99,72	0,174	0,168	245	0,24436
99,20	99,19	0,174	0,168	246	0,2453967
99,20	99,45	0,174	0,169	247	0,245397
98,81	99,05	0,174	0,169	248	0,2458098
99,59	99,87	0,174	0,169	249	0,24436
99,07	99,25	0,174	0,169	250	0,2453972
99,42	99,73	0,174	0,168	251	0,2443601
100,19	100,18	0,174	0,169	252	0,2433195
98,48	98,45	0,175	0,169	253	0,2474565
99,32	99,36	0,174	0,168	254	0,2449828
99,67	99,89	0,174	0,168	255	0,2439451
98,31	98,84	0,174	0,168	256	0,2468398
99,89	100,14	0,174	0,169	257	0,2433198
99,67	99,75	0,174	0,168	258	0,2441805
99,24	99,50	0,174	0,169	259	0,2453967
99,34	99,59	0,174	0,169	260	0,2449825
99,10	99,13	0,174	0,169	261	0,2458093
99,07	99,21	0,174	0,168	262	0,2453963

99,55	99,98	0,174	0,168	263	0,2439444
99,45	99,69	0,174	0,168	264	0,2443601
99,82	99,69	0,174	0,168	265	0,243945
99,23	99,81	0,174	0,169	266	0,2449824
99,16	99,74	0,174	0,169	267	0,2449826
99,04	98,96	0,174	0,169	268	0,2458099
99,04	99,01	0,174	0,168	269	0,2453971
98,65	98,93	0,174	0,168	270	0,2459735
98,93	99,29	0,174	0,168	271	0,2449825
99,28	99,61	0,174	0,168	272	0,2443601
99,19	99,37	0,174	0,168	273	0,2449821
99,48	99,75	0,174	0,168	274	0,2443604
99,06	99,31	0,174	0,168	275	0,2453968
99,56	99,46	0,174	0,168	276	0,2443597
99,70	99,61	0,174	0,168	277	0,2439448
99,27	99,21	0,174	0,168	278	0,2449819
98,87	99,02	0,174	0,168	279	0,2453968
99,93	100,24	0,174	0,168	280	0,2433196
99,40	99,85	0,174	0,169	281	0,2443598
98,93	99,11	0,174	0,168	282	0,2453968
98,41	98,24	0,174	0,168	283	0,2475233
99,84	99,70	0,174	0,168	284	0,2439452
99,06	99,05	0,174	0,168	285	0,2453965
98,73	99,01	0,174	0,168	286	0,2458096
98,77	99,08	0,174	0,168	287	0,2453961
97,91	98,33	0,174	0,168	288	0,2478658
98,86	98,83	0,174	0,168	289	0,2458096
99,26	99,13	0,174	0,168	290	0,2449825
99,44	99,48	0,174	0,168	291	0,244361
98,99	98,95	0,174	0,168	292	0,2458091
99,80	99,82	0,174	0,168	293	0,2433193
99,03	99,39	0,174	0,168	294	0,2449817
99,36	99,71	0,174	0,168	295	0,24436
99,55	99,68	0,174	0,168	296	0,2443596
99,37	99,60	0,174	0,168	297	0,2443593
99,09	99,18	0,174	0,168	298	0,2449819
99,78	99,51	0,174	0,168	299	0,2439446
98,17	98,45	0,174	0,168	300	0,2474551
99,32	99,71	0,174	0,168	301	0,2443602
99,20	99,80	0,174	0,168	302	0,2443599
98,87	99,15	0,174	0,168	303	0,2453967
99,65	99,86	0,174	0,168	304	0,2439444
99,42	99,52	0,174	0,168	305	0,2443599
98,47	98,53	0,174	0,168	306	0,2468394
99,12	99,17	0,174	0,168	307	0,2449815
99,01	98,93	0,174	0,168	308	0,2453961
99,79	100,05	0,174	0,168	309	0,2433191
99,03	99,27	0,174	0,168	310	0,2449817
98,83	99,02	0,174	0,168	311	0,2453961
99,69	99,89	0,174	0,168	312	0,243319
99,18	99,17	0,174	0,168	313	0,2449815
99,74	99,46	0,174	0,168	314	0,2439437
100,40	100,59	0,174	0,168	315	0,2424826
99,57	99,83	0,174	0,168	316	0,2439438

99,29	99,97	0,174	0,168	317	0,2443595
98,81	99,26	0,173	0,168	318	0,2453962
98,88	99,07	0,173	0,168	319	0,2453962
99,51	99,58	0,174	0,168	320	0,2443598
98,95	98,67	0,174	0,168	321	0,2458089
99,23	99,25	0,174	0,168	322	0,2449816
98,87	98,73	0,174	0,168	323	0,2458093
99,70	100,07	0,174	0,168	324	0,243319
99,31	99,82	0,173	0,168	325	0,24436
98,98	98,98	0,174	0,168	326	0,2453965
98,90	99,17	0,174	0,168	327	0,2453967
99,32	99,83	0,174	0,168	328	0,2443593
99,05	99,05	0,174	0,168	329	0,2453959
98,73	99,08	0,174	0,168	330	0,2458087
98,67	99,13	0,173	0,168	331	0,2453963
98,85	99,42	0,173	0,168	332	0,2453963
98,85	99,17	0,173	0,168	333	0,2453967
99,03	99,13	0,174	0,168	334	0,2453961
98,52	98,54	0,174	0,168	335	0,2468391
98,96	98,98	0,174	0,168	336	0,2453961
99,49	99,81	0,174	0,168	337	0,2439442
99,36	99,48	0,174	0,168	338	0,2443597
99,01	99,61	0,173	0,168	339	0,244982
98,18	98,50	0,173	0,168	340	0,2468389
98,75	99,03	0,173	0,168	341	0,2458094
99,03	99,26	0,174	0,168	342	0,2453971
99,58	99,21	0,174	0,168	343	0,2443599
99,01	99,23	0,174	0,167	344	0,2449825
99,62	99,77	0,174	0,168	345	0,2439577
98,66	99,08	0,174	0,168	346	0,2458213
98,66	99,11	0,173	0,168	347	0,2458091
98,58	98,94	0,173	0,168	348	0,2458094
98,97	99,13	0,173	0,168	349	0,2449823
99,11	98,91	0,173	0,167	350	0,2449818
99,31	99,54	0,174	0,168	351	0,2443599
98,97	98,71	0,174	0,167	352	0,2453967
100,24	100,53	0,173	0,167	353	0,2418545
99,40	99,83	0,173	0,168	354	0,2439449
98,96	99,26	0,173	0,168	355	0,2449824
99,31	99,85	0,173	0,168	356	0,2439457
99,21	99,48	0,173	0,168	357	0,2443601
99,22	99,01	0,174	0,168	358	0,244982
98,37	98,62	0,174	0,168	359	0,2468391
99,38	99,46	0,174	0,168	360	0,2443866

## APPENDIX 3: Calibration data



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-001 24/02/16

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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC15061429-7798010
No. Série:	7798010	Dernière date d'étalonnage:	22-Jun-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	22-Jun-16
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	0.0 °C	0.0 °C	0.00 °C	1.0 °C	T1 typeJ
125.0 °C	125.0 °C	125.0 °C	0.0 °C	125.0 °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	375.0 °C	0.0 °C	375.0 °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	375.0 °C	0.0 °C	375.0 °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	0.1 °C	0.1 °C	0.1 °C	1.0 °C	T1 typeK
125.0 °C	125.0 °C	125.2 °C	0.2 °C	125.2 °C	1.0 °C	T1 typeK
250.0 °C	250.0 °C	250.2 °C	0.2 °C	250.2 °C	1.0 °C	T1 typeK
375.0 °C	375.0 °C	375.2 °C	0.2 °C	375.2 °C	1.0 °C	T1 typeK
500.0 °C	500.0 °C	500.2 °C	0.2 °C	500.2 °C	1.0 °C	T1 typeK
0.0 °C	0.0 °C	0.2 °C	0.2 °C	0.2 °C	1.0 °C	T2 typeK
125.0 °C	125.0 °C	125.3 °C	0.3 °C	125.3 °C	1.0 °C	T2 typeK
250.0 °C	250.0 °C	250.2 °C	0.2 °C	250.2 °C	1.0 °C	T2 typeK
375.0 °C	375.0 °C	375.2 °C	0.2 °C	375.2 °C	1.0 °C	T2 typeK
500.0 °C	500.0 °C	500.2 °C	0.2 °C	500.2 °C	1.0 °C	T2 typeK

Conditions Environnementales: Température: 23 °C Humidité: 24 %RH

Type d'Étalonnage:

*[Signature]*  
2016-03-01

5F09101



Posttest dry gas meter calibration data

Date : 2016-05-30		Barometric pressure: 101.1		Tech/Eng. Maxime Martin	
Manufacturer. : Ravelli Model : RV100 Classic		Calibration factor : 0.993 DGM 1 : EM-178		Calibration factor 0.992 DGM 2 : EM-179	
		Calibration factor : 0.9928 DGM 3 : EM-070		Calibration factor 0.9968 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	563,3	562,3	1,000	75	0,984	394990,240	394961,650	1,010	75,2	0,9961	1,0125
2	0	564,3	563,3	1,000	74,9	0,984	395018,950	394990,240	1,014	75,2	1,0002	1,0166
3	0	565,3	564,3	1,000	74,9	0,984	395047,750	395018,950	1,017	75,2	1,0034	1,0198
Average calibration factor : 1.0163												

Previous cal factor	minus	Average cal factor	Divided by	Previous cal. factor	Multiplied * 100	Equals	Deviation percent Max5%
0.993	-	1.0163	/	0.993	*100	=	2.3 %

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	563,3	562,3	1,000	75	0,984	345164,12	345135,41	1,014	75,74	0,999	1,0157
2	0	564,3	563,3	1,000	74,9	0,984	345192,91	345164,12	1,017	75,74	1,002	1,0184
3	0	565,3	564,3	1,000	74,9	0,984	345221,49	345192,91	1,009	75,56	0,995	1,0113
Average calibration factor : 1.0151												

Previous cal factor	minus	Average cal factor	Divided by	Previous cal. factor	Multiplied * 100	Equals	Deviation percent Max5%
0.992	-	1.0151	/	0.992	*100	=	2.3 %



Posttest dry gas meter calibration data

Date : 2016-05-30		Barometric pressure: 101.1		Tech/Eng. Maxime Martin	
Manufacturer. : Ravelli Model : RV100 Classic		Calibration factor : 0.993 DGM 1 : EM-178		Calibration factor 0.992 DGM 2 : EM-179	
		Calibration factor : 0.9928 DGM 3 : EM-070		Calibration factor 0.9968 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	563,3	562,3	1,000	75	0,984	855,17	854,11	1,060	75,56	1,045	1,0623
2	0	564,3	563,3	1,000	74,9	0,984	856,11	855,17	0,940	75,38	0,927	0,9422
3	0	565,3	564,3	1,000	74,9	0,984	857,17	856,11	1,060	75,56	1,045	1,0621
Average calibration factor : 1.0222												

Previous cal factor	minus	Average cal factor	Divided by	Previous cal. factor	Multiplied * 100	Equals	Deviation percent Max5%
0.9928	-	1.0222	/	0.9928	*100	=	2.9 %



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-001 24/02/16

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.	Conditions Enviro:	Normale

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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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.

Martin Langlais - Technicien





## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-006 24/02/16

CLIENT		SPÉCIFICATION DE CALIBRATION	
Compagnie:	Services Polytests Inc	Procédure de service:	4IN9106
Adresse:	695 B rue Gaudette	Précision requise:	+/-0.25"H2O
	St-Jean-sur-Richelieu, Québec, J3B 7S7	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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Setra	No. du certificat d'étalonnage:	AC16021060-2784759
No. Série:	2784759	Dernière date d'étalonnage:	3-Feb-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	3-Feb-17
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	0.000 "H2O	0.000 "H2O	0.000 "H2O	0.25 "H2O	
0.1500 "H2O	0.150 "H2O	0.151 "H2O	0.001 "H2O	0.151 "H2O	0.25 "H2O	
0.2500 "H2O	0.250 "H2O	0.251 "H2O	0.001 "H2O	0.251 "H2O	0.25 "H2O	
0.3500 "H2O	0.350 "H2O	0.349 "H2O	-0.001 "H2O	0.349 "H2O	0.25 "H2O	
0.5000 "H2O	0.500 "H2O	0.493 "H2O	-0.007 "H2O	0.493 "H2O	0.25 "H2O	
Conditions Environnementales: Température: 23 °C Humidité: 24 %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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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.

Martin Langlais - Technicien

2016.03.01



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



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

## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-007 24/02/16

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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Setra	No. du certificat d'étalonnage:	AC16021060-2784759
No. Série:	2784759	Dernière date d'étalonnage:	3-Feb-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	3-Feb-17
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	0.0000 "H2O	0.0000 "H2O	0.0000 "H2O	0.25 "H2O	
0.1500 "H2O	0.1500 "H2O	0.1521 "H2O	0.0021 "H2O	0.1521 "H2O	0.25 "H2O	
0.2500 "H2O	0.2500 "H2O	0.2520 "H2O	0.0020 "H2O	0.2520 "H2O	0.25 "H2O	
0.3500 "H2O	0.3500 "H2O	0.3528 "H2O	0.0028 "H2O	0.3528 "H2O	0.25 "H2O	
0.5000 "H2O	0.5000 "H2O	0.5063 "H2O	0.0063 "H2O	0.5063 "H2O	0.25 "H2O	
Conditions Environnementales:			Température: 23 °C	Humidité: 24 %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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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'exacritude des étalonnages individuels effectués par les laboratoires accrédités.

Martin Langlais - Technicien

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



80 rue de la montagne  
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## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-012 05/02/15

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:	Divers
Manufacturier:	Keithley	Type de sortie:	Digitale
No. Model:	2750	Type de mesure:	Température
No. Série:	977470	Gamme:	Divers
Emplacement:	N.A.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC15011147-8180008
No. Série:	8180008	Dernière date d'étalonnage:	15-Jan-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	15-Apr-15
Commentaire:			


RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
Voir Commentaire						
Conditions Environnementales:			Température: 20 °C	Humidité: 24 %RH		
Type d'Étalonnage: Data Acquisition system Conforme Carte1: EM-185						

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:	5 Février 2015
Date du prochain Étalonnage:	5 Février 2016
Date d'émission du certificat:	5 Février 2015

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.



Martin Langlais - Technicien





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



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St-Joseph du lac  
(Québec), J0N 1M0  
Tél: (450) 473-6169  
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## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-015 24/02/16

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:	EM-047	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC15061429-7798010
No. Série:	7798010	Dernière date d'étalonnage:	22-Jun-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	22-Jun-16
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	-190.6 °C	-0.6 °C	-190.6 °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	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#2 TypeK
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#3 TypeK
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#4 TypeK
100.0 °C	100.0 °C	99.5 °C	-0.5 °C	99.5 °C	1.0 °C	Input#5TypeK
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#6TypeK
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#7TypeK
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#8TypeK
100.0 °C	100.0 °C	99.5 °C	-0.5 °C	99.5 °C	1.0 °C	Input#9TypeK
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °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	99.7 °C	-0.3 °C	99.7 °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	99.8 °C	-0.2 °C	99.8 °C	1.0 °C	Input#14TypeJ
100.0 °C	100.0 °C	99.8 °C	-0.2 °C	99.8 °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	12.001 mA	0.001 mA	12.001 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
<b>Conditions Environnementales:</b> Température: 21 °C Humidité: 21 %RH						

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## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-015 24/02/16

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:	EM-047	Conditions Enviro:	Normale
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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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.

Martin Langlais - Technicien

2016-03-01



**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-047 05/02/15

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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC15011147-8180008
No. Série:	8180008	Dernière date d'étalonnage:	15-Jan-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	15-Apr-15
Commentaire:			

RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
Voir Commentaire						
Conditions Environnementales:			Température: 20 °C	Humidité: 24 %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 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:	5 Février 2015
Date du prochain Étalonnage:	5 Février 2016
Date d'émission du certificat:	5 Février 2015

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.

Martin Langlais - Technicien

2015-02-15

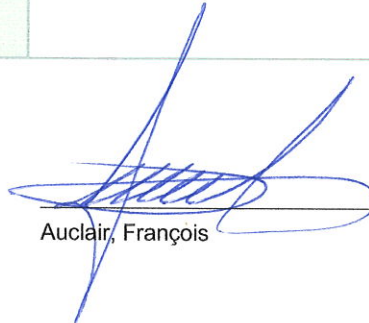
5F09101

## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>122-2E3F09-151-1649</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	14-09-2015

**Technicien :**  
Auclair, François  
  
Directeur de Service



Auclair, François

### DESCRIPTION DU SERVICE:

<b>Modèle de Balance :</b>	AR2140	<b>Méthode :</b>	ISO 17025
<b>Manufacturier :</b>	Ohaus	<b>Date d'approbation :</b>	14-09-2015
<b>Numéro de Série :</b>	M3658329010091	<b>Date prochain étalonnage :</b>	14-09-2016
<b>Numéro d'identification :</b>	EM-051	<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:	21.3	Pression kPa:	100.5	Humidité %:	69.2
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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.



2015-09-15

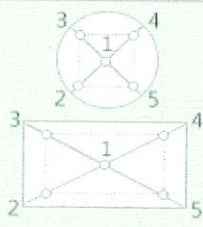
## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>122-2E3F09-151-1649</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Méthode :</b>	ISO 17025	<b>Certification CLAS n. :</b>	2010-01
		<b>Modèle de Balance :</b>	AR2140
		<b>Date d'étalonnage :</b>	14-09-2015
		<b>Date du prochain étalonnage :</b>	14-09-2016

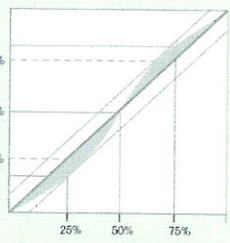
### TEST D'EXCENTRICITÉ:

Poids Test: 100 g Tolérance 0.0004 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:	0.0000 g	---	
3: Arrière Gauche:	0.0000 g	---	
4: Arrière Droit:	0.0000 g	---	
5: Avant Droit:	0.0000 g	---	
<b>Résultats</b>	0.0000 g	---	
<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	50.0003 g	---	
50.0000 g	49.9999 g	---	
100.0000 g	49.9999 g	---	
150.0000 g	50.0003 g	---	
---	---	---	
<b>Résultats</b>	<b>0.00020 g</b>	---	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	

### TEST DE SENSIBILITÉ:

Valeur de masse conventionnelle: 199.9998 g Tolérance: 0.0004 g

	Avant Ajustement	Après Ajustement	
Lecture:	199.9999 g	---	$S = \frac{\Delta W}{\Delta m}$
<b>Résultats:</b>	<b>0.0001 g</b>	---	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	



## CERTIFICAT D'ÉTALONNAGE

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<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>122-2E3F09-151-1649</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Méthode :</b>	ISO 17025	<b>Certification CLAS n. :</b>	2010-01
		<b>Modèle de Balance :</b>	AR2140
		<b>Date d'étalonnage :</b>	14-09-2015
		<b>Date du prochain étalonnage :</b>	14-09-2016

### TEST DE RÉPÉTABILITÉ:

#### AVANT AJUSTEMENT:

Charge Utilisée:  
100.0000 g

Tolérance:  
0.00010 g

Résolution d'affichage:  
0.0001 g

Moyenne:  
100.00041 g

Écart-type:  
**0.00003 g**

#	Vide	Chargé	Différence
1	0.0000 g	100.0004 g	100.0004 g
2	0.0000 g	100.0005 g	100.0005 g
3	0.0000 g	100.0004 g	100.0004 g
4	0.0000 g	100.0004 g	100.0004 g
5	0.0000 g	100.0004 g	100.0004 g
6	0.0000 g	100.0004 g	100.0004 g
7	0.0000 g	100.0004 g	100.0004 g
8	0.0000 g	100.0004 g	100.0004 g
9	0.0000 g	100.0004 g	100.0004 g
10	0.0000 g	100.0004 g	100.0004 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

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### 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
- Sp** = Incertitude de l'écart-type
- u(l)** = Incertitude associée à la linéarité
- u(dr)** = Incertitude associée à résolution si Sp = 0
- u(s)** = Incertitude liée à la sensibilité (span)

Valeur	Incertitude	Incertitude (%)
12.5000 g	0.00016 g	0.001288 %
25.0000 g	0.00016 g	0.000650 %
50.0000 g	0.00017 g	0.000336 %
100.0000 g	0.00019 g	0.000189 %
200.0000 g	0.00048 g	0.000238 %

### INCERTITUDE APRÈS AJUSTEMENT :

Valeur	Incertitude	Incertitude (%)
---	---	---
---	---	---
---	---	---
---	---	---

### 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 inférieur à 0,577d.



### RÉFÉRENCE

#### ENSEMBLE DE RÉFÉRENCE:

Référence	No de série	Fabricant	Date d'étalonnage
1mg - 5kg	DK000A161	Dispersion Laboratoire	21-08-2015

### 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:

## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	123-259410-142
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	30-10-2014

**Technicien :**  
Simard, Catherine

Technicienne Métrologie



Pierre Trépanier, Directeur laboratoire

### DESCRIPTION DU SERVICE:

<b>Description des masses :</b>	ASTM E617	<b>Date d'approbation :</b>	03-11-2014
<b>Classe de précision :</b>	ASTM 6	<b>Date prochain étalonnage :</b>	03-11-2015
<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>	Temp °C: 20.605	Pression kPa: 101.2	Humidité: 46.785
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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:



## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
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<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	123-259410-142
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Masse :</b>	2 kg	<b>Certification CLAS n. :</b>	2010-01
		<b>Classe d'exactitude :</b>	ASTM 6
		<b>Date d'étalonnage :</b>	30-10-2014
		<b>Date du prochain étalonnage :</b>	03-11-2015

### RÉSULTAT DE L'ÉTALONNAGE, MASSE CONVENTIONNELLE:

Valeur Nominale	No de série	No d'inventaire	Masse conventionnelle	Masse conventionnelle après ajustement	Tolérance ± (mg)	Incertitudes ± (mg)
2 kg		EM-090	2.0001350 kg		200 mg	2.0 mg

\*S'applique seulement pour les masses qui ont été ajustées\*    \*\*Hors-tolérance pour la classe spécifiée\*\*



## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
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<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>123-259410-142</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Masse :</b>	2 kg	<b>Certification CLAS n. :</b>	2010-01
		<b>Classe d'exactitude :</b>	ASTM 6
		<b>Date d'étalonnage :</b>	30-10-2014
		<b>Date du prochain étalonnage :</b>	03-11-2015

## RÉSULTAT DE L'ÉTALONNAGE DES POIDS, CORRECTIONS:

Valeur Nominale	No de série	No d'inventaire	Masse conventionnelle Correction	Masse conventionnelle Correction après ajustement	Tolérance ± (mg)	Incertitudes ± (mg)
2 kg		EM-090	135.0 mg		200 mg	2.0 mg

\*S'applique seulement pour les masses qui ont été ajustées\* \*\*Hors-tolérance pour la classe spécifiée\*\*



## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
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### 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

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### RÉFÉRENCES UTILISÉES

Poids	No de série	Fabricant	Date d'étalonnage
20kg	69976	Troemner	18-03-2014
1kg - 1mg	MT-01	Mettler Toledo	04-09-2014
300g	96-0888-50-2	Denver Instrument Company	04-09-2014
2kg	96-0888-50-3	Denver Instrument Company	04-09-2014
2kg	129098	Mettler Toledo	04-09-2014
5kg	96-0888-50-3	Denver Instrument Company	04-09-2014
5kg	129099	Mettler Toledo	04-09-2014
10kg	129100	Mettler Toledo	14-08-2014

### ÉTALONS CERTIFIÉS PAR LE CNRC:

Poids	No de série	Fabricant	Date d'étalonnage
100g	95170	Mettler Toledo	19-08-2014
1kg	95171	Mettler Toledo	02-05-2014

### RÉFÉRENCES DE LA STATION ROBOTISÉE:

Poids	No de série	Fabricant	Date d'étalonnage
1kg - 1mg	DK000A133	Laboratoire Dispersion	04-09-2014
1kg - 1mg	DK000A132	Laboratoire Dispersion	01-02-2013



## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
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<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>122-2E3F09-151-1648</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	14-09-2015

**Technicien :**

Auclair, François

Directeur de Service

Auclair, François



### DESCRIPTION DU SERVICE:

<b>Modèle de la Base :</b>	4X4HP-10K	<b>Capacité :</b>	400kg
<b>Numéro de Série Base:</b>	C18395	<b>Methode:</b>	ISO 17025 / Class III
<b>Modèle de Terminal:</b>	IQ355	<b>Résolution:</b>	0.05kg
<b>Numéro de Série Terminal:</b>	164851	<b>Date d'approbation :</b>	14-09-2015
<b>Numéro d'identification :</b>	EM-137 + EM. 114 DP	<b>Date prochain étalonnage :</b>	14-09-2016

<b>Condition d'essai :</b>	Temp °C:	20.1	Pression kPa:	100.5	Humidité %:	79.2
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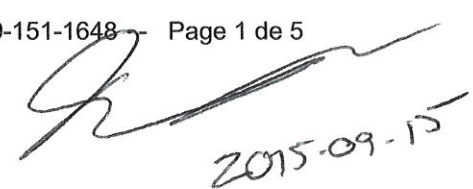
Note: Les conditions environnementales ne sont pas utilisées dans le calcul de l'incertitude.

### 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.



2015-09-15



## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>122-2E3F09-151-1648</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Méthode :</b>	ISO 17025	<b>Certification CLAS n. :</b>	2010-01
		<b>Modèle de la Base :</b>	4X4HP-10K
		<b>Date d'étalonnage :</b>	14-09-2015
		<b>Date du prochain étalonnage :</b>	14-09-2016

### TEST D'EXCENTRICITÉ:

Poids Test: 200 kg Tolérance 0.15 kg  
(Note: Le Poids Test est taré au centre du plateau de pesée)

Position	Avant Ajustement	Après Ajustement	
1: Centre:	0.00 kg	---	
2: Avant Gauche:	0.05 kg	---	
3: Arrière Gauche:	0.10 kg	---	
4: Arrière Droit:	0.10 kg	---	
5: Avant Droit:	0.05 kg	---	
<b>Résultats</b>	<b>0.10 kg</b>	---	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	

### TEST DE LINÉARITÉ:

Méthode: Accumulation Plage: 400 kg Poids Test: 100 kg Tolérance: 0.10 kg

Pré-Charge	Avant Ajustement	Après Ajustement	
0.00 kg	99.95 kg	---	
0.00 kg	199.95 kg	---	
0.00 kg	299.95 kg	---	
0.00 kg	400.00 kg	---	
---	---	---	
---	---	---	
<b>Résultats</b>	<b>0.050 kg</b>	---	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	

### TEST DE SENSIBILITÉ:

Valeur de masse conventionnelle: 400.00 kg Tolérance: 0.25 kg

	Avant Ajustement	Après Ajustement	
Lecture:	400.00 kg	---	$S = \frac{\Delta W}{\Delta m}$
<b>Résultats:</b>	<b>0.00 kg</b>	---	
<b>STATUT</b>	<b>CONFORME</b>	<b>N/A</b>	

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<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Méthode :</b>	ISO 17025	<b>Certification CLAS n. :</b>	2010-01
		<b>Modèle de la Base :</b>	4X4HP-10K
		<b>Date d'étalonnage :</b>	14-09-2015
		<b>Date du prochain étalonnage :</b>	14-09-2016

### TEST DE RÉPÉTABILITÉ:

#### AVANT AJUSTEMENT:

Charge Utilisée:  
100.00 kg

Tolérance:  
0.100 kg

Résolution d'affichage:  
0.05 kg

Moyenne:  
99.950 kg

Écart-type:  
**0.000 kg**

#	Vide	Chargé	Différence
1	0.00 kg	99.95 kg	99.95 kg
2	0.00 kg	99.95 kg	99.95 kg
3	0.00 kg	99.95 kg	99.95 kg
4	0.00 kg	99.95 kg	99.95 kg
5	0.00 kg	99.95 kg	99.95 kg
6	0.00 kg	99.95 kg	99.95 kg
7	0.00 kg	99.95 kg	99.95 kg
8	0.00 kg	99.95 kg	99.95 kg
9	0.00 kg	99.95 kg	99.95 kg
10	0.00 kg	99.95 kg	99.95 kg

Statut : **CONFORME**

#### APRÈS AJUSTEMENT:

Charge Utilisée:  
---

Tolérance:  
0.100 kg

Résolution d'affichage:  
0.05 kg

Moyenne:  
---

Écart-type:  
---

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

Statut : **N/A**



## CERTIFICAT D'ÉTALONNAGE

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### INCERTITUDE AVANT AJUSTEMENT :

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

- u(cr)** = Incertitude reliée à l'étalon utilisé
- Sp** = Incertitude de l'écart-type
- u(l)** = Incertitude associée à la linéarité
- u(dr)** = Incertitude associée à résolution si Sp = 0
- u(s)** = Incertitude liée à la sensibilité (span)

Valeur	Incertitude	Incertitude (%)
25.00 kg	0.0627975 kg	0.251190 %
50.00 kg	0.0627975 kg	0.125595 %
100.00 kg	0.0627975 kg	0.062797 %
200.00 kg	0.0627975 kg	0.031399 %
400.00 kg	0.119 kg	0.029760 %

### INCERTITUDE APRÈS AJUSTEMENT :

Valeur	Incertitude	Incertitude (%)
---	---	---
---	---	---
---	---	---
---	---	---

### 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 inférieur à 0,577d.



## CERTIFICAT D'ÉTALONNAGE

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### RÉFÉRENCE

#### ENSEMBLE DE RÉFÉRENCE:

Référence	No de série	Fabricant	Date d'étalonnage
1mg - 5kg	DK000A161	Dispersion Laboratoire	21-08-2015

### INCERTITUDES:

Les incertitudes que nous retrouvons comprennent :

3. *L'incertitude associée à l'étalon utilisé.*
2. *L'incertitude associée à l'écart-type.*
1. *L'incertitude associée à l'opération de pesage.*
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:



**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-124 24/02/16

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:	E39V060010/1	Gamme:	0-0.5"H2O
Emplacement:	N.A.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Setra	No. du certificat d'étalonnage:	AC16021060-2784759
No. Série:	2784759	Dernière date d'étalonnage:	3-Feb-16
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	3-Feb-17
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	0.0009 "H2O	0.0009 "H2O	0.0009 "H2O	0.25 "H2O	
0.1500 "H2O	0.1500 "H2O	0.1492 "H2O	-0.0008 "H2O	0.1492 "H2O	0.25 "H2O	
0.2500 "H2O	0.2500 "H2O	0.2510 "H2O	0.0010 "H2O	0.2510 "H2O	0.25 "H2O	
0.3500 "H2O	0.3500 "H2O	0.3533 "H2O	0.0033 "H2O	0.3533 "H2O	0.25 "H2O	
0.5000 "H2O	0.5000 "H2O	0.5066 "H2O	0.0066 "H2O	0.5066 "H2O	0.25 "H2O	
Conditions Environnementales:			Température: 23 °C	Humidité: 24 %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 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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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.

Martin Langlais - Technicien

2016-03-01

5F09106



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-126 24/02/16

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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Crystal XP2i 300	No. du certificat d'étalonnage:	AC15061148-864490
No. Série:	864490	Dernière date d'étalonnage:	10-Jun-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	10-Jun-16
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	
-7.50 "Hg	-7.50 "Hg	-7.60 "Hg	-0.10 "Hg	-7.60 "Hg	1 "Hg	
-15.00 "Hg	-15.00 "Hg	-15.20 "Hg	-0.20 "Hg	-15.20 "Hg	1 "Hg	
-22.50 "Hg	-22.50 "Hg	-22.80 "Hg	-0.30 "Hg	-22.80 "Hg	1 "Hg	
-28.00 "Hg	-28.00 "Hg	-28.37 "Hg	-0.37 "Hg	-28.37 "Hg	1 "Hg	
Conditions Environnementales:      Température: 23 °C      Humidité: 24 %RH						
Type d'Étalonnage:						

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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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.

Martin Langlais - Technicien



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-127 24/02/16

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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Crystal XP2i 300	No. du certificat d'étalonnage:	AC15061148-864490
No. Série:	864490	Dernière date d'étalonnage:	10-Jun-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	10-Jun-16
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	
-7.50 "Hg	-7.50 "Hg	-7.51 "Hg	-0.01 "Hg	-7.51 "Hg	1 "Hg	
-15.00 "Hg	-15.00 "Hg	-15.01 "Hg	-0.01 "Hg	-15.01 "Hg	1 "Hg	
-22.50 "Hg	-22.50 "Hg	-22.54 "Hg	-0.04 "Hg	-22.54 "Hg	1 "Hg	
-28.00 "Hg	-28.00 "Hg	-28.08 "Hg	-0.08 "Hg	-28.08 "Hg	1 "Hg	
Conditions Environnementales:			Température: 23 °C	Humidité: 24 %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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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

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Martin Langlais - Technicien

2016.03.01

5F09106




## CERTIFICAT D'ÉTALONNAGE

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	900-259410-141
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Date d'étalonnage :</b>	03-11-2014

**Technicien :**  
CB001,

Station d'étalonnage automatisée



Pierre Trépanier, Directeur laboratoire

### DESCRIPTION DU SERVICE:

<b>Description des masses :</b>	ASTM E617	<b>Date d'approbation :</b>	03-11-2014
<b>Classe de précision :</b>	ASTM 1	<b>Date prochain étalonnage :</b>	03-11-2015
<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:	20.51	Pression kPa:	101.195	Humidité:	48.615
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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:

## CERTIFICAT D'ÉTALONNAGE

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 www.dispersion.ca 1.866.390.5066

<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>900-259410-141</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Masse :</b>	100 mg - 200 g	<b>Certification CLAS n. :</b>	2010-01
		<b>Classe d'exactitude :</b>	ASTM 1
		<b>Date d'étalonnage :</b>	03-11-2014
		<b>Date du prochain étalonnage :</b>	03-11-2015

### RÉSULTAT DE L'ÉTALONNAGE, MASSE CONVENTIONNELLE:

Valeur Nominale	No de série	No d'inventaire	Masse conventionnelle	Masse conventionnelle après ajustement	Tolérance ± (mg)	Incertitudes ± (mg)
100 mg	1000014200	EM-128	99.9996 mg		0.010 mg	0.002 mg
200 g	1000026013	EM-129	200.00023 g		0.50 mg	0.11 mg

\*S'applique seulement pour les masses qui ont été ajustées\*    \*\*Hors-tolérance pour la classe spécifiée\*\*

**CERTIFICAT D'ÉTALONNAGE**


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<b>Client :</b>	Polytests	<b>No. du Certificat :</b>	<b>900-259410-141</b>
<b>Adresse :</b>	695 B rue Gaudette St-Jean-sur-Richelieu, QC J3B7S7	<b>Accréditation CCN n. :</b>	668
<b>Masse :</b>	100 mg - 200 g	<b>Certification CLAS n. :</b>	2010-01
		<b>Classe d'exactitude :</b>	ASTM 1
		<b>Date d'étalonnage :</b>	03-11-2014
		<b>Date du prochain étalonnage :</b>	03-11-2015

**RÉSULTAT DE L'ÉTALONNAGE DES POIDS, CORRECTIONS:**

Valeur Nominale	No de série	No d'inventaire	Masse conventionnelle Correction	Masse conventionnelle Correction après ajustement	Tolérance ± (mg)	Incertitudes ± (mg)
100 mg	1000014200	EM-128	-0.0004 mg		0.010 mg	0.002 mg
200 g	1000026013	EM-129	0.23 mg		0.50 mg	0.11 mg

\*S'applique seulement pour les masses qui ont été ajustées\*      \*\*Hors-tolérance pour la classe spécifiée\*\*

  
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 2014-11-05



## CERTIFICAT D'ÉTALONNAGE

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
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

108-86 Boulevard Des Entreprises, Boisbriand, Québec J7G 2T3  
www.dispersion.ca 1.866.390.5066

### RÉFÉRENCES UTILISÉES

Poids	No de série	Fabricant	Date d'étalonnage
20kg	69976	Troemner	18-03-2014
1kg - 1mg	MT-01	Mettler Toledo	04-09-2014
300g	96-0888-50-2	Denver Instrument Company	04-09-2014
2kg	96-0888-50-3	Denver Instrument Company	04-09-2014
2kg	129098	Mettler Toledo	04-09-2014
5kg	96-0888-50-3	Denver Instrument Company	04-09-2014
5kg	129099	Mettler Toledo	04-09-2014
10kg	129100	Mettler Toledo	14-08-2014

### ÉTALONS CERTIFIÉS PAR LE CNRC:

Poids	No de série	Fabricant	Date d'étalonnage
100g	95170	Mettler Toledo	19-08-2014
1kg	95171	Mettler Toledo	02-05-2014

### RÉFÉRENCES DE LA STATION ROBOTISÉE:

Poids	No de série	Fabricant	Date d'étalonnage
1kg - 1mg	DK000A133	Laboratoire Dispersion	04-09-2014
1kg - 1mg	DK000A132	Laboratoire Dispersion	01-02-2013



2014-11-05

## CERTIFICAT D'ÉTALONNAGE # 5138

Date d'étalonnage : 2015/09/18

Date d'émission du certificat : 2015/09/18

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.

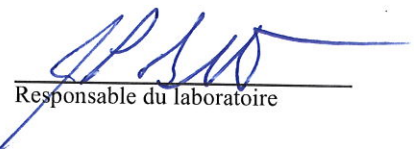
### APTITUDE EN MATIÈRE DE MESURE ET D'ÉTALONNAGE - CMC

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. 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 finales dans les tolérances
Remarques	Fréquence d'étalonnage aux 12 mois

  
Métrologiste

  
Responsable du laboratoire

## Certificat d'étalonnage # 5138

Numéro de série:	99A274209	Station de mesure:	3
Date d'étalonnage:	2015/09/18	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 (30 slpm)	3E4-VCR-V-Q	2359	1500173210	2015/11/12
DHI molbloc (120 slpm)	2E2-S	237	1500173211	2015/11/12
DHI molbox1	Molbox1	881	1500181338	2016/05/13
RTD Mist	M22	1871501	AC15021633-1871501	2016/03/27
Module 44.5 PSI avec Baro 163671	Module 30	160659	AC15041466-160659	2016/05/06

### 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	1010 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 ft3	Valeurs mesurées			Référence calculée ft3	Erreur calculée ft3	Tolérance acceptable ft3	TUR
		Pression PSIA	Température °C	Référence ft3				
40.5223	13.535	14.687	23.73	13.367	13.494	0.041	0.135	2.98
70.6538	11.800	14.712	23.67	11.674	11.763	0.037	0.118	3.98
161.3162	26.875	14.818	23.61	26.851	26.856	0.019	0.269	>4

Correction factor  
0,9968

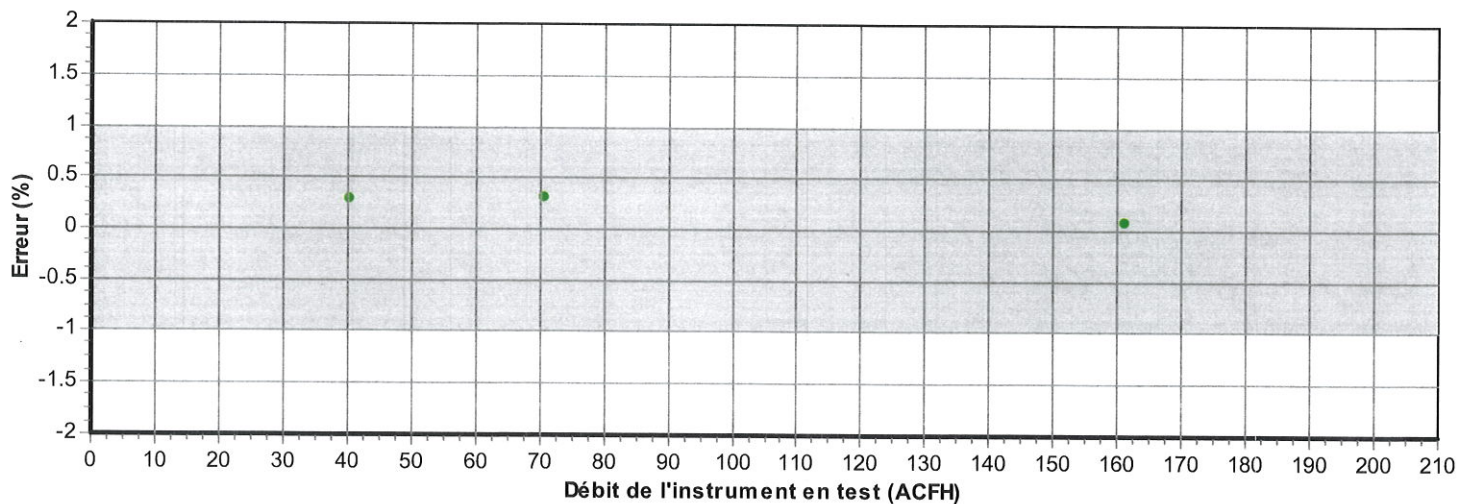
Bernard Poirier  
Métrologue

## Certificat d'étalonnage # 5138

Numéro de série: 99A274209  
Date d'étalonnage: 2015/09/18  
Identification de l'instrument: EM-130

Station de mesure: 3  
Procédure: POS-CAL-005

### 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]*  
2015-09-25

*[Signature]*  
Signature



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-136 07/03/16

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.	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Vaisala Portable 1	No. du certificat d'étalonnage:	AC15071230-U4840010
No. Série:	U4840010/U4920031	Dernière date d'étalonnage:	17-Jul-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	17-Jul-16
Commentaire:			

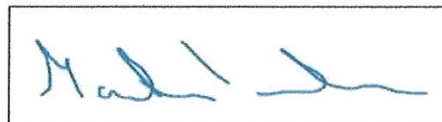
RÉSULTAT D'ÉTALONNAGE						
Entrée Source	Valeur Donnée	Valeur Actuelle	Erreur de Déviation	Valeur après Étalonnage	Incertitude Élargie	Commentaire
25.0 °C	25.0 °C	25.2 °C	0.2 °C	25.2 °C	1.0 °C	
40.0 °C	40.0 °C	40.0 °C	0.0 °C	40.0 °C	1.0 °C	
33.0 %RH	33.0 %RH	33.2 %RH	+0.2 %RH	33.2 %RH	3.0 %RH	
50.0 %RH	50.0 %RH	50.9 %RH	+0.9 %RH	50.9 %RH	3.0 %RH	
80.0 %RH	80.0 %RH	79.6 %RH	-0.4 %RH	79.6 %RH	3.0 %RH	
Conditions Environnementales:      Température: N.A.      Humidité: N.A.						
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 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:	7 Mars 2016
Date du prochain Étalonnage:	7 Mars 2017
Date d'émission du certificat:	7 Mars 2016

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.



Martin Langlais - Technicien



2016-03-09

# CERTIFICATE OF NIST TRACEABLE CALIBRATION

Calibration Certificate No: 50431

## Customer Information

Customer: Services Polyttests, Inc.

Address : 695-B Gaudette

St-Jean-sur-richelieu  
J3B 7S7

Customer PO #: 100365



**LABORATORY  
ACCREDITATION  
BUREAU** a division of A-5-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>Graftel ID</u>	<u>Manufacturer</u>	<u>Model #</u>	<u>Description</u>	<u>CAL Due</u>
10171	Furness	FC0332-2W	0 - .4" H2O	11/13/2015
10100	Graftel	n/a	Temperature	10/29/2016
60030	Paroscientific	760-100A	Pressure, 100 psia	5/7/2016
10155	HOBO	UX100-011	RH/Temp logger	11/18/2015
10187	Vaisala	PTB210	Barometric Pressure Gauge	6/16/2016

## 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

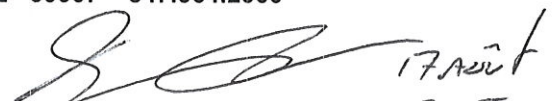
Comments: Calibration Date: 08-04-2015

*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. Graftel, LLC. Quality Assurance System complies with applicable requirements of ISO/IEC-17025-2005, ANSI/NCSL 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 Graftel, 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: 

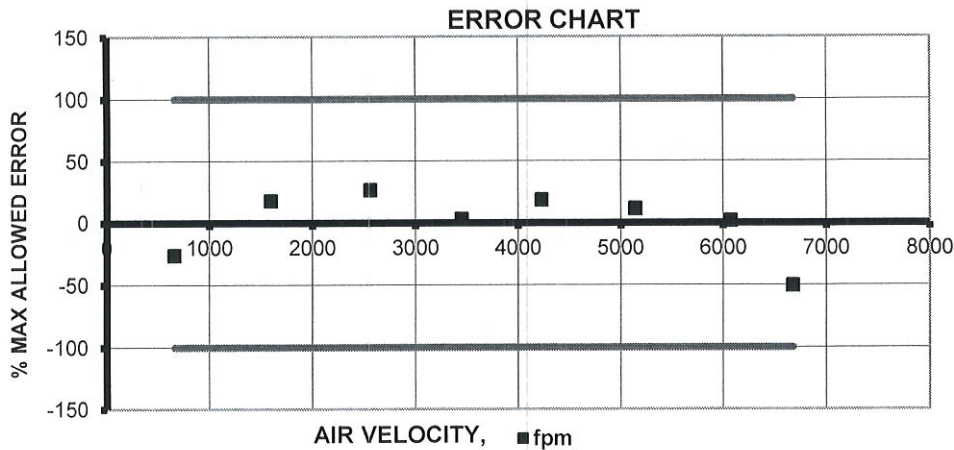
Date: 8/4/2015

D. Stocks  
Calibration Technician

  
17 Aug  
2015

**ATTACHMENT TO CALIBRATION CERTIFICATE 50431  
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	
662	654	660	670	-2	3.31	Pass
1600	1583	1603	1617	3	8.00	Pass
2562	2535	2569	2589	7	12.81	Pass
3449	3414	3450	3484	1	17.25	Pass
4231	4188	4239	4274	8	21.16	Pass
5144	5092	5150	5196	6	25.72	Pass
6074	6012	6075	6136	1	30.37	Pass
6678	6610	6644	6746	-34	33.39	Pass



**INSTRUMENT SPECIFICATIONS**

Test Fluid	Air	
Lower Range	40	fpm
Upper Range	7800	fpm
Rated Accuracy	1% Rding +1 fpm	

**LABORATORY AMBIENT CONDITIONS**

Pressure	14.31	psia
Humidity	50.90	% RH
Temperature	74.56	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]*  
17 Aug 2015



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-154 24/02/16

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:	EM-047	Conditions Enviro:	Normale

SPÉCIFICATION DE L'ÉTALON			
Étalon Utilisé:	Fluke 744	No. du certificat d'étalonnage:	AC15061429-7798010
No. Série:	7798010	Dernière date d'étalonnage:	22-Jun-15
Certificat fait par:	Alpha Controls	Prochaine date d'étalonnage:	22-Jun-16
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	-17.000 mV	-0.000 mV	-17.000 mV	0.1 mV	Input#1
0.000 mV	0.000 mV	-0.001 mV	-0.001 mV	-0.001 mV	0.1 mV	Input#1
20.000 mV	20.000 mV	19.999 mV	-0.001 mV	19.999 mV	0.1 mV	Input#1
30.000 mV	30.000 mV	30.001 mV	0.001 mV	30.001 mV	0.1 mV	Input#2
Input#3 Non-Conforme						
100.0 °C	100.0 °C	99.4 °C	-0.6 °C	99.4 °C	1.0 °C	Input#4 TypeJ
30.000 mV	30.000 mV	30.000 mV	0.000 mV	30.000 mV	0.1 mV	Input#5
30.000 mV	30.000 mV	29.993 mV	-0.007 mV	29.993 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	100.0 °C	0.0 °C	100.0 °C	1.0 °C	Input#12 TypeT
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#13 TypeJ
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#14 TypeJ
100.0 °C	100.0 °C	99.6 °C	-0.4 °C	99.6 °C	1.0 °C	Input#15 TypeJ
100.0 °C	100.0 °C	99.5 °C	-0.5 °C	99.5 °C	1.0 °C	Input#16 TypeJ
100.0 Ohms	100.0 Ohms	99.9 Ohms	-0.1 Ohms	99.9 Ohms	1.0 Ohms	Input#17
100.0 Ohms	100.0 Ohms	99.9 Ohms	-0.1 Ohms	99.9 Ohms	1.0 Ohms	Input#18
100.0 Ohms	100.0 Ohms	100.0 Ohms	0.0 Ohms	100.0 Ohms	1.0 Ohms	Input#19
100.0 Ohms	100.0 Ohms	99.9 Ohms	-0.1 Ohms	99.9 Ohms	1.0 Ohms	Input#20
12.000 mA	12.000 mA	12.001 mA	0.001 mA	12.001 mA	1.00 mA	Input#21
12.000 mA	12.000 mA	12.001 mA	0.001 mA	12.001 mA	1.00 mA	Input#22
Conditions Environnementales: Température: 21 °C Humidité: 21 %RH						



## CERTIFICAT D'ÉTALONNAGE

No.Certificat: CE-EM-154 24/02/16

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:	EM-047	Conditions Enviro:	Normale
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:	24 Février 2016
Date du prochain Étalonnage:	24 Février 2017
Date d'émission du certificat:	24 Février 2016

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.

Martin Langlais - Technicien



**Ulrich Métrologie inc.**  
**Ulrich Metrology Inc.**  
 9912, Côte-de-Liesse  
 Montréal (Québec) H8T 1A1

Tél. (514) 631-6653  
 Fax (514) 631-6122  
[info@ulrich.ca](mailto:info@ulrich.ca)  
[www.ulrich.ca](http://www.ulrich.ca)



**ACCREDITATION**  
**ISO 17025**  
 SCC Scope Number 220

# CALIBRATION CERTIFICATE

<b>Certificate no.:</b>	472805	<b>Calibration date:</b>	May 19, 2015
<b>Identification:</b>	EM-176	<b>Certificate issued:</b>	May 21, 2015
<b>Description:</b>	CALIPER, DIGITAL, 6 IN	<b>Interval:</b>	12 months
<b>Size:</b>	6 IN	<b>Due date:</b>	May 19, 2016
<b>Manufacturer:</b>	MITUTOYO	<b>Procedure no.:</b>	CP-28 rev. 2
<b>Model no.:</b>	500-171-20	<b>Procedure date:</b>	2010-07-08
<b>Serial no.:</b>	12610701	<b>Environment:</b>	CLAS Type 1 Laboratory
		<b>Temperature:</b>	20 ± 1°C
		<b>Humidity:</b>	35 - 55% RH
		<b>Metrologist:</b>	MOH

**Property of:** SERVICES POLYTESTS INC  
 695-B GAUDETTE  
 ST-JEAN-SUR-RICHELIEU, QC J3B 7S7

**Approved by:**   
 David Llorens, Quality Manager

*This calibration certificate is issued in accordance with the applicable requirements of ISO/IEC 17025 and Ulrich Metrology's quality manual QM-09 Revision 9. Measurement results provided are traceable to either the National Research Council Canada (NRC), the National Institute of Standards and Technology (NIST), a national laboratory of another country signatory to the CIPM Mutual Recognition Arrangement (MRA), or a calibration laboratory accredited by an accrediting body with which Canada has an equivalence agreement.*

## CALIBRATION STANDARDS

Identification	Description	Cal. date	Due date
27071932	Gauge Blocks, In, 81 Pcs	2015-01-09	2017-01-31
76072	Caliper Checker, Mitutoyo 515-560-um	2015-01-07	2016-01-31
SP-3	Granite Surface Plate	2013-10-28	2015-10-31


## MEASUREMENT UNCERTAINTY

Outside: ± 0.00030 in. Inside: ± 0.00030 in. Depth: ± 0.00030 in.  
 The uncertainties are expanded using a coverage factor K=2 for a level of confidence of approximately 95%, assuming a normal distribution.

## INSTRUMENT CONDITION

**Received (As Found):** Out of Specifications      **Returned (As Left):** Within Specifications

## CALIBRATION DATA

Attribute	Minimum	Maximum	As Found	As Left	Units
Outside 1 in	-1	1	-2	0	.001 in 
Outside 2 in	-1	1	-2	0	.001 in 
Outside 4 in	-1	1	-2	0	.001 in 
Outside 6 in	-1	1	-2	0	.001 in 
Inside 1 in	-1	1	2	0	.001 in 
Inside 6 in	-1	1	2	0	.001 in 
Depth 1 in	-1	1	0	0	.001 in
Depth 6 in	-1	1	0	0	.001 in

The Calibration Laboratory Assessment Service (CLAS) of the National Research Council of Canada (NRC) has assessed and certified specific calibration capabilities of this laboratory and traceability to the International System of Units (SI) or to standards acceptable to the CLAS program. This certificate of calibration is issued in accordance with the conditions of certification granted by CLAS and the conditions of accreditation granted by the Standards Council of Canada (SCC). Neither CLAS nor SCC guarantee the accuracy of individual calibrations by accredited laboratories.



  
 30 MAY 2015



**Ulrich Métrologie inc.**  
**Ulrich Metrology Inc.**  
 9912, Côte-de-Liesse  
 Montréal (Québec) H8T 1A1

Tél. (514) 631-6653  
 Fax (514) 631-6122  
[info@ulrich.ca](mailto:info@ulrich.ca)  
[www.ulrich.ca](http://www.ulrich.ca)



**ACCREDITATION**  
**ISO 17025**  
 170  
 SCC Scope Number 220

<b>Certificate no.:</b> 472805	<b>Calibration date:</b> May 19, 2015
<b>Identification:</b> EM-176	<b>Certificate issued:</b> May 21, 2015

**CALIBRATION DATA**

Attribute	Minimum	Maximum	As Found	As Left	Units
-----------	---------	---------	----------	---------	-------

■ : Adjusted

**Notes:**

*Gauge was received out of tolerance.  
 Gauge was adjusted.*



## CERTIFICAT D'ÉTALONNAGE # 5144

Date d'étalonnage : 2015/09/21

Date d'émission du certificat : 2015/09/22

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. 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 finales dans les tolérances
Remarques	Tolérance placée à 2% OR à la demande du client

  
Métrologiste

  
Responsable du laboratoire

  
2015-09-25



## Certificat d'étalonnage # 5144

Numéro de série:	23544	Station de mesure:	3
Date d'étalonnage:	2015/09/21	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	2359	1500173210	2015/11/12
DHI molbloc (5 slpm)	5E3-VCR-V-Q	2473	1500177779	2016/03/03
DHI molbloc (10 slpm)	1E4-VCR-V-Q	2969	1500180895	2016/05/08
DHI molbox1	Molbox1	881	1500181338	2016/05/13
RTD Mist	M22	1478002	AC15041413-1478002	2016/04/24
Module 44.5 PSI avec Baro 163671	Module 30	160659	AC15041466-160659	2016/05/06

### Spécifications finales de l'appareil

### Condition d'étalonnage

Spécifications finales de l'appareil		Condition d'étalonnage	
Gaz	Air	Gaz	Air
Température d'opération	70 °F	Température ambiante	22 °C
Pression à l'entrée		Pression ambiante	1022 mbar
Pression à la sortie	14.7 PSIA	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	Référence calculée L	Erreur calculée L	Tolérance acceptable L	TUR
		Pression PSIA	Température °C	Référence L					
238.92417	39.9800	14.8361	23.21	39.8618	39.7672	0.2128	0.7953	>4	
358.99658	59.9500	14.8388	23.15	60.0432	59.8780	0.0720	1.1976	>4	
478.19782	79.9100	14.8426	23.12	79.8495	79.6030	0.3070	1.5921	>4	
598.14179	99.9900	14.8459	23.13	99.6913	99.3646	0.6254	1.9873	>4	
1194.42507	200.6300	14.8537	23.14	199.5841	198.8317	1.7983	3.9766	>4	

Bernard Poirier  
Métrologue

*Correction factor 0.99614*

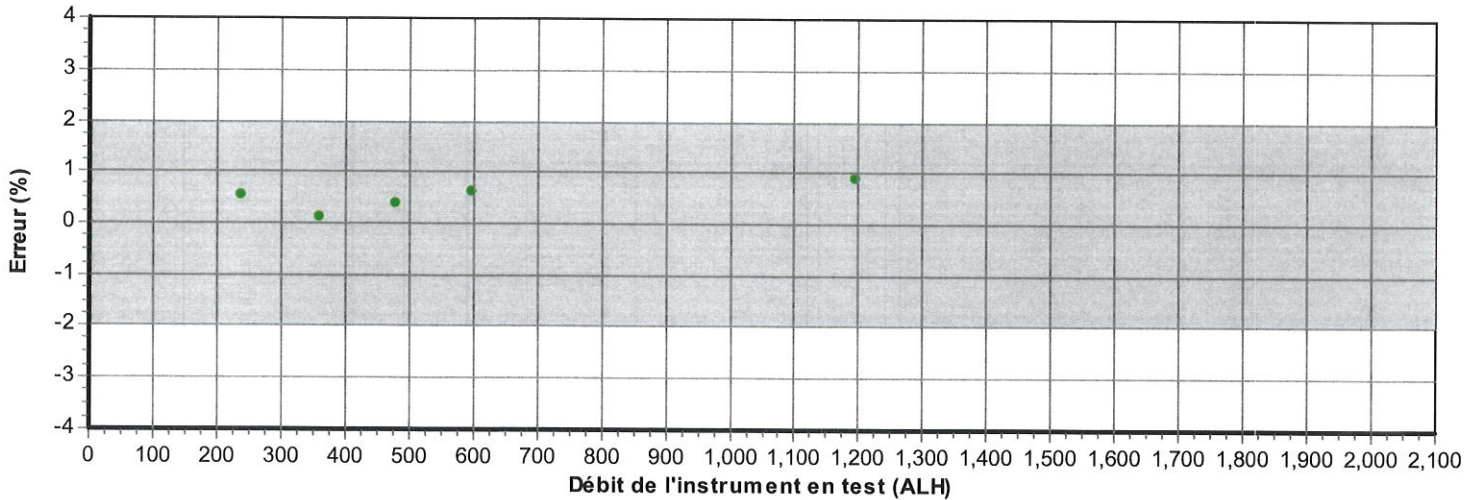
*B. Poirier*  
Signature

2015.09.25


## Certificat d'étalonnage # 5144

Numéro de série:	23544	Station de mesure:	3
Date d'étalonnage:	2015/09/21	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

  
2015-09-25

Bernard Poirier  
Métrologue

  
Signature

## CERTIFICAT D'ÉTALONNAGE # 5145

Date d'étalonnage : 2015/09/21

Date d'émission du certificat : 2015/09/22

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

Étalonnage d'un  
Shinigawa DC Da-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.

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. 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 finales dans les tolérances
Remarques	Tolérance placée à 2% OR à la demande du client

  
Métrologue

  
Responsable du laboratoire

  
2015-09-25

## Certificat d'étalonnage # 5145

Numéro de série:	23543	Station de mesure:	3
Date d'étalonnage:	2015/09/21	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	2359	1500173210	2015/11/12
DHI molbloc (5 slpm)	5E3-VCR-V-Q	2473	1500177779	2016/03/03
DHI molbloc (10 slpm)	1E4-VCR-V-Q	2969	1500180895	2016/05/08
DHI molbox1	Molbox1	881	1500181338	2016/05/13
RTD Mist	M22	1478002	AC15041413-1478002	2016/04/24
Module 44.5 PSI avec Baro 163671	Module 30	160659	AC15041466-160659	2016/05/06

### Spécifications finales de l'appareil

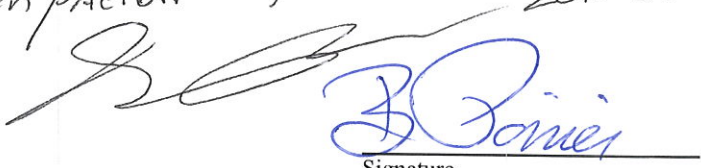
### Condition d'étalonnage

Gaz	Air	Gaz	Air
Température d'opération	70 °F	Température ambiante	22 °C
Pression à l'entrée		Pression ambiante	1022 mbar
Pression à la sortie	14.7 PSIA	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				
240.2115	40.5300	14.8534	23.08	40.2907	40.1306	0.3994	0.8026	>4
357.9294	60.2300	14.8526	23.10	59.8336	59.6039	0.6261	1.1921	>4
482.1559	81.1350	14.8519	23.09	80.5968	80.2884	0.8466	1.6058	>4
597.9776	100.5650	14.8533	23.10	99.9645	99.5776	0.9874	1.9916	>4
1201.7844	202.2300	14.8569	23.10	200.8896	200.0572	2.1728	4.0011	>4

correction factor 0,99005 2015-09-25



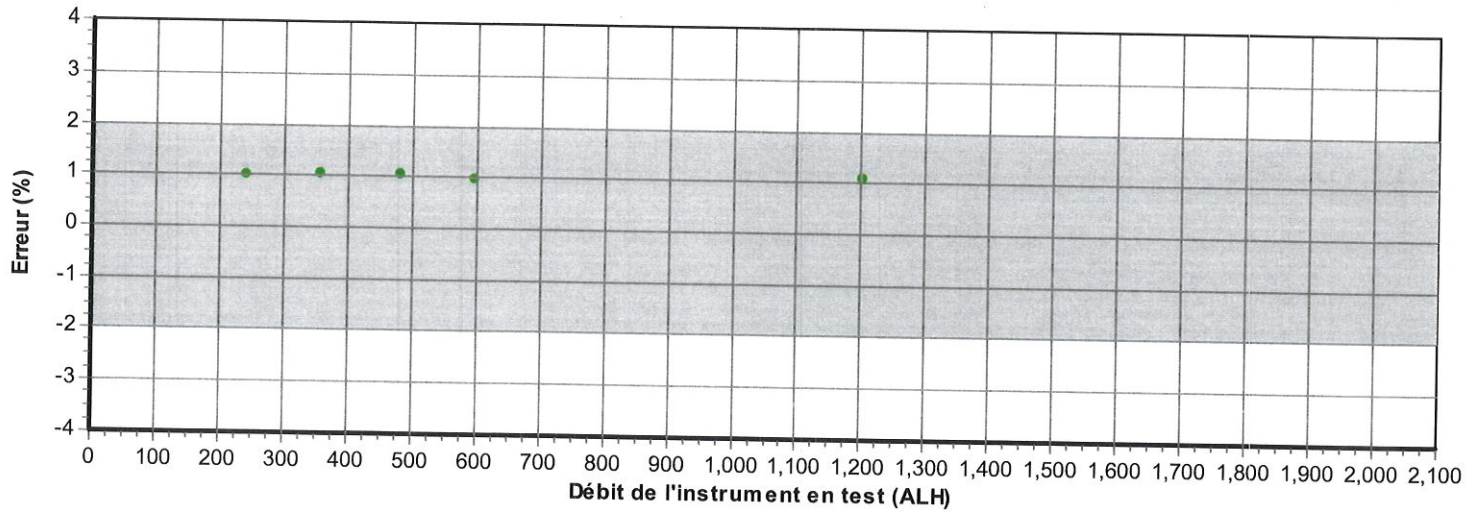
Signature

Bernard Poirier  
Métrologue

## Certificat d'étalonnage # 5145

Numéro de série:	23543	Station de mesure:	3
Date d'étalonnage:	2015/09/21	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

 2015-09-25

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**

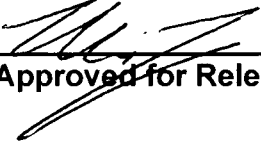
Part Number:	X04NI79C15A2VF3	Reference Number:	37-400238139-1
Cylinder Number:	SG9140147	Cylinder Volume:	151.0 CF
Laboratory:	ANE - Cheshire (SAP) - CT	Cylinder Pressure:	2015 PSIG
Analysis Date:	Aug 16, 2013	Valve Outlet:	590
Lot Number:	37-400238139-1		

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

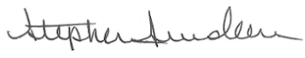


Twin Ports Testing, Inc.  
 1301 North 3rd Street  
 Superior, WI 54880  
 p: 715-392-7114  
 p: 800-373-2562  
 f: 715-392-7163  
 www.twinportstesting.com

**Report No:** USR:W215-0978-01  
**Issue No:** 2  
*Revised Report. Previous report is USR:W215-0978-01 issue number 1*

## Analytical Test Report

**Client:** POLYTESTS  
 695-B Gaudette  
 St-jean-sur-richelieu, QB J3B 7S7  
**Attention:** Danick Power  
**PO No:** 100371

**Signed:**   
 Stephen Sundeen  
 Chemistry Laboratory Manager  
**Date of Issue:** 9/17/2015  
*THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL*

**Sample Details**  
**Sample Log No:** W215-0978-01      **Sample Date:**  
**Sample Designation:** Pellet Sample      **Sample Time:**  
**Sample Recognized As:** Pellets      **Arrival Date:** 9/8/2015

### Test Results

	METHOD	UNITS	MOISTURE FREE	AS RECEIVED
Moisture Total	ASTM E871	wt. %		5.90
Ash	ASTM D1102	wt. %	0.38	0.36
Volatile Matter	ASTM D3175	wt. %		
Fixed Carbon by Difference	ASTM D3172	wt. %		
Sulfur	ASTM D4239	wt. %	0.007	0.006
SO <sub>2</sub>	Calculated	lb/mmbtu		0.015
Net Cal. Value at Const. Pressure	ISO 1928	GJ/tonne	18.89	16.58
Net Cal. Value at Const. Pressure	ISO 1928	J/g	18890	16582
Gross Cal. Value at Const. Vol.	ASTM E711	J/g	20214	19021
Gross Cal. Value at Const. Vol.	ASTM E711	Btu/lb	8691	8178
Carbon	ASTM D5373	wt. %	50.43	47.45
Hydrogen*	ASTM D5373	wt. %	6.08	5.73
Nitrogen	ASTM D5373	wt. %	< 0.20	< 0.19
Oxygen*	ASTM D3176	wt. %	> 42.90	> 40.36

\*Note: As received values do not include hydrogen and oxygen in the total moisture.

Chlorine	ASTM D6721	mg/kg		
Fluorine	ASTM D3761	mg/kg		
Mercury	ASTM D6722	mg/kg		

Bulk Density	ASTM E873	lbs/ft <sup>3</sup>		
Fines (Less than 1/8")	TPT CH-P-06	wt. %		
Durability Index	Kansas State	PDI		
Sample Above 1.50"	TPT CH-P-06	wt. %		
Maximum Length (Single Pellet)	TPT CH-P-06	inch		
Diameter, Range	TPT CH-P-05	inch		to
Diameter, Average	TPT CH-P-05	inch		
Stated Bag Weight	TPT CH-P-01	lbs		
Actual Bag Weight	TPT CH-P-01	lbs		

**Comments**



## APPENDIX 4: Unit pre burn

Temps  
acquisition  
de données  
minutes

Flue	Room	scale
temp	temp	
°F	°F	lbs

	Flue	Room	weight
0,00	281,44	66,59	13,1373
15,00	280,44	66,77	12,5567
30,00	279,08	67,03	44,9731
45,00	274,68	66,97	44,3819
60,00	271,09	67,46	43,7829
75,00	264,99	67,71	43,1856
90,00	261,53	67,87	42,5724
105,00	259,49	68,30	41,9843
120,00	262,06	68,61	41,3837
135,00	266,98	69,07	40,7896
150,00	261,10	69,72	40,1877
165,00	256,72	70,22	39,5729
180,00	258,87	70,13	39,0882
195,00	263,66	70,09	38,4842
210,00	259,96	71,43	37,8863
225,00	258,17	72,46	37,2900
240,00	261,82	73,11	36,8030
255,00	262,24	73,77	36,1956
270,00	263,45	74,40	35,5847
285,00	266,56	74,92	35,0095
300,00	269,16	75,49	34,4135
315,00	268,19	75,93	33,8967
330,00	269,01	76,34	33,3023
345,00	270,57	76,87	32,7150
360,00	268,13	77,27	32,0279
375,00	268,32	77,72	31,5135
390,00	269,83	78,57	30,9101
405,00	272,54	80,26	30,3161
420,00	272,95	80,98	29,7144
435,00	274,94	81,58	29,1222
450,00	273,14	81,81	28,6133
465,00	276,14	81,59	27,9185
480,00	281,49	79,66	27,4254
495,00	Flue	Room	weight
510,00	283,26	69,83	9,5598
525,00	279,07	70,00	24,2288
540,00	284,37	70,18	23,6280
555,00	282,48	70,25	23,0238
570,00	276,00	70,47	22,4156
585,00	278,22	70,70	21,9314
600,00	272,63	70,89	21,3266
615,00	277,07	71,00	20,7260
630,00	279,60	71,13	20,1203
645,00	272,62	69,68	19,6398
660,00	276,17	70,93	19,0371
675,00	282,29	71,41	18,3312
690,00	275,99	71,98	17,8304
705,00	278,15	72,46	17,2434
720,00	276,63	72,50	16,6393

735,00	280,27	73,10	16,1386
750,00	272,67	73,37	15,5546
765,00	297,91	73,92	14,9488
780,00	182,35	74,58	14,9538
795,00	132,65	75,88	14,9530
810,00	Flue	Room	weight
825,00	246,11	77,66	30,4135
840,00	265,91	77,66	43,3733
855,00	275,74	77,82	42,6724
870,00	272,12	77,78	42,0994
885,00	277,46	77,75	41,4813
900,00	279,46	77,83	40,7969
915,00	301,54	77,73	40,1831
930,00	301,55	77,66	39,5736
945,00	295,29	77,45	38,8929
960,00	297,74	77,33	38,3015
975,00	289,30	77,26	37,5991
990,00	289,75	77,24	36,9939
1005,00	289,19	76,98	36,3923
1020,00	291,31	76,95	35,6843
1035,00	289,04	76,88	35,1072
1050,00	288,50	76,72	34,4826
1065,00	288,61	76,56	33,8073
1080,00	288,76	76,45	33,1981
1095,00	290,29	76,33	32,4928
1110,00	294,45	76,15	31,9115
1125,00	288,36	75,95	31,3138
1140,00	288,97	75,72	30,7023
1155,00	293,15	75,76	30,0051
1170,00	290,82	75,47	29,4117
1185,00	288,43	75,34	28,8217
1200,00	287,84	75,13	28,1172
1215,00	292,67	75,18	27,5012
1230,00	295,35	74,97	26,8114
1245,00	294,84	74,79	26,2189
1260,00	292,83	74,60	25,5170
1275,00	290,14	74,44	24,9330
1290,00	296,11	74,34	24,3322
1305,00	287,47	74,13	23,7212
1320,00	294,43	73,97	23,0253
1335,00	296,79	73,88	22,3243
1350,00	293,64	73,74	21,7155
1365,00	294,48	73,71	21,1386
1380,00	289,05	73,51	20,4387
1395,00	287,82	73,43	19,8317
1410,00	290,80	73,21	19,2308
1425,00	299,21	73,05	18,5297
1440,00	284,45	72,98	18,0446
1455,00	289,73	72,70	17,4361
1470,00	289,05	72,64	16,7349
1485,00	289,50	72,49	16,1366
1500,00	288,17	72,30	15,5541
1515,00	287,50	72,20	14,8524
1530,00	289,93	72,07	14,2458
1545,00	290,48	71,89	13,6432

1560,00	292,94	71,90	13,0398
1575,00	292,91	71,73	12,3430
1590,00	293,76	71,59	11,8523
1605,00	289,49	71,49	11,2500
1620,00	293,93	71,46	10,5525
1635,00	289,53	71,42	9,9493
1650,00	290,37	71,53	9,2489
1665,00	295,14	71,75	28,9220
1680,00	297,41	72,08	28,2188
1695,00	295,95	72,40	27,5190
1710,00	299,50	72,77	26,9133
1725,00	291,22	73,11	26,3072
1740,00	293,39	73,33	25,6275
1755,00	294,30	73,96	25,0334
1770,00	Flue	Room	weight
1785,00	241,81	79,27	40,2797
1800,00	256,55	79,43	39,6985
1815,00	262,46	79,61	39,0066
1830,00	266,74	79,24	38,3941
1845,00	272,86	79,48	37,6896
1860,00	271,78	79,60	37,0971
1875,00	265,70	79,99	36,4853
1890,00	273,86	79,79	35,8144
1905,00	276,23	80,05	35,2100
1920,00	276,85	80,39	34,6015
1935,00	283,02	80,38	33,9011
1950,00	281,37	80,26	33,2000
1965,00	288,81	80,21	32,6060
1980,00	285,12	80,26	31,9180
1995,00	288,20	80,29	31,1271
2010,00	285,80	80,11	30,5143
2025,00	288,79	80,10	29,9164
2040,00	285,23	80,00	29,3096
2055,00	282,54	79,93	28,6034
2070,00	287,87	79,86	28,0250
2085,00	287,06	79,79	27,4263
2100,00	288,73	79,63	26,7176
2115,00	278,87	79,57	26,1136
2130,00	283,25	79,47	25,5154
2145,00	278,97	79,35	24,9270
2160,00	291,15	79,30	24,2282
2175,00	287,04	79,19	23,6240
2190,00	288,83	79,16	22,9276
2205,00	289,59	78,96	22,3265
2220,00	294,15	79,01	21,6238
2235,00	281,97	78,85	21,0378
2250,00	286,88	78,72	20,4350
2265,00	285,36	78,72	19,7395
2280,00	298,25	78,58	19,0329
2295,00	284,89	78,41	18,4295
2310,00	285,09	78,18	17,8296
2325,00	287,24	78,10	17,2452
2340,00	290,14	77,97	16,6432
2355,00	285,93	77,79	15,9450
2370,00	280,38	77,70	15,3361

2385,00	289,01	77,59	14,7325
2400,00	290,42	77,43	14,1508
2415,00	287,72	77,29	13,4541
2430,00	288,94	77,11	12,8503
2445,00	284,09	76,96	12,2466
2460,00	286,81	76,94	11,6611
2475,00	284,16	76,75	10,9632
2490,00	290,00	76,75	10,3601
2505,00	288,14	76,60	9,6556
2520,00	280,31	76,51	9,0525
2535,00	281,05	76,37	8,5695
2550,00	288,26	76,23	7,8682
2565,00	284,73	76,14	7,2655
2580,00	286,43	76,06	6,5625
2595,00	283,52	76,04	5,9619
2610,00	294,09	76,00	5,3568
2625,00	292,93	75,87	4,6762
2640,00	291,16	75,74	3,9769
2655,00	277,98	75,74	3,4698
2670,00	267,95	75,51	2,9645
2685,00	259,89	75,39	2,4779
2700,00	234,01	75,27	2,1666
2715,00	227,15	75,05	1,7778
2730,00	208,90	74,96	1,4662
2745,00	209,81	74,82	1,1738
2760,00	192,05	74,57	0,9796
2775,00	181,03	74,48	0,7851
2790,00	176,75	74,23	0,6685
2805,00	168,50	74,10	0,5708
2820,00	162,12	73,92	0,4738
2835,00	147,22	73,83	0,3763
2850,00	136,86	73,68	0,3762
2865,00	285,93	77,79	15,9450
2880,00	280,38	77,70	15,3361
2895,00	289,01	77,59	14,7325
2910,00	290,42	77,43	14,1508
2925,00	287,72	77,29	13,4541
2940,00	288,94	77,11	12,8503
2955,00	284,09	76,96	12,2466
2970,00	286,81	76,94	11,6611
2985,00	284,16	76,75	10,9632
3000,00	290,00	76,75	10,3601
3015,00	288,14	76,60	9,6556
3030,00	280,31	76,51	9,0525
3045,00	281,05	76,37	8,5695
3060,00	288,26	76,23	7,8682
3075,00	284,73	76,14	7,2655

## 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)

## APPENDIX 6: Drawings and specifications



## APPENDIX 7: Operator's manual



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## Stoves with RDS technology

Francesca - RV 80 Ceramica  
Nicole - RV 100 Classic - Roma



**SAVE THESE INSTRUCTIONS**

**Please read this entire manual before installation and use of this pellet fuel-burning room heater. Failure to follow these instructions could result in property damage, bodily injury or even death. Contact local building or fire officials about restrictions and installation inspection requirements in your area. Contact local authorities to see if a permit must be obtained before installation.**

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## INTRODUCTION



Please read this manual carefully. It describes all the phases necessary for perfect functioning of the stove.



The regulations on installation and operation in this manual may differ from the regulations in force locally. In this case, the indications of the competent local authorities must always be followed. The drawings shown in this manual are indicative and not to scale.

### Information

The packaging that we have used offers good protection against any damage due to transport. Always check the stove immediately after delivery: in the event of any damage, please inform your Ravelli dealer immediately.

### Description of use and maintenance manual

With this use and maintenance manual, Ravelli wishes to provide the user with all the information on safety in using the stove, in order to avoid damage to persons or things or parts of the stove. Please read this manual carefully before use and any work on the product.

## WARNINGS

Ravelli stoves are manufactured taking care even on the individual components in order to protect both the user and the installer from any accidents.

The authorized personnel, after any work on the product, should therefore always pay special attention to the electrical connections.

Installation must be performed by authorized personnel, who must give the purchaser a declaration of conformity of the appliance, and who will assume all responsibility for the final installation and consequent good functioning of the product installed. It is also necessary to take into consideration all the laws and national, regional, provincial and local regulations present in the country in which the appliance has been installed. In the event of failure to respect these precautions, Aico S.p.A. declines all responsibility.

This instruction manual is an integral part of the product: please make sure that it is always with the stove, including in the case of transfer to another owner or user, or transfer to another place. In the case of its damage or loss, please request another copy from the Technical service.

**This stove must be used for the purpose for which it has been specifically manufactured. Do not use the appliance as an incinerator or in any way other than that for which it was designed. All contractual and tort responsibility of the manufacturer is excluded for damage caused to persons, animals or things, due to errors of installation, maintenance regulation or improper use. No other fuel except the pellets must be used. Do not use liquid fuels.**

After having removed the packaging, please make sure that the contents are complete and intact.

**All the electrical components that make up the stove must be replaced with original spare parts exclusively from an authorized technical assistance centre.**

Maintenance of the stove must be performed at least once a year, planning it in time with the technical assistance centre. Do not make any unauthorized modification to the appliance.

For safety reasons, please remember that:

- the stove must not be used by children or disabled people without assistance;
- do not touch the stove when barefoot or when any parts of the body are wet;
- the safety devices or adjustment devices must not be modified without the authorization or instructions of Ravelli.

The stove, especially the external surfaces, reaches very high temperatures when it is in operation; take care when touching it to avoid burns.

The stove has been designed to function in any climatic condition; in the event of particularly adverse conditions (wind, freezing), safety systems could switch off the stove.

If this occurs, contact the technical assistance and, in any case, do not disable the safety systems.

## THANK YOU

Dear Customer,

We would like to thank you and congratulate you on the excellent choice you have made.

With the Ravelli stove, you will see that quality and economy can go hand in hand, offering excellent performances with limited consumption and being totally practical. Please find below some suggestions, which we would like to give you, to obtain the most from your stove and to fully enjoy all the advantages that it can give you.

Through this, we want to be close to our customers to offer the maximum technical support to all those who use our technology.

Aico S.p.A. thanks you for your confidence and wishes you happy times in the company of your pellet stove.

## **SAFETY INFORMATION**

The stove must be installed and tested by specialized personnel instructed by the Ravelli. Please read this use and maintenance manual before installing and putting the stove into operation!  
If you require further information, please contact your Ravelli dealer.

### **IMPORTANT**

**The place of installation of the stove must comply with local, national and Federal regulations.**

The stove must be fuelled only with quality pellets with a diameter of 6 mm as described in the specific chapter.

The stove cannot operate with traditional wood

The stove must not be used as an incinerator. **FIRE HAZARD!!!**

Installation, the electrical connections, checking the functioning and maintenance must be performed by qualified and authorized personnel.

Improper installation or poor maintenance (not compliant with what is shown in the following manual) may cause damage to persons and things. In this condition, Ravelli is relieved of all civil or criminal responsibility.

Before connecting the stove electrically, the connection of the exhaust tubes must be completed (specifically for pellet stoves, not made from aluminium) with the flue.

The protection grille inside the pellet hopper must never be removed.

There must be sufficient circulation of air in the room where the stove is installed.

Never open the door of the stove whilst it is functioning. **FIRE HAZARD!!!**

The stove must not be used with the door open or with the glass broken. **FIRE HAZARD!!!**

When the stove is operating, the surfaces, the glass, the handle and the pipes become overheated: during functioning, these parts must only be touched with the adequate protection.

Do not light the stove without having first performed the daily inspection as described in the MAINTENANCE chapter of this manual.

Do not place any washing on the stove to dry. Keep clothes and similar at a suitable distance from the stove. **FIRE HAZARD!!!**

**DO NOT INSTALL A FLUE DAMPER**

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

Attachment and securement of the exhaust venting system to the product and to each adjoining section. All joints for connector pipe shall be required to be fastened with at least three screws. If vented horizontally, joints shall be made gaslight in a manner that shall be specified.

Perform regular inspection, maintenance, and cleaning of the chimney and chimney connector

Disposal of Ashes: Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials, and moved outdoors immediately. 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. Other waste shall not be placed in this container. Caution against the storage or use of flammable liquids, as follows: 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.

**Creosote - Formation and Need for Removal**

When wood is burned slowly, it produces tar and other organic vapors, which combine with expelled moisture to form creosote. The 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

The exhaust venting system should be inspected at least once every two months during the heating season to determine if a creosote buildup has occurred.

If creosote has accumulated it should be removed to reduce the risk of a chimney fire.

Scrupulously follow the maintenance programme.

Do not switch off the stove by disconnecting the electricity mains supply.

Do not clean the stove until the structure and the ashes have cooled down completely.

Carry out all operations in maximum safety and tranquillity.

Comply with exhaust venting system termination requirements including location restrictions to air inlets, distances from windows, doors, and air inlets and distance to combustible materials.

Do not connect to or use in conjunction with any air distribution ductwork

Hot while in operation. Keep children, clothing and furniture away. Contact may cause skin burns.

The type of chimney shall be suitable for solid fuel and the chimney connector must be in good condition and kept clean. Establish a routine for the fuel, pellet 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 or fire authority for information on how to handle a chimney fire. Have a clearly understood plan to handle a chimney fire. Keep firing and deashing doors closed and maintain all seals in good conditions.

Do not strike or slam shut the door, the glass can break. The glass shall be cleaned only when cold, do not clean a hot glass. Use a dry cloth with normal glass detergent, do not use any abrasive cleaner.

The type of chimney shall be suitable for solid fuel and the chimney connector must be in good condition and kept clean.

When this room heater is not properly installed, a house fire may result. To reduce the risk of fire, follow the installation instructions. Contact local building or fire officials about restrictions and installation inspection requirements in your area. This room heater must be connected to a chimney complying with the requirements for type HT chimneys in the standard UL 103 or a code-approved masonry chimney with a flue liner.

This wood heater needs periodic inspection and repair for proper operation. It is against federal regulations to operate this wood heater in a manner inconsistent with operating instructions in this manual. - This wood heater has a manufacturer-set minimum low burn rate that must not be altered. It is against federal regulations to alter this setting or otherwise operate this wood heater in a manner inconsistent with operating instructions in this manual.

This heater is designed to burn wood pellet only. **DO NOT BURN ANY OTHER FUEL.** Burning other materials may result in release of toxic fumes or render the heater ineffective and cause smoke.

Do not overfire. Attempts to achieve heat output rates that exceed heater design specifications can result in permanent damage to the heater.

Flue gases contain carbon monoxide (CO), it is recommended to install smoke monitors and CO monitors for areas that are expected to generate CO. Inspect the chimney to minimize visible emissions.

**Soot and Flyash: Formation and Need for Removal**—The products of combustion will contain small particles of flyash. The flyash will collect in the exhaust venting system and restrict the flow of the flue gases. Incomplete combustion, such as occurs during startup, shutdown, or incorrect operation of the room heater will lead to some soot formation which will collect in the exhaust venting system. The exhaust venting system should be inspected at least once every year to determine if cleaning is necessary.

## GENERAL

The Stove must only operate in rooms. As it is controlled by an electronic board, combustion is completely automatic and controlled and the control unit regulates the ignition phase, 5 levels of power and the switching off phase, guaranteeing safe functioning. Most of the ashes produced by the combustion of the pellets fall into the collection drawer.

However, always check the fire pot every day, as not all pellets have high standards of quality and could leave residue that is difficult to remove.

The glass has a special air circulation for self-cleaning. However, a slight greyish film cannot be avoided after a few hours of functioning.

As already mentioned earlier, pellets with a diameter of 6 mm must be used with the stove.

### Responsibility

Ravelli declines all responsibility, both civil and criminal, with the delivery of this manual, for any accidents deriving from partial or total failure to observe the instructions it contains,

Ravelli declines all responsibility deriving from the improper use of the stove, from its incorrect use by the user, by unauthorized modifications and/or repairs or from the use of spare parts which are not original.

The manufacturer declines all direct civil or criminal responsibility due to:

- failure to observe the instructions in the manual
- use not compliant with the safety instructions
- installation that is not compliant with the regulations in force in the country.
- installation by personnel who are not qualified or authorized
- modifications and repairs that are not authorized by the manufacturer
- use of spare parts that are not original
- exceptional events

### Majolica finishes

Due to the special hand finish of the majolica surface imperfections such as shadowing may occur. Those are details that make every majolica one of its kind. As it is a delicate material, please handle with care whilst cleaning and avoid blows as sudden breakage may occur. Please also take care when loading the hopper (Ed.'s note; tank containing the pellets) with the bag of pellets: do not place it on the stove!

### What are the wood pellets

The wood pellets are made from sawdust and wood shavings produced in joiners' shops. The material used cannot contain any foreign substance such as glue, varnish or synthetic substances.

Subjecting it to high pressure, the wood is pressed through a plate with holes and due to the high pressure the sawdust is heated activating the natural binders of the wood. Thus, the pellets keep their shape even without the addition of bonding substances. The density of the wood pellet varies according to the type of wood and can be 1.5 – twice greater than that of natural wood.

The diameter of the cylindrical rods is 6 mm and their length can vary between 10 and 40 mm.

Their real weight is greater than 650 kg/m<sup>3</sup>. Due to the low content of water (<10%) they have a high energy content.

The standards ISO 17225-2:2014 define the quality of the pellets:

Length: < 40 mm

Diameter: 6 mm approx.

Real weight: > 600 kg/m<sup>3</sup>

Lower heating value: ≥ 16,5 MJ/kg (≥ 7100 BTU/lb)

Residual humidity: < 10 %

Ashes: < 1.2 %

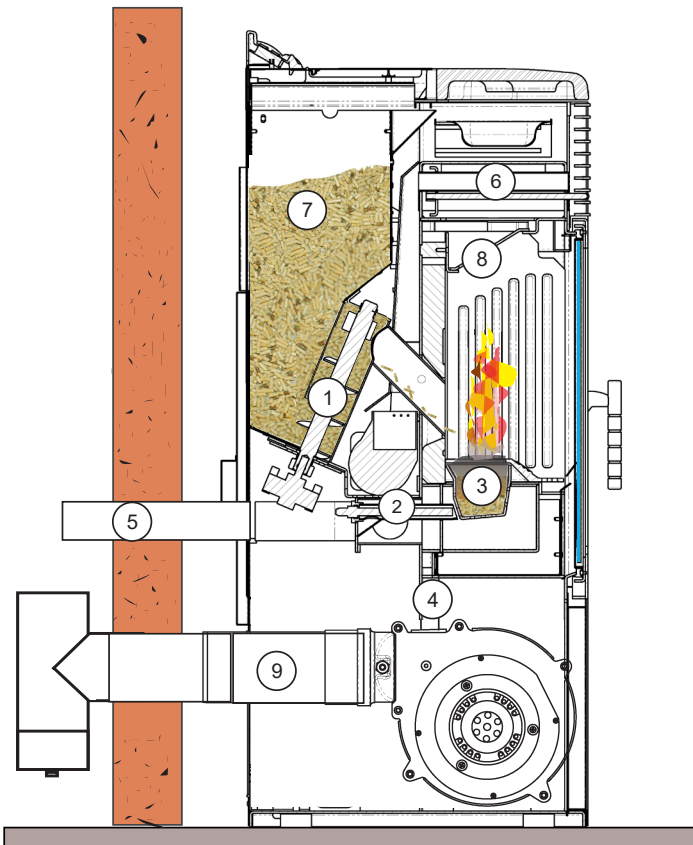
Specific weight: >1000 kg/m<sup>3</sup>

Do not put the bag of pellets on the ceramic parts during the loading operations.



The pellets must be transported and stored in a dry place. They swell on contact with damp, and cannot be used, They must always be protected from the damp both during transport and in storage. Do not place such fuel within the space heater installation clearances or within the space required for charging and ash removal.

### The components of the stove



- 1) pellet loading auger
- 2) electrical igniter
- 3) combustion fire pot
- 4) tube for passage of smoke
- 5) air intake tube
- 6) stainless steel heat exchanger
- 7) pellet hopper
- 8) baffle
- 9) smoke exhaust tube

This drawing shows the internal parts of a pellet stove.

By filling the hopper (7), the pellets are loaded into the fire pot (3) through the loading auger (1).

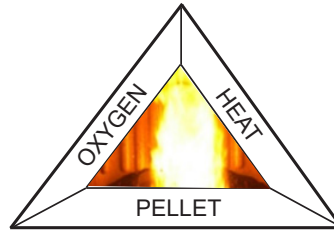
Ignition is by means of the electrical igniter (2), which overheats the air from the special entrance (5) which on contact with the pellets will allow the development of the flame. At this point the exhaust smoke is deviated towards the stainless steel exchanger (6) and through the smoke extraction tube (4) it is released into the flue, through the connection with the smoke exhaust pipe. (9).



### The combustion

The combustion is a chemical reaction between fuel and oxidizer. The result of this reaction is the heat. The three elements that are required for the combustion are:

- Fuel (pellet)
- Oxidizer (oxygen available in the air)
- Ignition (heat of embers or electrical ignitor)



To get the combustion, the combustible and the carburant must be available in a correct proportion.

The reaction between combustible and carburant is made by an external starter. The start can be made by the hot reaction or by a sparkle.

The combustion is NOT CORRECT, the flame is too tight with too much incandescent pellet in the fire pot.

Adjust the Set pellet/air reducing the air percentage (from 0 up to -5); in the vent this is not enough to get a proper flame, increase the loading quantity of the pellet (from 0 up to +5) to reach the flame condition shown in picture 3.



**Pic. 1**

INCORRECT combustion, flame too drawn, in "blowtorch" style with a high quantity of incandescent pellets coming out of the grate. Correct the pellet/air set by reducing the percentage of air (from 0 to -5); if not sufficient, also increase the percentage of falling pellets (from 0 to +5) to arrive to the condition in Figure 3.

If the changes made to the settings do not bring the stove to the right combustion conditions in Figure 3, contact the Technical Support Centre.



**Pic. 2**

INCORRECT combustion, "spring" flame in "wood stove" style with high quantity of pellets not burning on the grate. Firstly, check the door is closed and the ash pan. Secondly, correct the pellet/air set by increasing the percentage of air (from 0 to +5); if not sufficient, also reduce the percentage of falling pellets (from 0 to -5) to arrive to the condition in Figure 3.

If the changes made to the settings do not bring the stove to the right combustion conditions in Figure 3, contact the Technical Support Centre.



**Pic. 3**

The combustion IS CORRECT, full flame yellow/white and minimum quantity of pellet in the fire pot.

The combustion is fine and no ad.

The picture 3 shows a flame done with a stove working at power P5.

### Compliance status

This manual describes the installation and operation of the Ravelli, Francesca 2015, Nicole, RV80 Ceramica wood pellet heater. This heaters meet the 2020 U.S. Environmental Protection Agency's wood pellet emission limits for wood heaters sold after May 15<sup>th</sup> 2015. Under specific test conditions this heater has been shown to deliver **heat at rates ranging from 11695 to 28231 Btu/hr.**

This manual describes the installation and operation of the Ravelli, Roma wood pellet fireplace insert. This heater meets the 2020 U.S. Environmental Protection Agency's wood pellet emission limits for wood heaters sold after May 15<sup>th</sup> 2015. Under specific test conditions this heater has been shown to deliver **heat at rates ranging from 10250 to 31500 Btu/hr.**

This manual describes the installation and operation of the Ravelli, RV100 CLASSIC wood pellet heater. This heaters meet the 2020 U.S. Environmental Protection Agency's wood pellet emission limits for wood heaters sold after May 15<sup>th</sup> 2015. Under specific test conditions this heater has been shown to deliver **heat at rates ranging from 10750 to 34500 Btu/hr.**

	Emission Rate (g/hr)	Heating Efficiency (% Overall)	1st hour Emission Rate (g/hr)	CO emission gr/hr
Francesca 2015, Nicole and RV80 Ceramica	1.00	80.73%	1.09	6.24
RV100 Classic	0.7	80.2%	0.67	2.72
Roma	0.74	75.5%	1.33	9.45

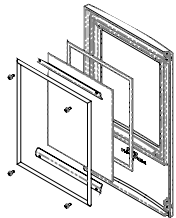
### Spare parts

Use original spare parts only. Do not use any substitute material. Do not wait for the components to be worn before replacing them. Replace a worn component before it is completely broken to prevent any accidents caused by the sudden breakage of components, perform the periodic maintenance checks as described in the dedicated chapter. Removal of broken or damaged components shall be only done by authorized technical service.

### Glass and gasket replacement

Use only ceramic type glass. To replace the glass the door needs to be disassembled according to the below drawing.

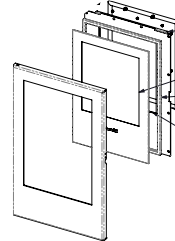
#### Francesca 2015 - Nicole



**Ceramic glass dimensions:**  
250 x 307 mm (9.8" x 12.08")  
thickness 4mm (0.16")

**Glass twist tricovet gasket:**  
diam. 10 mm / 0.39"  
L1230 mm / 48.43"

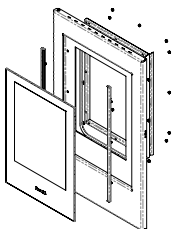
#### RV 80 Ceramica



**Ceramic glass dimensions:**  
305 x 449 mm (12" x 17.68")  
thickness 4mm (0.16")

**Glass twist tricovet gasket:**  
diam. 14 mm / 0.55"  
L1250 mm / 49.21"

#### RV 100 Classic

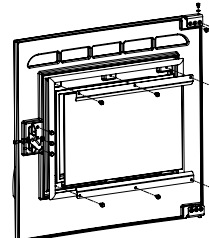


**Ceramic glass dimensions:**  
319 x 460 mm (12.55" x 18.11")  
thickness 5 mm (0.20")

**Glass ribbon trecotee gasket:**  
10 mm x 3 mm (0.39" x 0.12")  
L1344 mm (52.91")

**Door tricovet gasket:**  
diam. 14 mm / 0.55"  
L1365 mm / 53.77"

#### Roma



**Ceramic glass dimensions:**  
260 x 375 mm (10.24" x 14.76")  
thickness 5mm (0.20")

**Glass ribbon trecotee gasket:**  
10 mm x 3 mm (0.39" x 0.12")  
L1100 mm (43.31")

**Door tricovet gasket:**  
diam. 10 mm / 0.39"  
L1500 mm / 59.06"

## SAFETY DEVICES

The stove is fitted with sophisticated safety systems so that, in the case of breakage of one of the individual parts or defects in the flue, no damage will be caused to the stove and the room in which it is installed. In any case, when a problem arises, the pellets stop falling immediately and the “ switch off ” phase is activated.

The corresponding alarm will be shown on the display. The details can be seen in chapter 9 "DESCRIPTION OF ALARMS".

## TECHNICAL FEATURES

		Francesca 2015	Nicole	RV 80 Ceramica	RV 100 Classic	Roma
Height	Inch	37.67	36.8	39	44.1	31.5
Width	Inch	17.32	17.4	20.20	21.7	43.4
Depth	Inch	18.46	19.6	19.1	21.9	29.5
Weight	Lbs	200	253	270	320	550
Diameter of smoke exit tube	Inch	3.14	3.14	3.14	3.14	3.14
Min - max hourly consumption of pellets	Lbs/h	1.7 - 4.3	1.7 - 4.3	1.7 - 4.3	1.5 - 5.1	1.6 - 5
Supply	V - Hz	120 - 60	120 - 60	120 - 60	120 - 60	120 - 60
Hopper capacity	Lbs	35	35	35	50	50
Efficiency *	%	80.73	80.73	80.73	80.2	75.5
Smoke temperature min - max	°F	176 - 302	176 - 302	176 - 302	200 - 415	240 - 410

\*overall heating efficiency is determined using higher heating value of the fuel.

The data shown above are indicative and not binding. Ravelli reserves the right to make any modifications for the purpose of improving the performances of the product.

The stove is equipped with a combustion air control device that automatically sets the parameters for good combustion, optimising consumption of pellet and ensuring maximum efficiency.



## POSITIONING, ASSEMBLY AND INSTALLATION

### **Environment of use**

The positioning of the stove is decisive for a successful and equal heating of the room. Before deciding where to place the stove, the following must be taken into account:

- The stove must be installed on a floor with a sufficient carrying capacity. If the existing building does not meet this requisite, appropriate measures must be taken (i.e. load distribution plate).
- The combustion air cannot be obtained from a garage or from an area without ventilation or exchange of air, but from a free or external space
- The stove must not be installed in a bedroom, bathroom or shower, or where there is already another heating appliance without an autonomous air flow (chimney, stove etc.)
- A non-combustable Hearth board 6" from front of unit and 6" from the sides must be installed before unit is placed on the floor.
- Installation is better in a large and central room in the house to ensure maximum circulation of the heat;
- Connection to the main supply is recommended using a grounded outlet (if the cable supplied is not long enough to reach the nearest outlet, use an extension cord with a surge protector);
- The stove must be placed in a position that receives the necessary level of air for appropriate combustion of the pellets (at least 131.23 f<sup>3</sup>/h must be available), in accordance with installation regulation and local legislations;
- All joints for connector pipe is required to be fastened with at least three screws.
- If vented horizontally joint should be siliconed with hi-temp. silicone and screwed so they are gas tight. (RTU 500 silicone)
- the chimney connector shall not pass through an attic or roof space, closet or similar concealed space, or a floor or ceiling. Where passage through a wal, or partition of combustible construction is desired, the installation shall conform to CAN/CSA-B365.

The stove must be installed and assembled by qualified personnel.

The room must be:

- Prepared for the environmental functioning conditions
- Prepared with an adequate system of evacuation of smoke
- Have a 120V 60 Hz electricity mains supply
- Do not connect this unit to a chimney flue serving another appliance
- Use only UL Listed Type L Vent or Pellet Vent 3" in. I.D. venting system to exhaust. Do not install flue damper in the exhaust system of this unit.
- The chimney connector and each other adjoining section must be firmly attached and secured to the stove.

### **Mobile Home Requirements**

- Outside air is required
- The heater must be secured to the floor using lag bolts.
- The heater must be grounded to the chassis of the mobile home.
- Installation should be in accordance with the manufactured home.
- When outside air is required, system parts, such as vent sections, supports, spark arresters, rodent screens, etc. must be used.
- The space heater is to be connected to a factory built chimney conforming to CAN/ULC-S629.
- It is important to use all the specified components, do not use other components.
- Installation shall maintain an effective vapour barrier at the location where the chimney or other component penetrates to the exterior of the structure.
- Operating the space heater with open firing doors can cause serious injuries and health damages due to escaping flames or carbon monoxide generation inside the room.
- Adequate ventilation is required to avoid air starvation and icing which can determine an unhealthy indoor environment.
- Do not overfire.
- If the space heater is not correctly installed and operated it can interfere with smoke detectors.



Do not install in bedroom



The structural integrity of the mobile home floor, ceiling, walls, roof must be maintained.



Refer to HUD Requirements, CFR 3280, Part 24



Install vent at clearances specified by the vent manufactures.



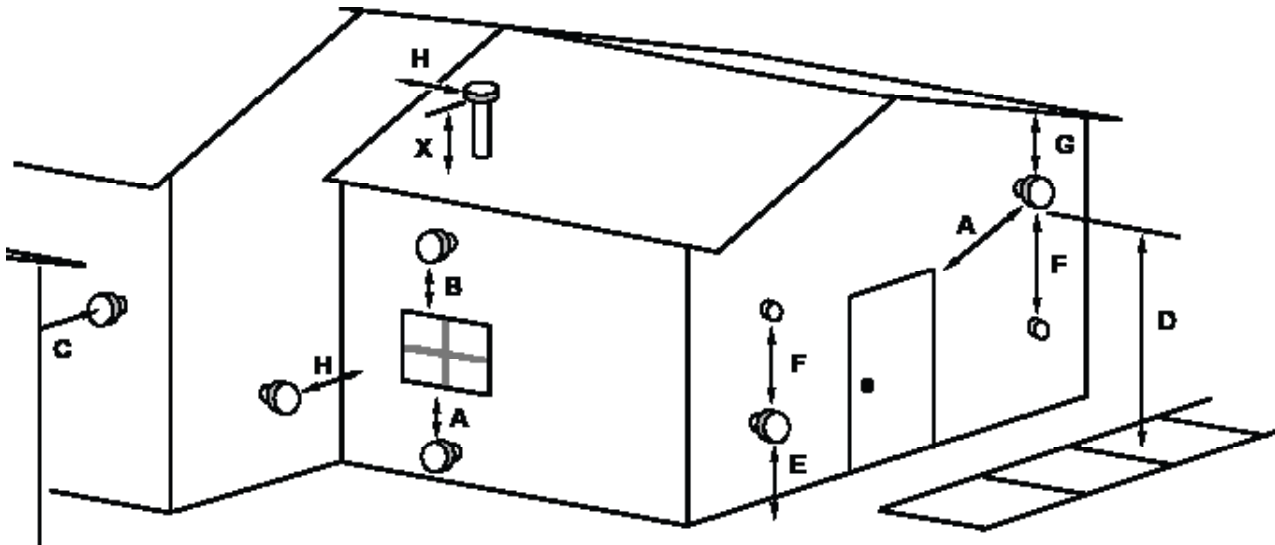
Measure clearances to the nearest edge of the exhaust hood.



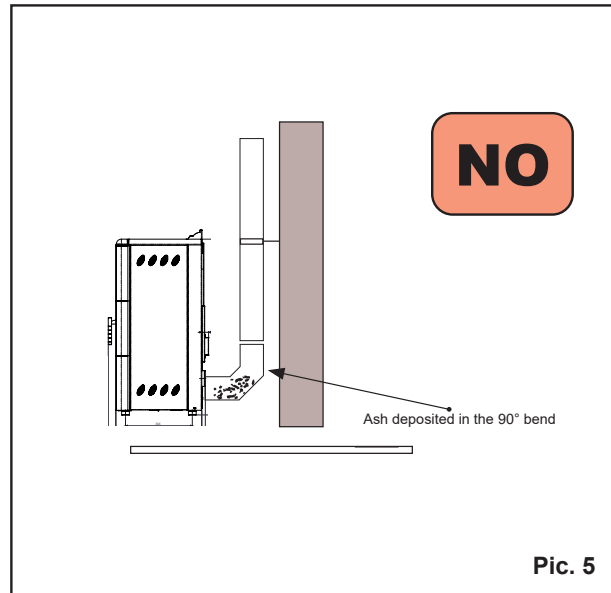
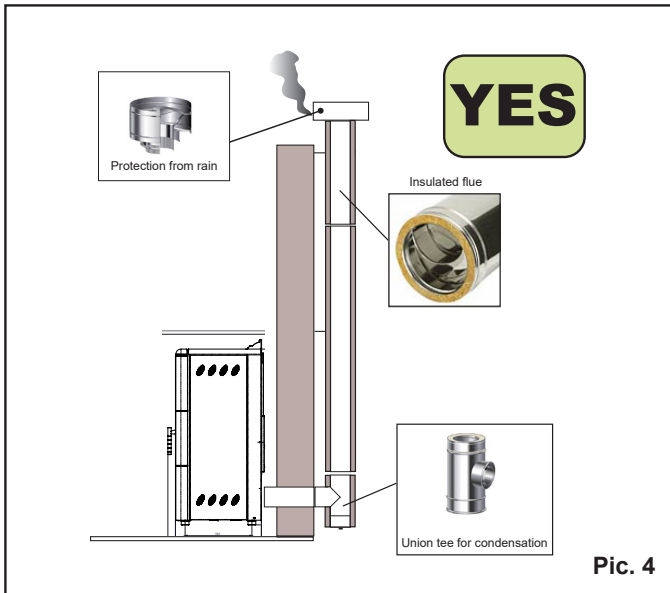
Vent may not terminate in covered walkway or breezeway.



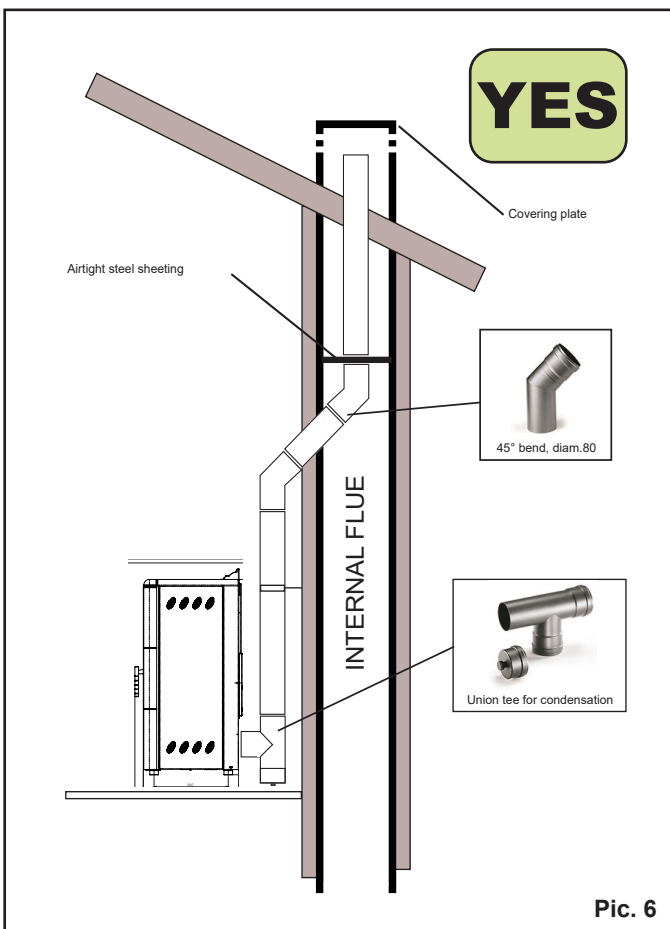
If venting horizontally, check your venting specifications for distance pipe should extrude from building.

**Vent Termination Locations**


- A) Minimum 4' clearance below or beside any door or window that opens (with outside air installed, 1' below or beside)  
Minimum 1' clearance below or beside any window that does not open.
- B) Minimum 1' clearance above any door or window that opens
- C) Minimum 2' clearance from any adjacent building
- D) Minimum 7' clearance above any grade when adjacent to public walkways
- E) Minimum 2' clearance above any grass, plants, or other combustible materials
- F) Minimum 3' clearance from any forced air intake of any other appliance
- G) Minimum 2' clearance below eaves or overhangs
- H) Minimum 1' clearance horizontally from combustible wall
- X) Must be a minimum of 2' above the roof

**Examples of installation**


This type of installation (see Pic. 4) requires an insulated flue, as all the smoke pipe has been installed outside the house. In the lower part of the flue, a union tee has been mounted with an inspection cap. A 90° bend should not be installed as the first initial piece as the ashes would quickly obstruct the passage of smoke, causing problems for the draught of the flue. (See Pic. 5).



This type of installation (see Pic. 6) does not require an insulated flue as the smoke tube has been assembled partly inside the house and partly inside an existing flue.

In the lower part of the flue a union tee has been installed with a peephole cap.

A 90° bend should not be installed as the first piece, as the ash would quickly block the passage of smoke, causing problems for the draught of the flue (See Pic. 5).

Please note the use of 2 45° bends, to guarantee that the ash falls in the union tee with a peephole.

### Determining Size of Pipe to install

To determine the diameter of pipe to use (3" or 4"), you can use the following guidelines.

Fillout the installation chart (table 1), and calculate your total equivalent pipe length.

Then use the total equivalent pipe length and the altitude in the pipe selection chart. (Pic. 7) to determine if your installation requires 3" or 4" exhaust pipe.

**Table 1 - Installation chart**

Type of Pipe	# of Elbows or Feet of Pipe		Equivalent
90° Elbows/ Tee (A & G)		x	5 feet (1.5 m)
45° Elbows (C)		x	3 feet (1.0 m)
Horizontal (B & F)		x	1 feet (0.3 m)
Vertical (E)		x	0.5 feet (0.15 m)

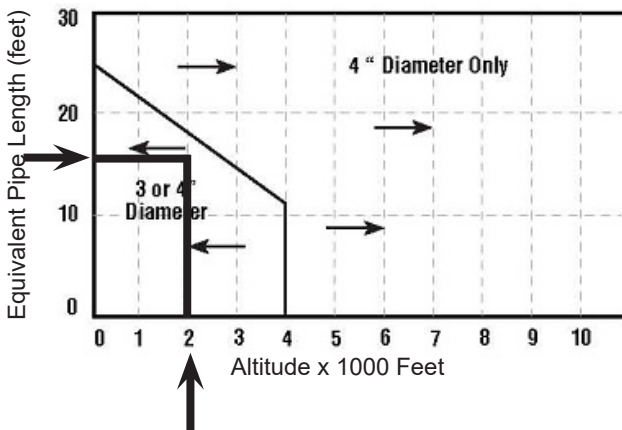
**Sample installation chart**

Type of Pipe	# of Elbows or Feet of Pipe		Equivalent	Total Equivalent
90° Elbows/ Tee (A & G)	2	x	5 feet (1.5 m)	10 feet (3.0 m)
45° Elbows (C)	1	x	3 feet (1.0 m)	3 feet (1.0 m)
Horizontal (B & F)	3	x	1 feet (0.3 m)	1 feet (1,0 m)
Vertical (E)	8	x	0.5 feet (0.15m)	1 feet (1,2 m)

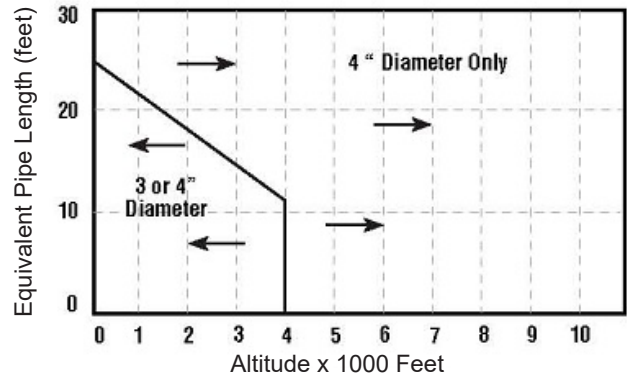
**Table 2 - Sample chart for Pic. 8**

Equivalent pipe length = (10 + 3 + 1 + 1) ft = 15 ft

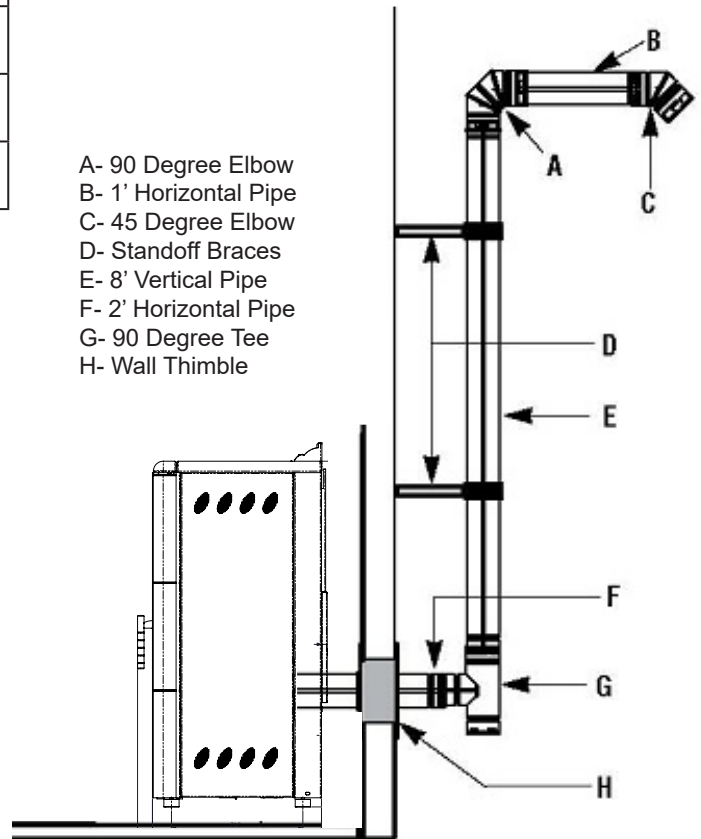
If the stove is installed in a place with an altitude of 2000 ft, it is possible to use either a pipe of 3" or 4", as you can see in the pipe selection chart below.



**Pic. 7 - Pipe Selection Chart**



- A- 90 Degree Elbow
- B- 1' Horizontal Pipe
- C- 45 Degree Elbow
- D- Standoff Braces
- E- 8' Vertical Pipe
- F- 2' Horizontal Pipe
- G- 90 Degree Tee
- H- Wall Thimble



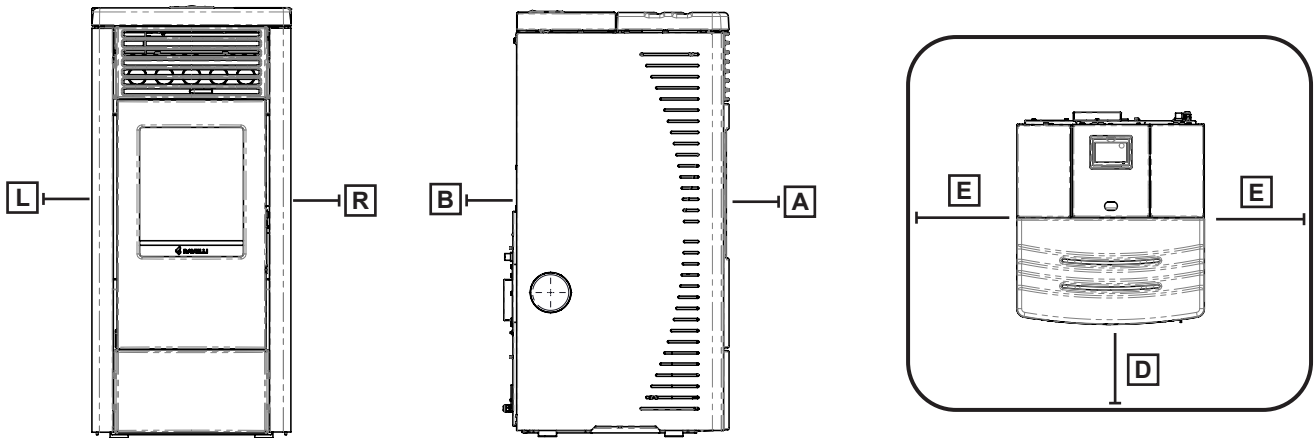
**Pic. 8 - See sample installation chart**



The vent pipe can be a minimum of 2 feet and a maximum of 45 feet long.

**Minimum distance from combustible material**

For Francesca 2015, Nicole, Rv80 ceramica, Rv100 classic



NOTE: Install vent at clearances specified by the vent manufactures.

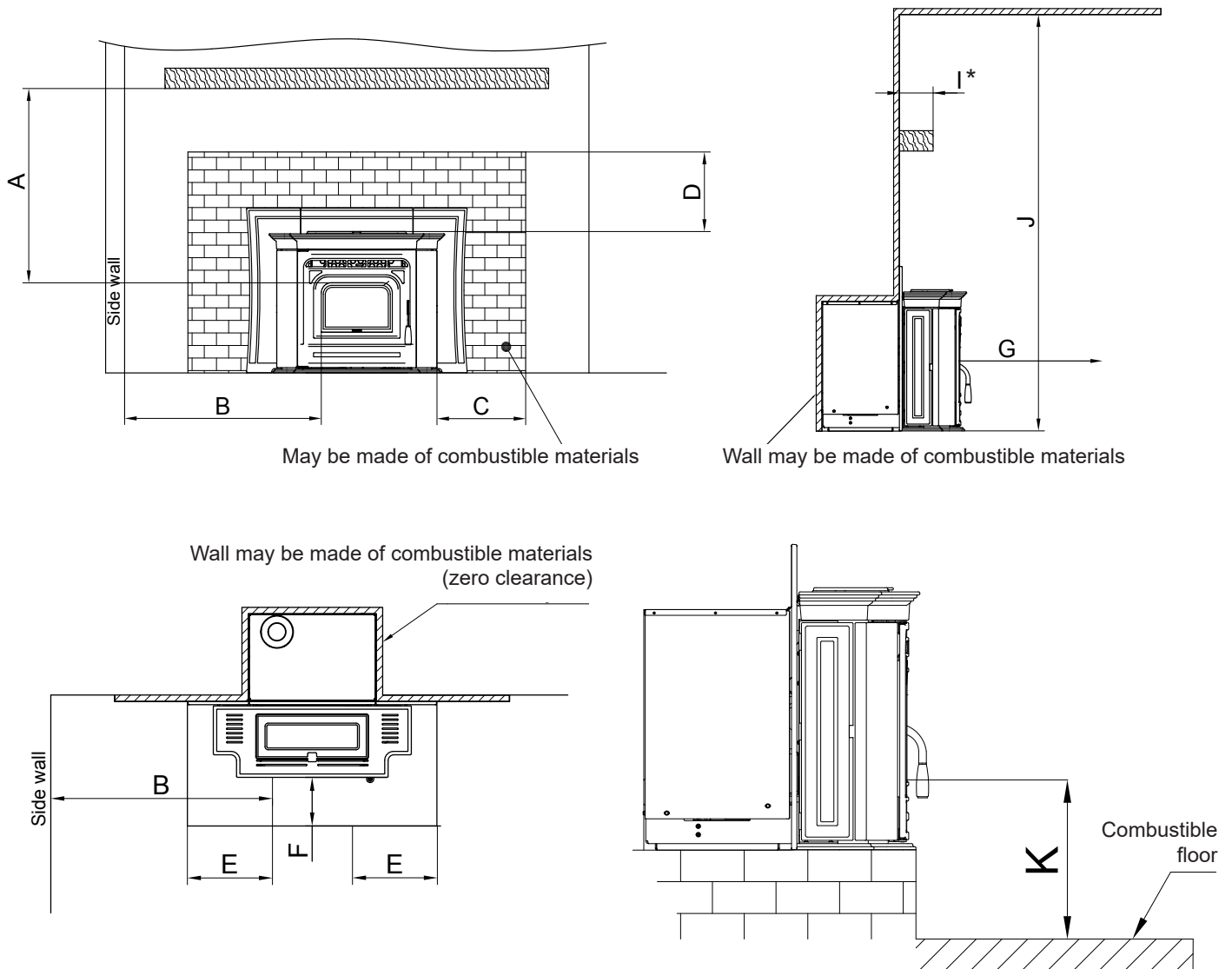
	STANDARD INSTALLATION					ALCOVE INSTALLATION			FLOOR PROTECTION	
	Side wall from stove (R, L)	Rear side wall from stove (B)	Front side (A)	Ceiling from floor (F)	Corner from stove	Side wall from stove	Rear side wall from stove	Ceiling from floor	Front (D)	Side (E)
Unit of measurement	Inch / mm	Inch / mm	Inch / mm	Inch / mm	Inch / mm	Inch / mm	Inch / mm	Inch / mm	Inch / mm	Inch / mm
Francesca, Nicole, RV 80 Ceramica	4 / 102	2 / 51	40 / 1000	84 / 2134	4 / 102	6 / 152	10 / 254	57 / 1450	6 / 152	6 / 152
Rv 100 Classic	4 / 102	4 / 102	40 / 1000	84 / 2134	4 / 102	4 / 102	4 / 102	52 / 1320	6 / 152	6 / 152

Floor: combustible floor;

Floor protection: 6 in in front and sides.

N.B. The floor protection must extend under the chimney connector and 2 inches (51 mm) beyond each side.

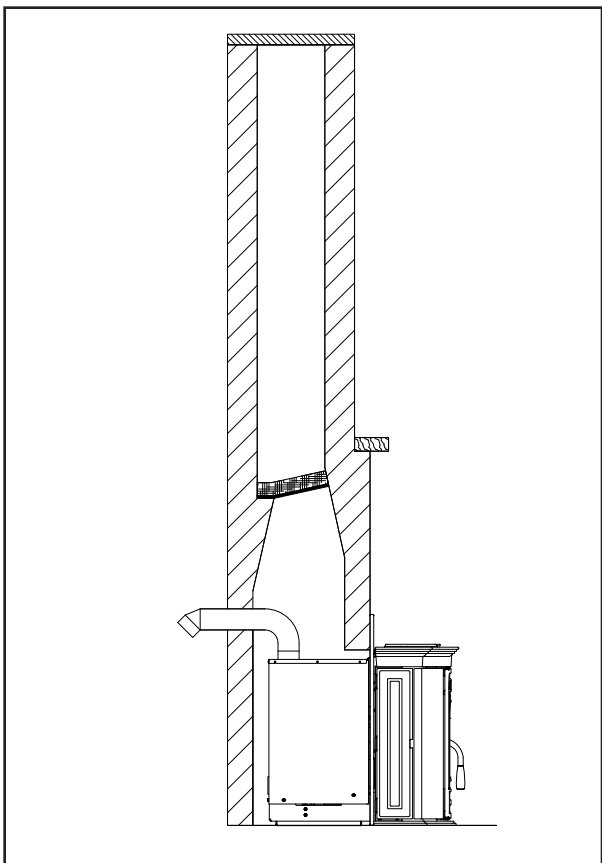
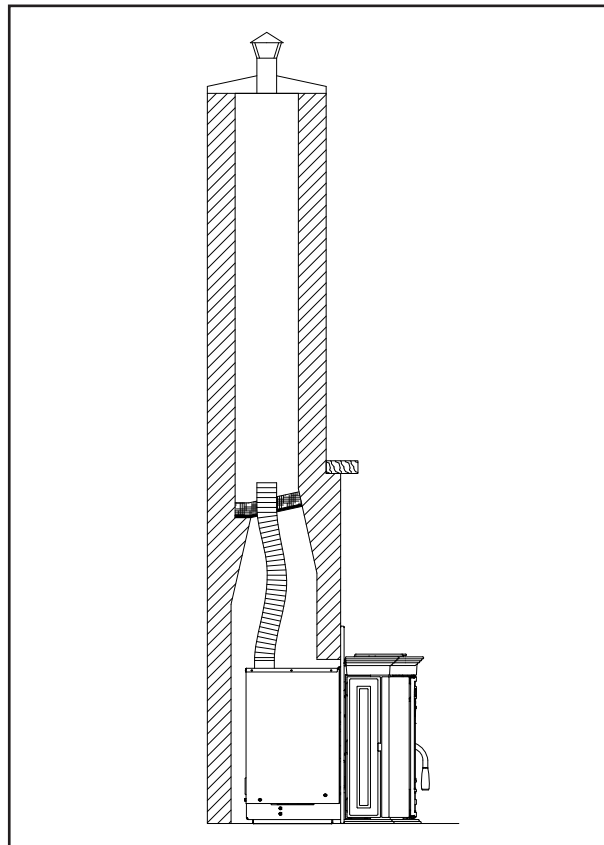
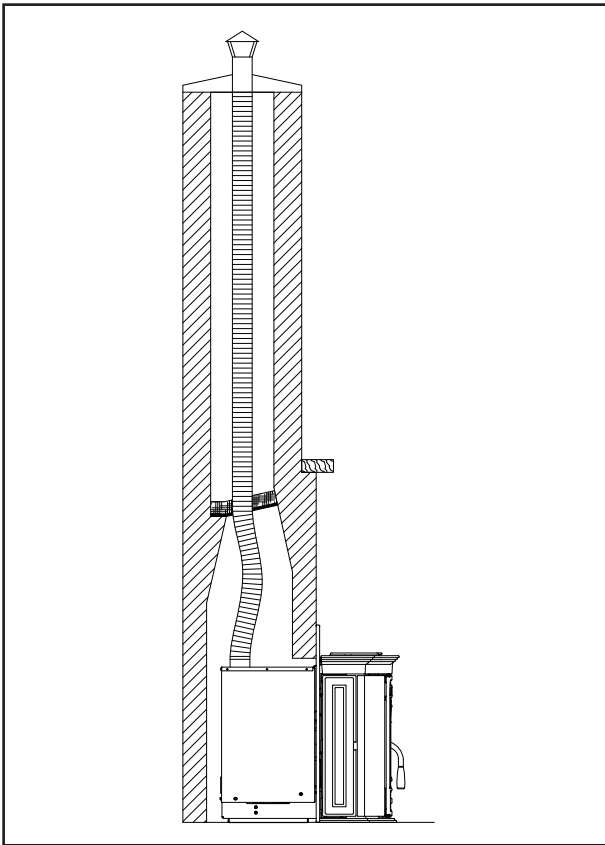


**Minimum distance from combustible material for pellet fireplace insert (Roma)**


	Unit of measurement	Roma
A = clearance to mantel	Inch / mm	18 / 470
B= clearance to sidewall	Inch / mm	15 / 381
C = clearance to face trim (side)	Inch / mm	0 / 0
D = clearance to face trim (top)	Inch / mm	0 / 0
E = floor protection	Inch / mm	6 / 152
F = floor protection	Inch / mm	6 / 152
G = clearence to front	Inch / mm	48 / 1220
I = mantel depth (*Max Depth)	Inch / mm	6 / 152
J = ceiling from bottom of unit	Inch / mm	72 / 1830
K = combustible floor from bottom of the glass	Inch / mm	10 / 241

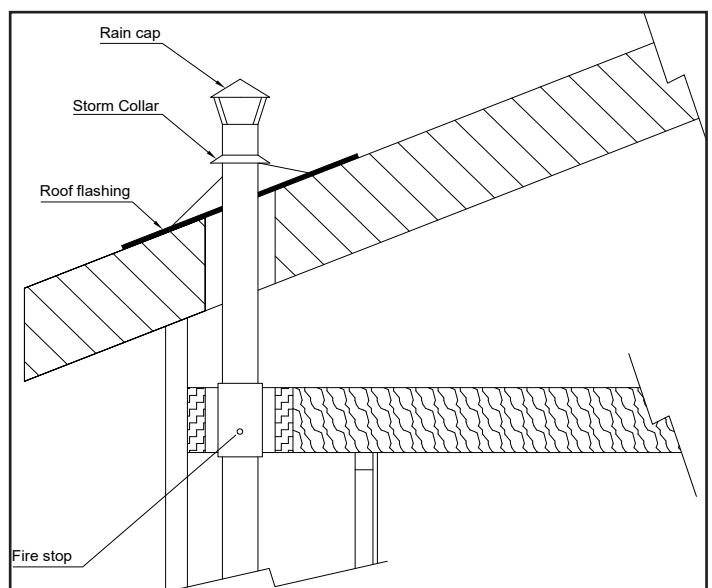
The I (mantel depth) is a maximum depth. All other distances are minimum distances. Reasonably if the clearance A is much more than the required minimum, depth I could be slightly higher, but other arrangements have not been tested.

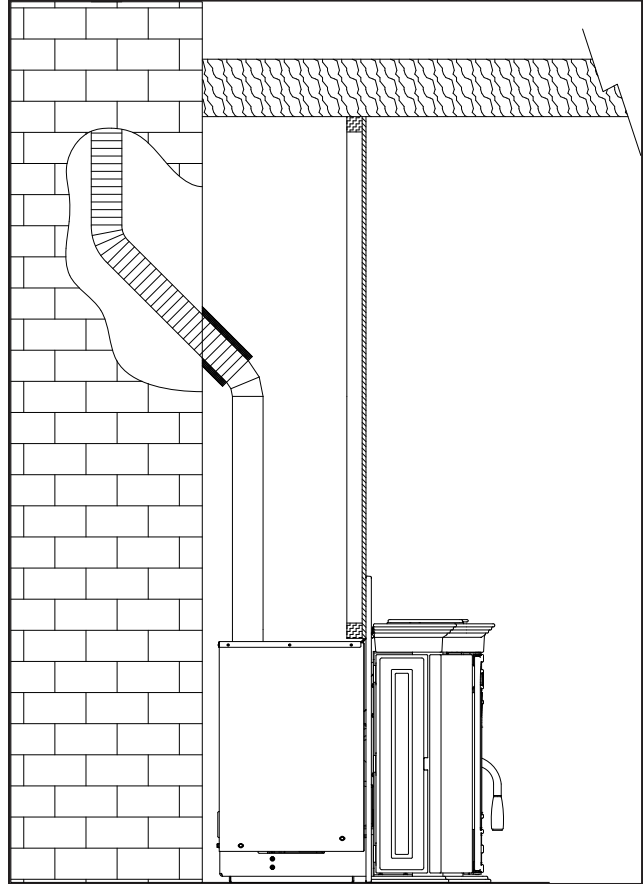
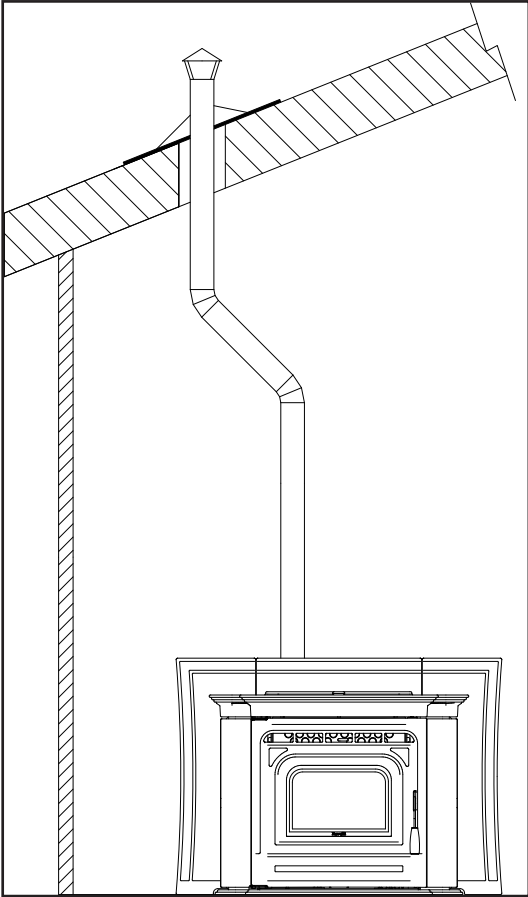
**Examples of installation (only for pellet fireplace insert)**




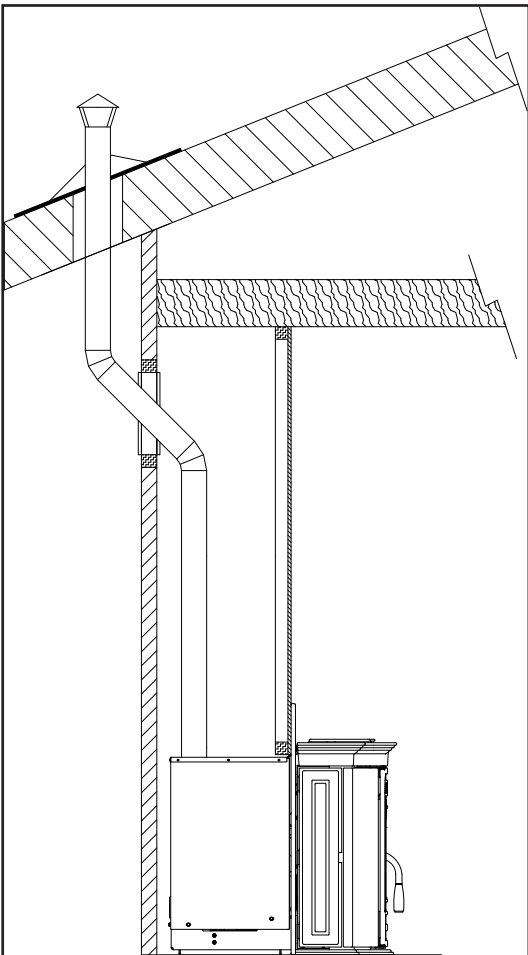
The damper area must be sealed with a steel plate and a non-combustible insulation on the top of the plate to reduce the possibility of condensation.

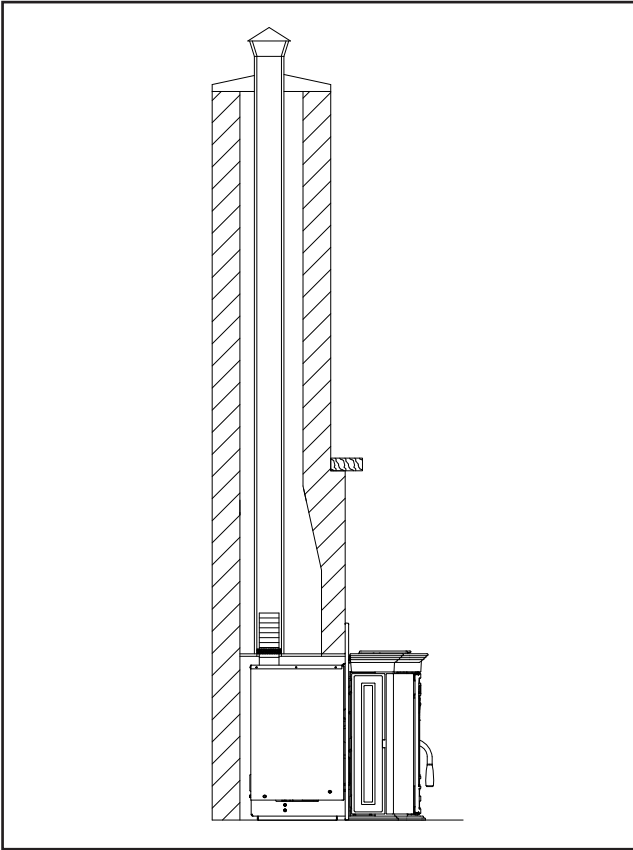
**This fireplace has not been tested with unvented Gas log set. To reduce risk of injury, do not install an unvented gas log set into this fireplace. Do not pack required air spaces with insulation or other materials. Do not use a fireplace insert or other products not specified for use with this fireplace.**



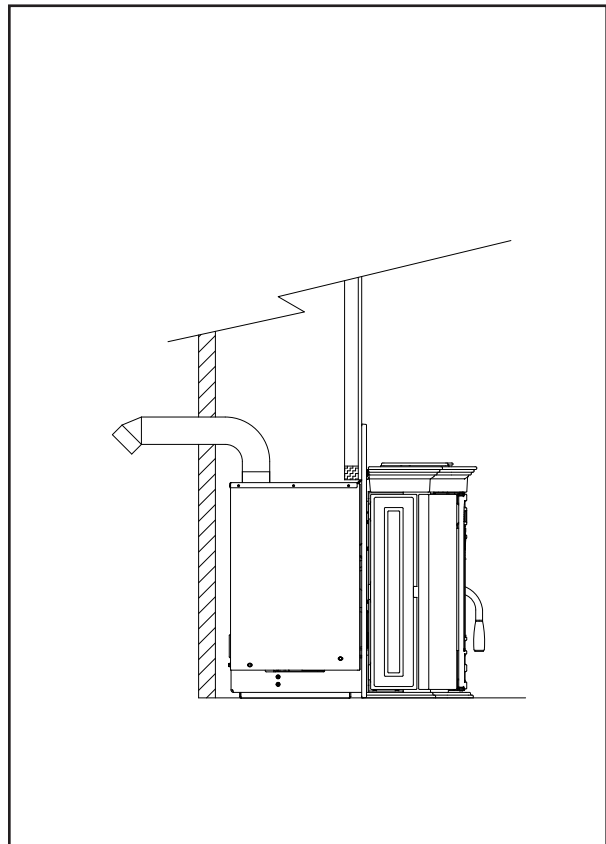
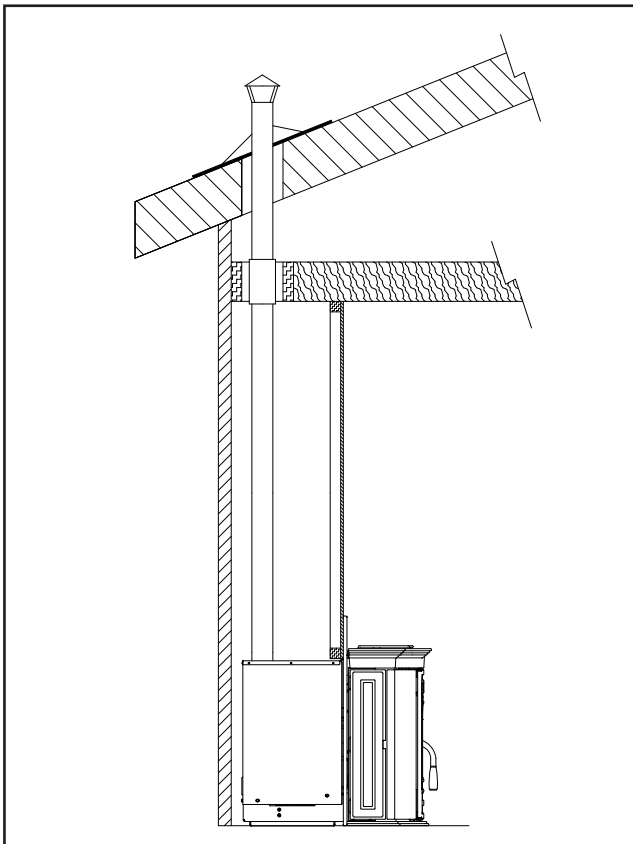


 Use only 45° or 30° bends, do not use 90° bends.

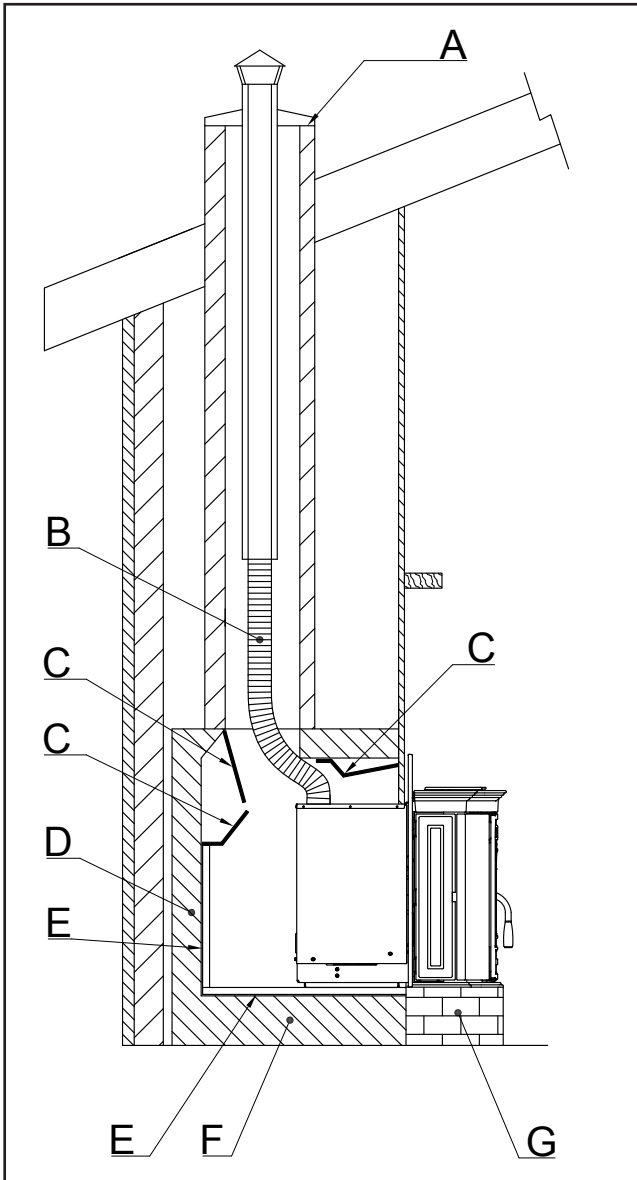




In Canada this fireplace insert must be installed with a continuous chimney liner of a minimum 3" diameter extending from the insert to the top of the chimney. The chimney liner must conform to the class 3 requirements of CAN/ULC-S635, Standard for Lining Systems for Existing Masonry or Factory Built Chimneys and Vents, or CAN/ULC-S640, Standard for Lining Systems for New Masonry Chimneys.

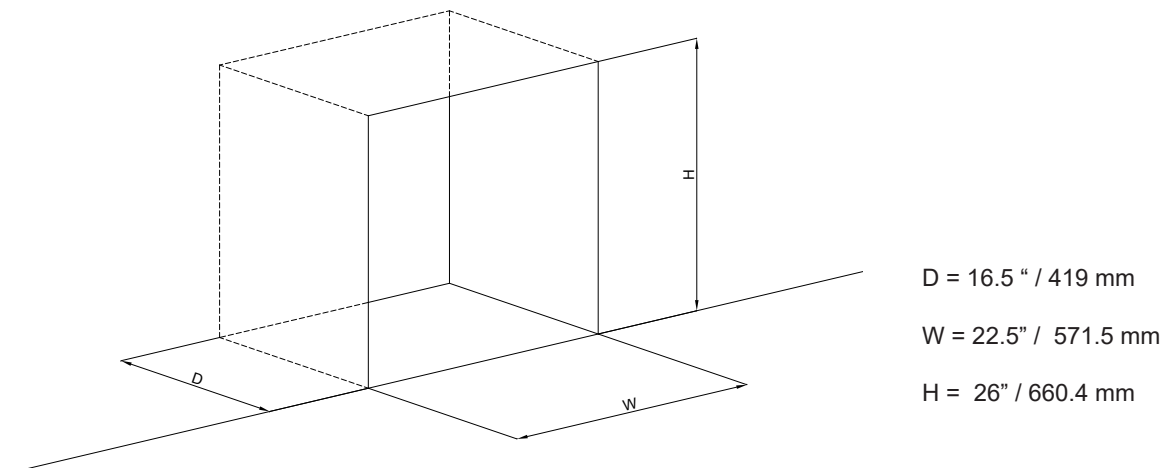


This pellet insert is suitable for Zero Clearance installation. Flex pipe for vent is not approved these types of installation.



- A) Seal the cover plate (non-combustible);
- B) "L" vent flex section;
- C) The smoke baffle, damper and shields may be removed if attached with mechanical fasteners;
- D) The metal sides, frame members, or other structural components of the factory built fireplace may not be removed or altered;
- E) The firebrick (refractory) may be removed;
- F) The metal floor of the firebox may be removed leaving the fireplace floor outer wrap;
- G) You shall built a support for insert on raised fireplace.

**Minimum opening for masonry and manufactured fireplace (only for pellet fireplace insert)**



### Standard horizontal installation configurations



**Ravelli does not recommend the horizontal venting in areas with particular environmental conditions such as: proximity to lakes or sea, very cold, very windy, very humid areas, etc..**

1. Locate the proper position for the listed type "PL" wall thimble. Avoid cutting wall studs when installing your pipe. Use a saber saw or keyhole saw to cut the proper diameter hole through the wall to accommodate the wall thimble. Use extreme caution to avoid cutting into power lines within the wall of the home.

The hole size will depend on the brand of pellet vent that you are using. Install the wall thimble in the hole.

2. ALL INTERLOCKING PIPE CONNECTIONS WITH-IN THE ROOM MUST BE SEALED WITH HIGH TEMPERATURE RTV AND SECURED WITH A MINIMUM OF 3 FASTENERS PER CONNECTION. Position the stove approximately 12" (305 mm) from the wall on the floor pad. Push the "PL" pipe through the wall thimble. Squeeze a bead of high temperature silicone (RTV) sealer around the end of the machined portion of the 3" (76mm) pipe connector on the back of the stove. Firmly push on a section of "PL" pipe until inner pipe liner pushes into the bead of RTV sealer.

3. Push the stove with pipe attached towards the wall (the pipe will go through the wall thimble). Do not position the back of the stove closer than 2" (51mm) from the wall.

4. Install listed type "PL" 45 degree elbow with optional rodent screen or cap (recommended) on outside end of pipe. The rodent screen should be no less than 1/2" (13 mm) mesh and may clog with soot and ash if left unattended during the burn season.

NOTE: The end of the exhaust pipe must extend a minimum of 12" (305 mm) from the outside of the building.

5. If the installation includes a source of outside combustion air; cut a separate hole through the wall for the fresh air tube. Use a galvanized or stainless steel pipe for the duct. The minimum size for the duct shall be not less than 50% of the cross sectional flue area. Connect outside air pipe to air inlet on stove.

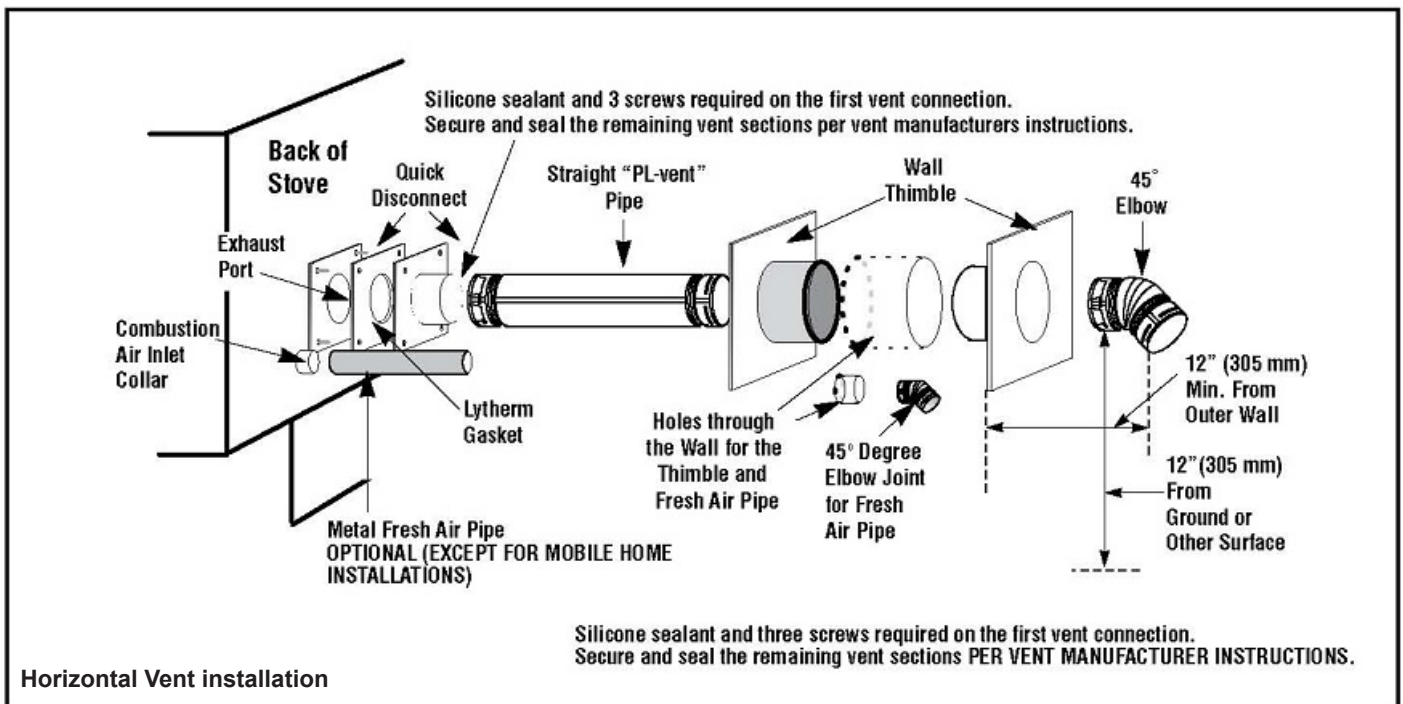
This tube must be terminated with a 45 degree elbow or hood.

#### NOTES:

Combustion air may also be drawn from a vented crawl space under the home.

All joints for connector pipe are required to be fastened with at least three screws. If vented horizontally, joints shall be made gas-tight (air tight, sealed connection) in a manner as specified on this page (see instruction #2).

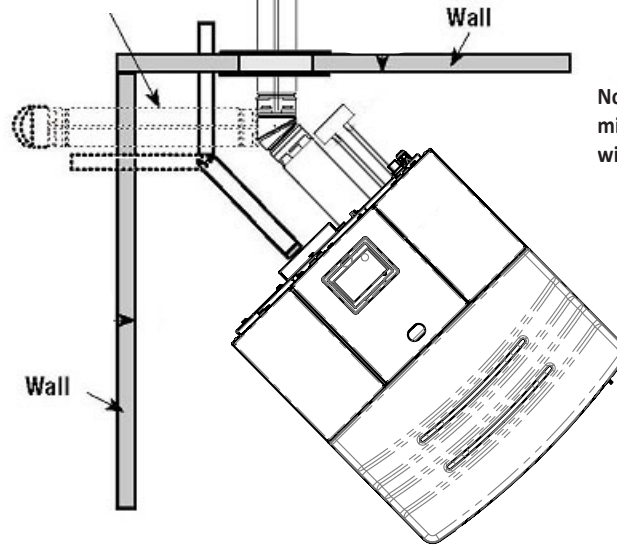
Install vent at clearances specified by the vent manufacturer.



3" (75 mm) Minimum clearance between wall and pipe. If you vent to the furthest wall, the vent pipe must maintain a 3" clearance parallel to the other wall.

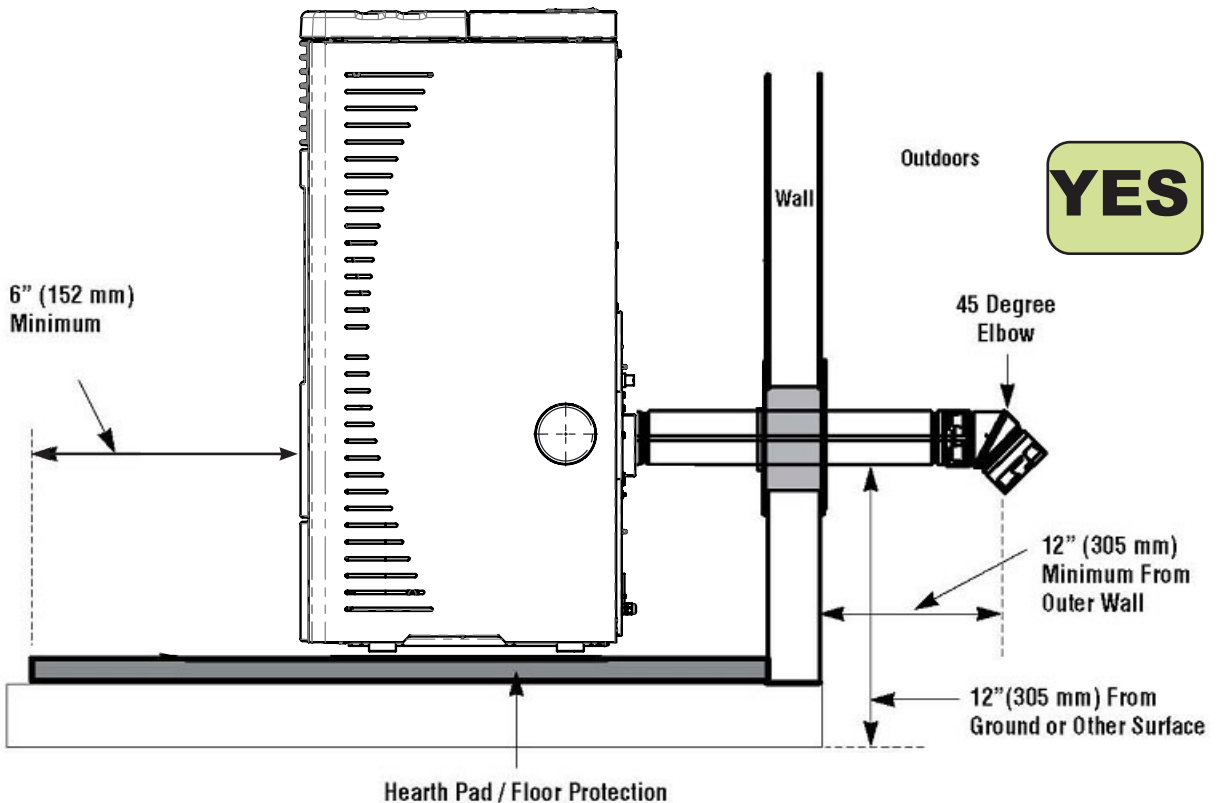
Top View Illustration

**YES**



Notes: It is not recommended to terminate exhaust vent on the prevailing wind side of the house

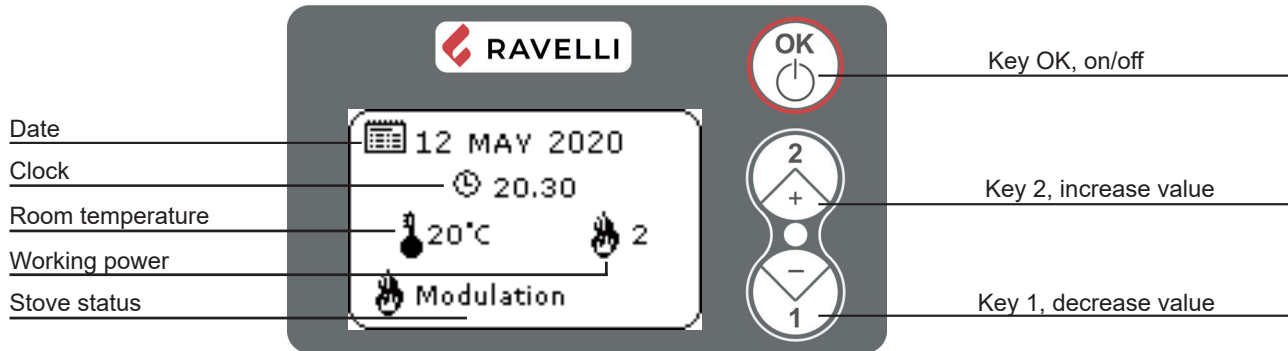
Corner Through the Wall



Parallel Through the Wall

## DESCRIPTION OF THE FUNCTIONING AND SYMBOLOGY OF THE DISPLAY

The display of the handheld set is described below (in "Home" mode):



Key "OK": in the Home screen, long press to turn the appliance on / off or reset the alarms; short press to enter the menu

Key "1": access key to "set room temperature" and regulation (decrease value)

Key "2": access key to "set power" and regulation (increase value)



The first press of any key with active display turns on its backlight, not interpreting it as a command.

## PROCEDURES FOR USE



If the chimney catches fire you must call the fire brigade immediately.

### Checks prior to start-up



You have read and perfectly understood the contents of this instructions manual.

Before lighting the stove, you must ensure that:

- the combustion chamber is clean;
- the fire door and ash drawer seals are functioning properly;
- the electrical plug is connected correctly;
- all items that could burn (instructions, various adhesive labels) have been removed;
- the fire pot, if removable, is correctly positioned in its housing.



During the first hours of use the paints used for the stove finish may release an unpleasant odour. You might also smell the typical odour of metal parts subject to high temperatures. Make sure sufficient air circulation is guaranteed in the room. These unavoidable inconveniences will disappear after the first hours of operation. To reduce your discomfort to a minimum, keep the stove on for a few hours on low power and in the beginning, do not overload it, avoiding intense heating-cooling cycles



At the initial start-up, the paint finishes drying and hardens. Accordingly, to avoid ruining it, we advise you not to touch the stove's painted surfaces at this time.

### Pellet auger loading

Before starting the stove for the first time, whenever the stove is in alarm "06 - Pellets finished", and in any case whenever the hopper has emptied completely, the initial auger loading is required.

This phase allows the stove to fill the pellet loading system (the system that carries the pellets from the tank to the fire pot), so that at the time of ignition, the pellets can be loaded into the fire pot and then the stove can be ignited. If the auger loading operations are not carried out, the stove could fail to ignite.

To load the auger, follow the instructions given in the paragraph "Stove status menu".




After loading the auger and before lighting the stove, always remember to empty the fire pot and check that the fire pot is clean. Never empty the fire pot inside the hopper.



After each maintenance operation, make sure that the fire pot is positioned correctly in its seat.

### Switching the appliance on and off

From the "Home" screen, it is possible to switch the stove on and off by keeping the OK button  pressed on the device for a few seconds. An acoustic signal will warn you that the appliance has switched on or off.



Do not turn off the stove by disconnecting the electric plug from the wall socket.





The appearance of the "SET RDS" message indicates that the initial parameter testing and calibration procedure was not carried out correctly. This indication does not imply blocking the stove (see SIGNALING POP UP section).

**Failed ignition**

If the system does not detect the ignition of the flame within the preset time, operation will be blocked with the "No ignition" alarm. Before relighting the stove, check that there are pellets in the hopper, that the door and ash drawer compartment are closed, that there are no obstructions to the combustion air inlet system and above all that, in models without self-cleaning fire pot, the fire pot is empty, clean and correctly positioned. If the problem persists, it could be due to a technical problem (ignition plug, adjustments, etc ...), so please contact a Ravelli CAT.



The accumulation of unburned pellets in the fire pot after a failed ignition must be removed before proceeding with a new ignition.



The fire pot could be very hot: danger of burns



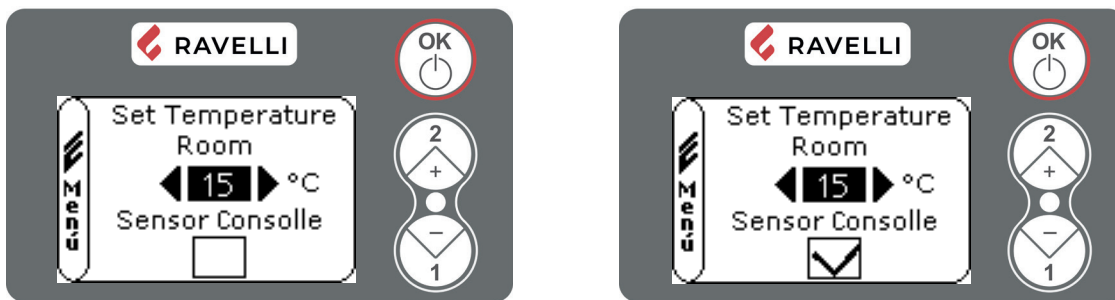
Never empty the fire pot inside the hopper.

**Set of the room temperature**

The functioning of the stove with room thermostat activated is of 3 types:

- With supplied room sensor positioned on the backside of the stove
- With room sensor integrated to the display (recommended for use with wall mounted display only)
- With external thermostat

Press key 1 from the "Home" screen to enter the room temperature setting page



Set the desired temperature with keys 1 and 2. The selectable values are: EST, from 7 °C to 40 °C (or from 44 °F to 104 °F), MAN. The EST value must be selected if you want to use the external thermostat and MAN when you want to make the stove work at constant power.

To go back directly to the "Home" screen, press keys 1 and 2 at the same time, or press OK to go to "Console probe".

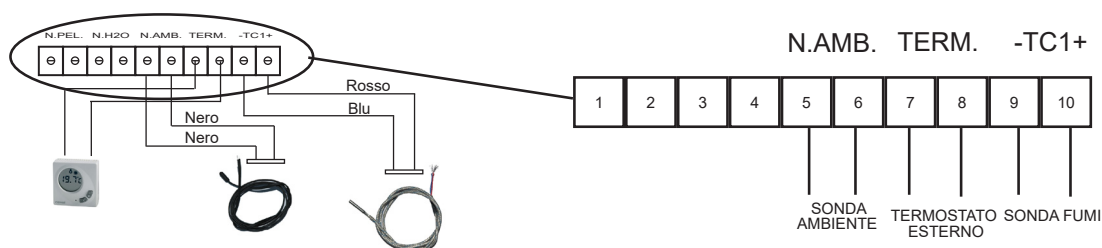
By enabling the "Console probe" function, the temperature reading with the ambient probe integrated in the display is enabled. Enable the function with key 2 and disable it with key 1. To return to the Home screen, press OK

If you use an external thermostat correctly connected as shown in the electrical scheme, the display will not show the room temperature but the writing T ON ( when the contact is closed) or T OFF ( when the contact is open).

To use the external thermostat, the "console probe" must be deactivated.

The room temperature will be adjusted by the external thermostat.

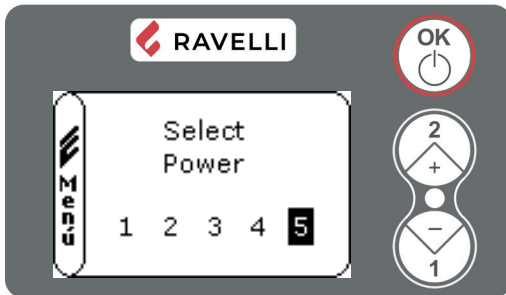
Once reached the set temperature of the thermostat the display will show MODULATION, so the stove will reduce to minimum the pellet consumption and the power as well. If activated the mode COMFORT CLIMA, the stove will switch on and off automatically.



If you want to use the COMFORT CLIMA is advisable an external thermostat with OFF-SET of at least 3°C.

### Set of the working power

To modify the working power press key 2 to enter in the dedicated menu and with keys 1 and 2 to set the power you desire from 1 to 5 and confirm with key OK. Increasing the power also the pellet consumption and the speed of the fan increase as well.



## OPERATING PHASES OF THE APPLIANCE

### Sequence of ignition phases

During the ignition phase, the following indications will appear on the display:

- IGNITION: loading phase of the pellets in the fire pot and heating of the ignition electrode (variable waiting time according to the factory parameters)
- WAITING FLAME: flame ignition waiting phase (variable waiting time depending on the factory parameters)
- FLAME LIGHT: phase of development and stabilization of combustion (waiting time varies depending on the factory parameters)
- WORK: normal operating mode, according to the chosen settings

If the ignition command is given when the stove is still hot, i.e. in FINAL CLEANING, the stove will remain in the WAITING RESTART phase for a few minutes, after which it will automatically re-ignite (IGNITION RESTART).

### Modulation

During the work phase, the appliance should reach the room temperature set; when this condition is met, the stove switches to MODULATION mode in which fuel consumption is minimum.

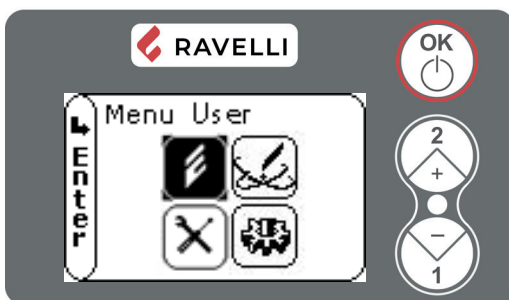
### Description of menu functions

To access the menu from the "Home" screen, press the OK button (short press).

To scroll the menu list, use buttons 1 and 2 and then confirm with OK to enter the submenus.

Then, to return to the "Home" screen, press keys 1 and 2 at the same time. To return to the previous menu, press OK (long press).

The stove is equipped with many functions available in each menu programming. Some of these menu are accessible for the end user, other are protected with a password so they are accessible only for the After sales center.

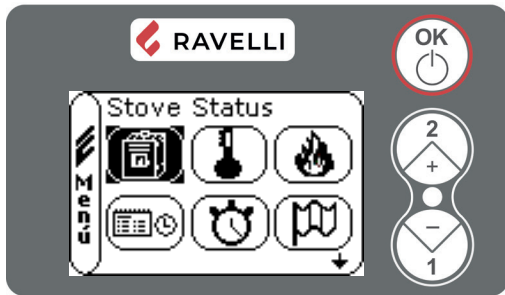


- Menu USER
- Menu SET RDS
- Menu DEFAULT SETTINGS
- Menu STANDARD PARAMETERS

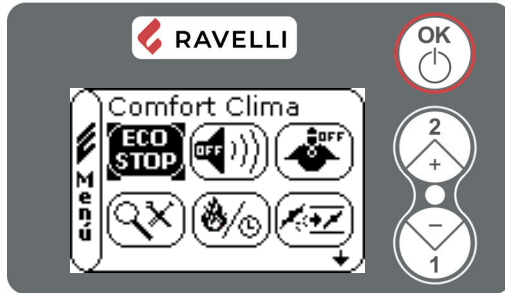


The SET RDS, DEFAULT SETTINGS, and STANDARD PARAMETERS menus are password protected. Changing parameters within these menus could compromise the operation and safety of the stove. In this case the warranty will be invalidated.

The submenus of the USER MENU (the only one accessible for the end user) are the following:



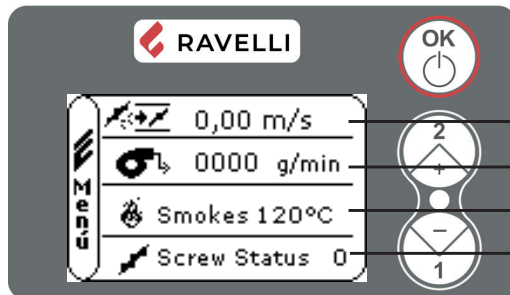
- Menu STOVE STATUS
- Menu SET TEMPER. ROOM
- Menu SET POWER
- Menu CLOCK
- Menu TIMER
- Menu LANGUAGE







- Menu COMFORT CLIMA
- Modalità SILENCE
- Modalità SELF CONTROL SYSTEM
- Menu VIEW SETTINGS
- Menu VIEW WORKING HOURS
- Menu SET DRAUGH/PELLET

### Menu STOVE STATUS

In this menu you can check the correct functioning of the most important components of the stove. Here is a list of real data of the stove useful for service during inspection.

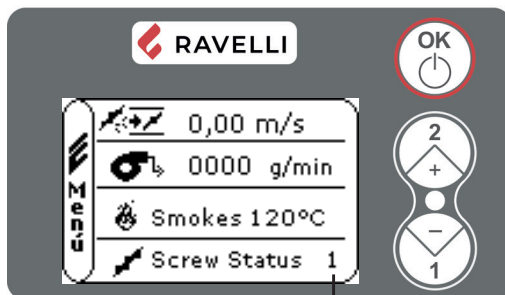


Speed inlet flow  
Rpm smoke fan  
Smokes temperature  
Screw status

-  RDS current reading RDS (m/s)
-  RPM current smoke extractor speed (rpm)
-  Smokes temperature (°C)
-  Screw status
- SET** Set value RDS (m/s)
- DF** Cold probe temperature RDS (°C)
- DR** Hot probe temperature RDS (°C)
- SK** Electronic board temperature (°C)

To go to the second screen, press key 1.

From the first screen it is possible to activate the initial loading of the auger by pressing key 2. The Screw Status value will become 1.



Screw ON

The initial load will stop automatically after a pre-set time, to stop it first press key 2.

Repeat the operation several times until you see the pellet fall into the firepot. It is possible to do this operation only if the stove is in FINAL CLEANING phase or OFF.

**Menu SET TEMPERATURE ROOM**


To modify the setting please reference to paragraph "Set of the room temperature"

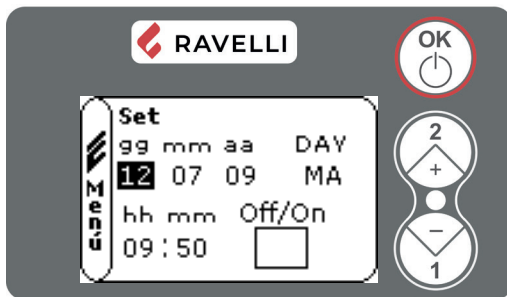
**Menu SET POWER**


To modify the setting please reference to paragraph "Set of the working power"

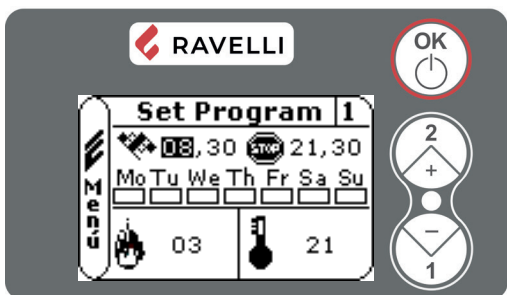
**Menu CLOCK**


To modify the settings use keys 1 and 2 and by pressing OK you confirm the data and go on to the following one. By activating the box (flag) ON/OFF you enable the function chrono.

By last confirmation with OK you save all settings and return automatically to the screen with the icons.


**Menu TIMER**


With the function chrono thermostat is possible to program for each day of the week the switch on and off of the stove in four independent intervals time. To enable the TIMER, see what is reported in the Clock menu.



**1** TIMER program number



START: switch on time



STOP: switch off time



DAY: days of activation of the program



POWER: desired power at the time of switch ON of the stove



TEMPERATURE: setting of ambient temperatures

In ducted stoves it is possible to set the temperatures of the individual rooms:

F (front) temperature of the stove installation room

R (Rear, single duct) room temperature heated by ducting

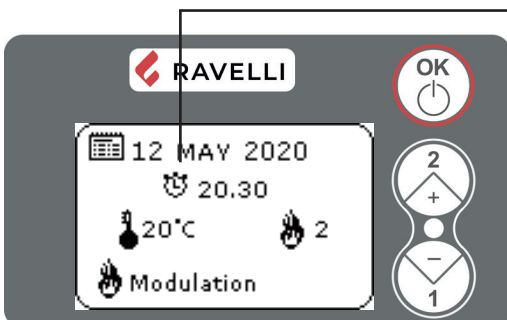
RL and RR (Rear Left and Rear Right for double ducting)

The EST (operation with external thermostat) and MAN (constant power operation) values can also be set

To choose the prog.tion use keys 1 and 2; confirms with OK.

Use keys 1 and 2 to modify the settings and by each press of OK you confirm the data and go on to the following one.

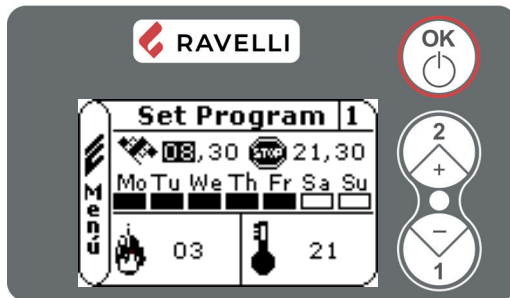
By last confirmation with OK you save all settings and return automatically to the screen with the icons.



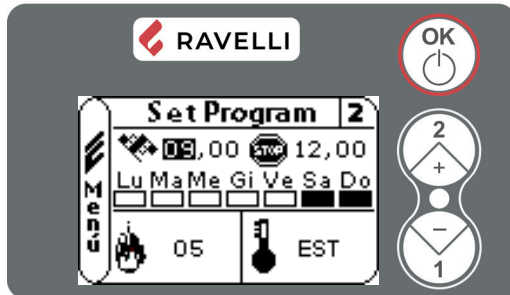
The symbol indicates that the chrono function is active. It is however possible to program the chrono even if it is deactivated. To make it work, refer to the chapter dedicated to setting the clock.

**Description**

Description	Settable values
START	From OFF to 23:50 by step of 10'
STOP	From OFF to 23:50 by step of 10'
DAY	On/off for the days from Monday to Sunday
POWER	From 01 to 05
SET AMB.	From EST to MAN

**Examples**


Activation days: Monday to Friday  
 Switch on at 8.00  
 Switch off at 21.30  
 Power: 3  
 Room temperature: 21°C



Activation days: Saturday and Sunday  
 Switch on at 9.00  
 Switch off at 12.00  
 Power: 5  
 Room temperature: Regulated by an external thermostat

The Comfort Clima function also works with the Timer active.

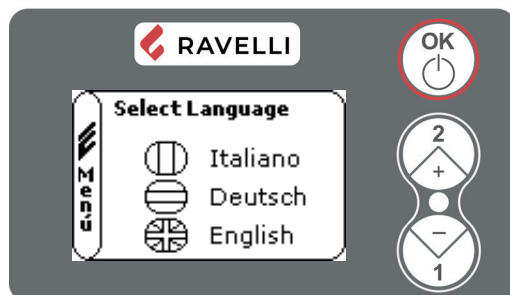


By using this mode it is necessary to check that after every automatic switching off the firepot is always well cleaned in order to guarantee a perfect automatic ignition.

**Menu LANGUAGE**

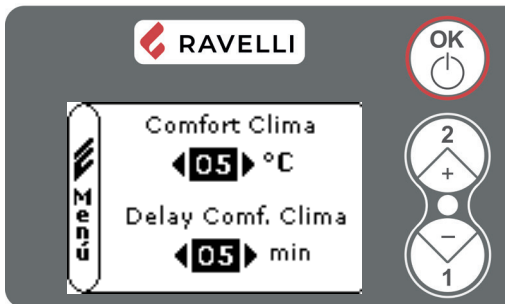

To select language please use keys 1 and 2.

By last confirmation with OK you save all settings and return automatically to the screen with the icons.



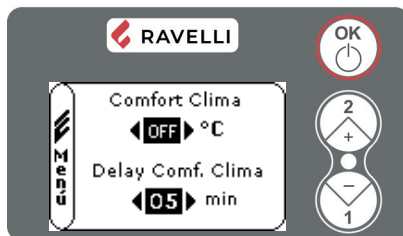
**Menu COMFORT CLIMA**

To modify the settings use keys 1 and 2 and by pressing OK you confirm the data and go on to the following one. By last confirmation with OK you save all settings and return automatically to the screen with the icons.

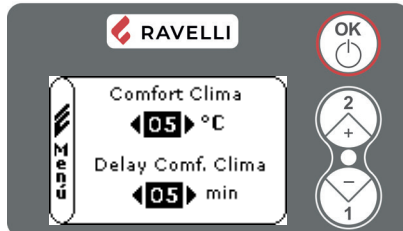


The activation of this function enables the stove to reduce pellet consumption by activating the modulation phases, after the desired temperature has been reached. Subsequently, the stove checks that the temperature is maintained steady for a preset time (DELAY COMFORT CLIMA). If this condition is met, it automatically switches off, and on display appears the writing ECO STOP. The stove turns on again when the temperature drops below the set threshold (COMFORT CLIMA).

Below are given the steps for accessing the relative menu.


**Example**

To activate the function, set the COMFORT CLIMA value different from OFF using buttons 1 and 2. Confirm with OK. Set the time in which the stove must remain in MODULATION, before switching to ECO STOP (default 4 ').



The set value (in this case 5 ° C) activated the Comfort Clima function.

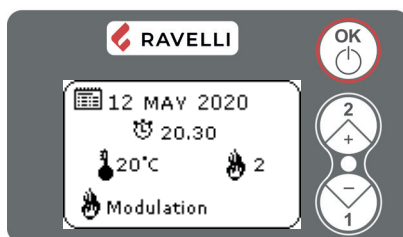
OPERATION:

The value adjusts the re-ignition temperature of the stove.

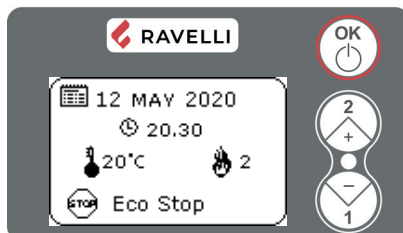
EXAMPLE:

- room temperature set at 21 ° C
- Comfort Clima value set at 5 ° C

With this adjustment, the stove will switch off when it reaches 21 ° C and will switch on again when the room temperature is 15 ° C ( $21\text{ ° C} - 5 - 0.5\text{ tolerance} = \text{about } 15\text{ ° C}$ ). The strings shown in the screens on the left will appear in sequence on the display.



The modulation phase is activated, as the room set temperature has been reached. If the temperature is maintained for the set "DELAY COMFORT CLIMA" time, the stove switches off.



Once the switch-off phase is complete, the display will show ECO STOP. The stove will remain in this state until the temperature drops to 15 ° C, only then will the ignition phase be restarted.



The operation of the stove in COMFORT CLIMA mode can start the ignition and shutdown phase several times during the day; this can compromise the duration of the resistance for automatic stove ignition.

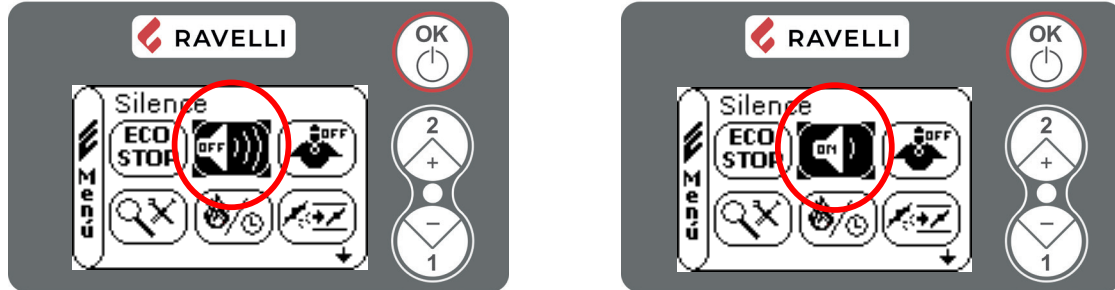


Using this mode, it is necessary to make sure that after each automatic switch-off, the fire pot always remains perfectly clean in order to guarantee correct automatic ignition. The COMFORT CLIMA mode also works with an external thermostat connected.

**Mode SILENCE** 

Enable or disable the function by using key OK.

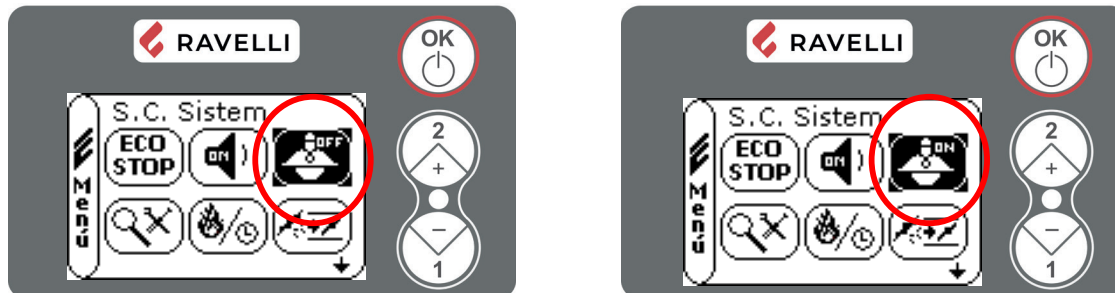
Mode SILENCE has been realized for reducing noise level of fan. It reduce the speed of the fan in all five working power. Use is suggested especially during night time.



**Mode SELF CONTROL SYSTEM (S.C.S)** 

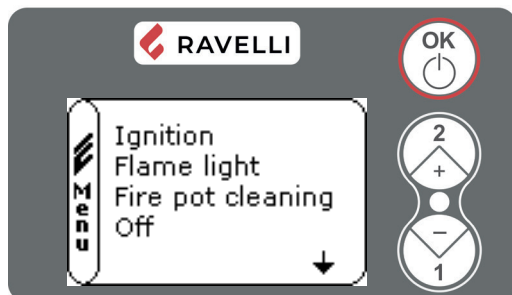
Enable or disable the function by using key OK.

Mode SELF CONTROL SYSTEM (S.C.S) has been realized allowing the stove to recognize faster an eventual problem just in case you are out of home or far from the stove. It is advisable to activate this function especially if you are not in the vicinity of the stove during work phase.



**Menu VIEW SETTINGS** 

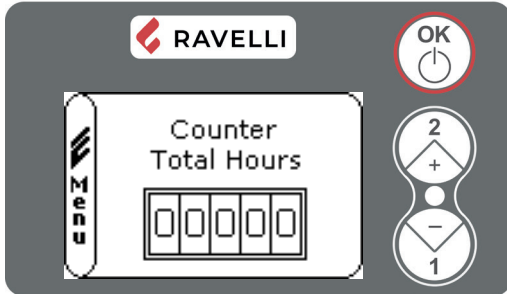
In this menu you can verify the parameters set in the motherboard.



To scroll the list of parameters use key 1 and 2, to view the parameters press OK.

### Menu VIEW WORKING HOURS

In the menu VIEW WORKING HOURS you can check the total or partial working hours and also the number of ignitions of the stove. This menu is used by the After Sales Center to evaluate the total working hours of the stove during the season and consequently to evaluate the need of cleaning ("service hours").



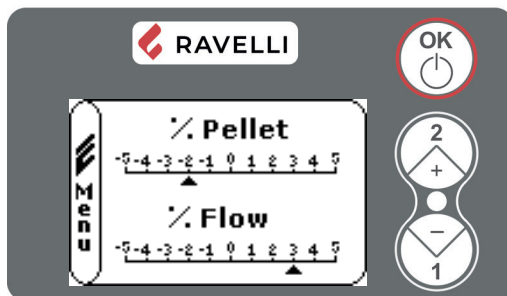
You can see the working hours of the stove. To scroll the different counters (total or partial hours and number of ignitions) use key 1 and 2.

### Menu SET DRAUGH/PELLET

This setting of the PELLETT-FLOW mixture allows to adjust the combustion by varying the quantity of pellets loaded in the fire pot and/or the quantity of air. Infact, by its nature, pellets vary in grain size and composition: even bags of pellets of the same brand can have different characteristics. If combustion is not optimal, vary the flow parameter to adjust the combustion air. If air regulation alone is not sufficient, it may also be necessary to modify the pellet parameter.



Combustion regulation is an operation that requires a lot of experience. We recommend that you contact an Authorised Service Centre to calibrate the stove appropriately.



By accessing the menu, the adjustment of the draft / pellet mixture is displayed. To change the percentage use buttons 1 and 2, to switch from adjusting the quantity of pellets to adjusting the inlet air flow, press OK.

At the last confirmation with OK, the settings are saved and you automatically return to the icons screen.

### Service hours

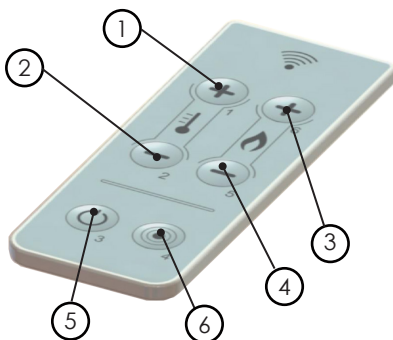
All our models need in addition to the regular cleaning, also a special cleaning which should be done by the installer (authorized by the producer).

At the time of the installation it is possible to set a number of working hours appropriate for the model. At the end of these hours on the display will appear the message "SERVICE HOURS" followed by an acoustic signal. When this message appears please contact the installer to do the special cleaning of the stove.

If the cleaning is not done the message will appear by each ignition but will not interrupt the functioning of the stove.

### Remote control

Infrared handheld device for remote control



- **1 - 2 Set temperature:** allows to set the desired value for the room temperature from minimum 6 °C to maximum 40 °C (or from 44 °F to 104 °F).
- **3 - 4 Set power:** allows to set the working power between a range of minimum 1 to maximum 5.
- **5 ON/OFF:** by keeping pressed for 2 second longs it allows the manual switch on and off of the stove
- **6 Without function**



**Stove phase general layout**

Phase	Description
<b>FINAL CLEANING</b>	The stove is switching off, the cooling phase is not yet completed
<b>IGNITION</b>	The ignition phase has started, the pellets are loaded into firebox
<b>WAITING FLAME</b>	The pellet is lighted by the hot air passing through the ignition candle
<b>FLAME LIGHT</b>	The flame is visible in the fire pot
<b>WORK</b>	The stove completed switch ON phase; you can change power
<b>FIRE POT CLEANING</b>	The stove is performing the cleaning
<b>MODULATION</b>	The room temperature set has been reached
<b>ECO STOP</b>	Comfort Clima activated, temperature set has been reached; the stove is off.
<b>T ON / T OFF</b>	The room sensor is off or an external thermostat has been connected and the room set is set to EXT
<b>WAITING START</b>	The stove is cooling DOWN: when stove is cooled down can start automatically
<b>WAITING RESTART</b>	The stove is in the cooling DOWN: when stove is cooled down can restart automatically.
<b>HOT SMOKES</b>	The maximum fume temperature threshold has been reached. To facilitate cooling, the stove brings the capacity to a minimum with ventilation at max power level
<b>OFF</b>	The stove is off
<b>ANOMALY (general)</b>	The stove has detected an anomaly; refer to the troubleshooting chapter.

**Description of alarms**

AL	Warning	Reason	Solution
AL 01	BLACK - OUT	No electricity supply during working phase	Press the off button and repeat switching on the stove
			If the problem continues, contact the area Technical Assistance Centre.
AL 02	SMOKE SENSOR	The smoke sensor is malfunctioning	Please contact the local Technical Assistance Centre
		The smoke sensor has been disconnected from the board	Please contact the local Technical Assistance Centre
AL 03	HOT SMOKE	Combustion in the fire pot is not optimal	Switch off the stove, clean the fire pot and regulate combustion with the setting of the pellets.
		The centrifugal fan is defective	Contact local Technical Assistance Centre.
			If the problem continues, contact the area Technical Assistance Centre.
AL 04	FAN BROKEN	Smoke extractor encoder is not functioning or not correctly connected	Contact local Technical Assistance Centre.
		No electricity supply to smoke extractor	Contact local Technical Assistance Centre.
		The smoke extractor is blocked	Contact local Technical Assistance Centre.

AL	Warning	Reason	Solution
AL 05	NO IGNITION	The pellet tank is empty.	Check if there are pellets inside the tank.
		Setting of pellets and of intake during ignition phase insufficient.	Contact local Technical Assistance Centre.
		The resistance for lighting is defective or not in position	Contact local Technical Assistance Centre.
AL 06	NO PELLETS	The pellet tank is empty	Check whether there are pellets in the tank
		The ratiomotor does not load pellets.	Empty the tank to check that no objects have fallen inside which could prevent the correct functioning of the auger
		No pellet loading	Regulate the pellet setting
			If the problem continues, contact the area Technical Assistance Centre.
AL 07	THERMAL ALARM WITH RESET	The thermostat with manual reset has intervened	Reset the thermostat pressing the button on the back of the stove
		The centrifugal fan is defective	Please contact local Technical Assistance Centre.
		Combustion in the fire pot is not optimal	Switch off the stove, clean the fire pot and regulate combustion with the setting of the pellets.
			If the problem continues, contact the area Technical Assistance Centre.
AL 08	DEPRESSION	The combustion chamber is dirty	Follow the cleaning operations of the stove as per the instructions in the booklet
		The flue is blocked	Check that the flue is clear and clean
		The vacuum switch is malfunctioning	Please contact local Technical Assistance Centre
AL 09	AIR-FLOW METER	The device who read the quantity of inlet air could be disconnected or defect	Please contact the local Technical Assistance Centre
		The device could be dirty and so not read correctly	Please contact the local Technical Assistance Centre
AL 11	LOW FLAME	The pellet tank is empty.	Check whether there are pellets in the tank
		Bad setting of pellet and air on ignition in phase	Contact local Technical Assistance Centre
AL 12	FAN RPM	The revolution of smoke fan lowering more the 15% of speed to fan congestion	Contact local Technical Assistance Centre
AL 13	INSUFFICIENT FLOW	The door and the ashtray are not correctly closed	Check the devices are closed
		Bad combustion in the fire pot	Switch off the stove, clean the fire pot, the grid and set the combustion through the set pellet/flow.
		Presence of a foreign body inside the air inlet pipe	Check for its presence and extract the unwanted body
			Please contact the local Technical Assistance Centre
AL 14	AUGER PHASE	The gear motor is not correctly connected	Please contact the local Technical Assistance Centre
AL 15	AUGER TRIAC	The device in the motherboard who gears the auger is defect	Please contact the local Technical Assistance Centre



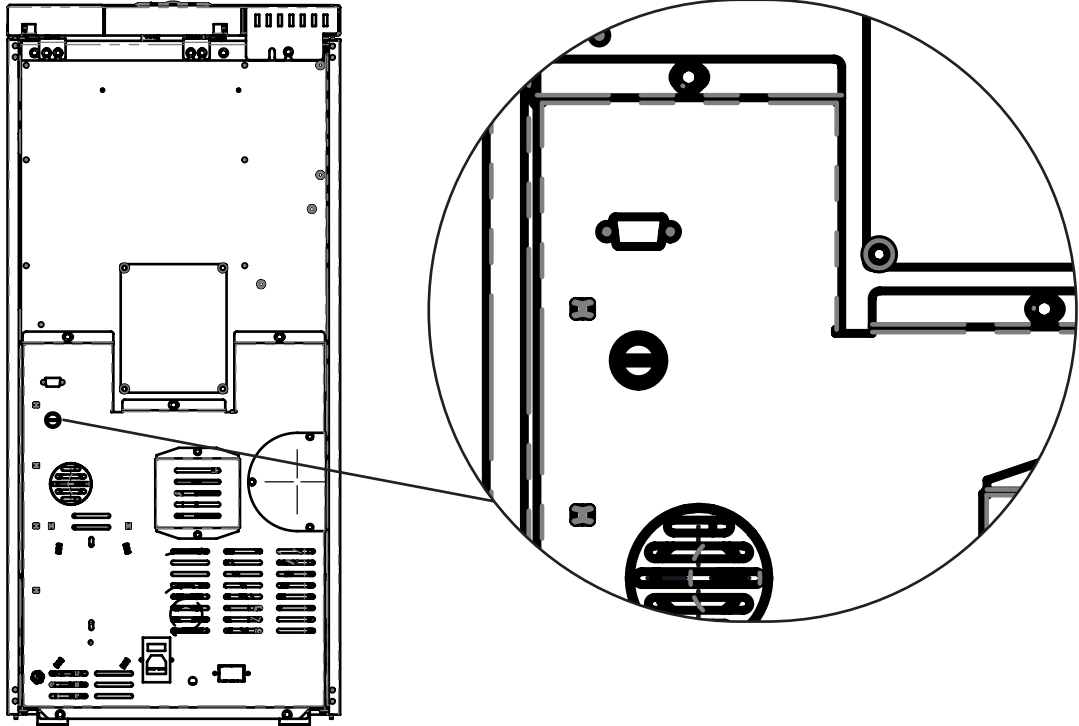
AL 09 - AIR-FLOW METER is an alarm that do not block the operation of the stove. In these conditions, the stove goes into modulating work, working at fixed extractor revolutions (RDS off). In any case, a periodic visual and acoustic signal indicating the type of problem remains active. Please contact the local Technical Assistance Centre.

To reset the alarm, keep the OK key pressed for a few seconds. The stove can be restarted manually or automatically (in the case of an active chronothermostat or external thermostat) only after resetting the alarm.

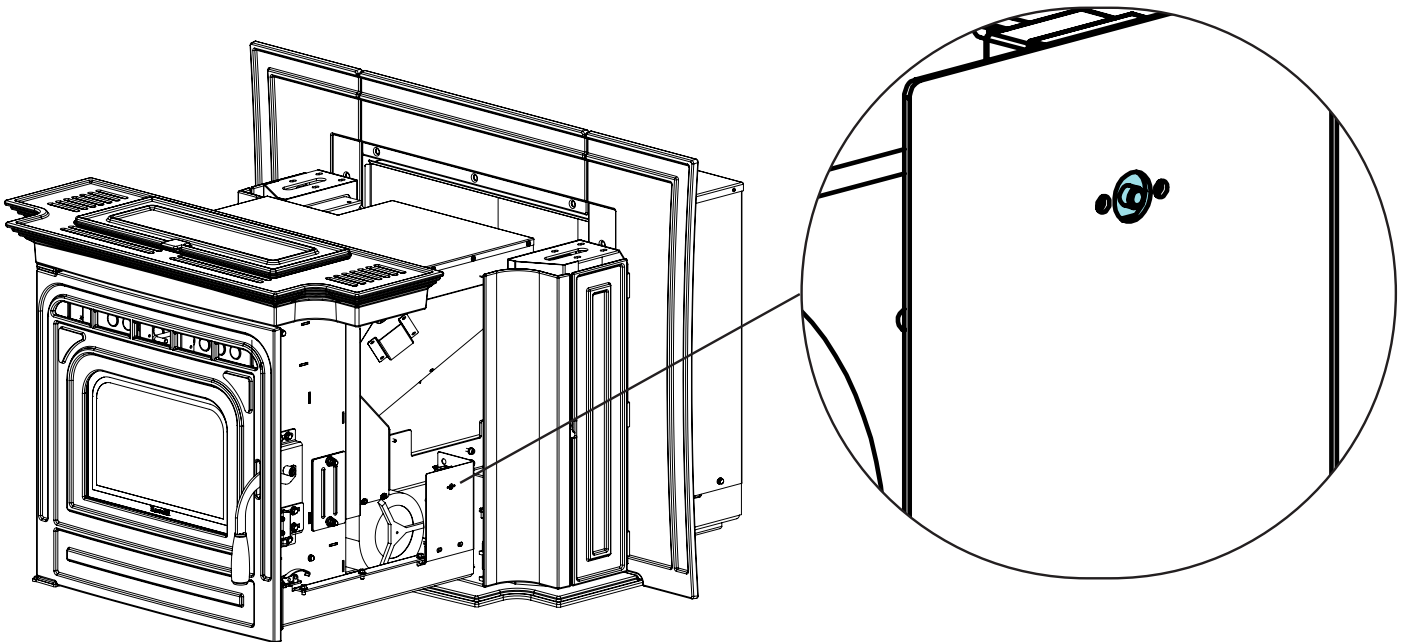
**Thermal alarm with reset**

- 1) By pressing the button OK on the display, the alarm can be reset.
- 2) Unscrew the protection cap and press the button to reset the thermostat alarm.
- 3) Try and repeat lighting after the cooling phase.

For Francesca 2015, Nicole, Rv80 Ceramica, Rv100 classic

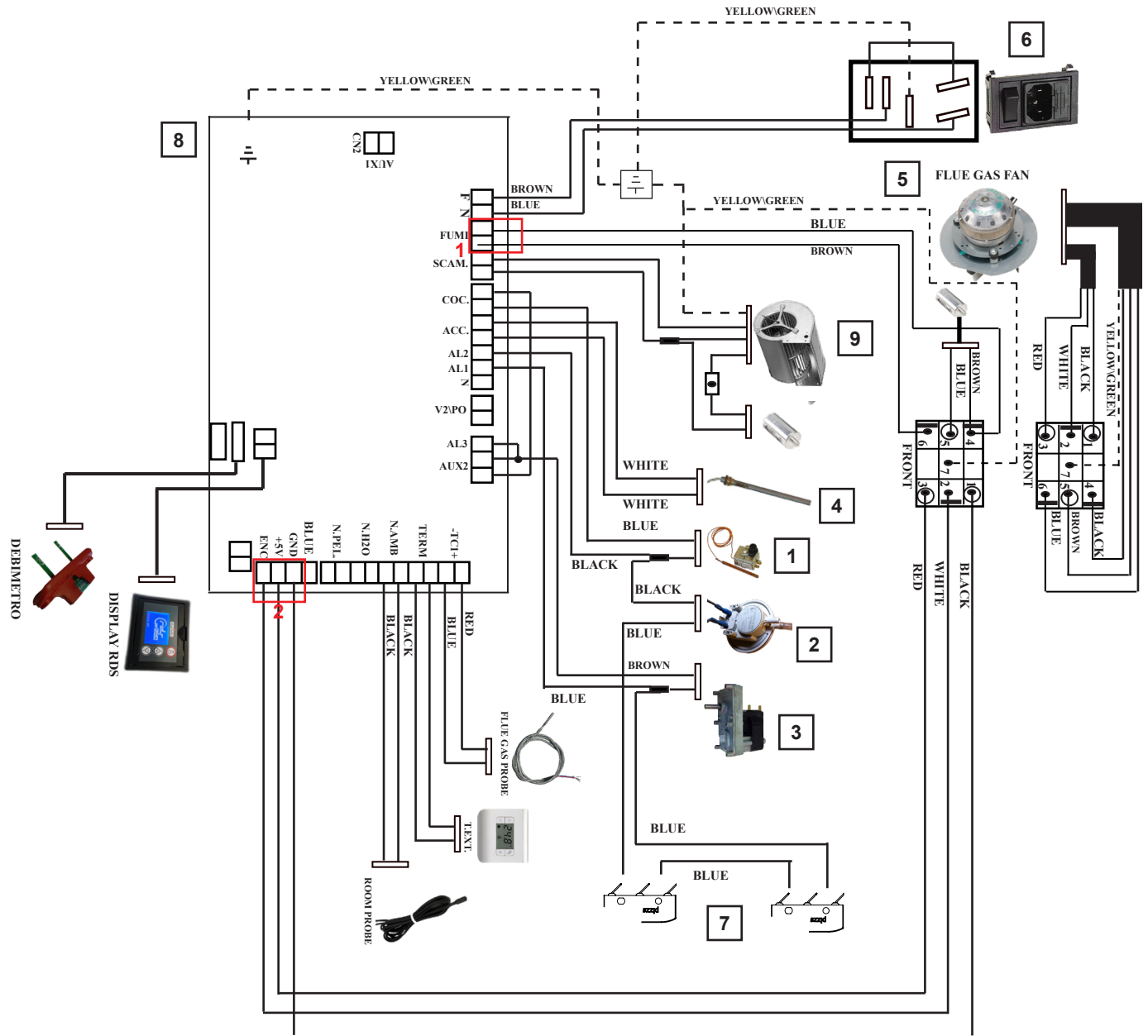


For pellet fireplace insert (Roma)

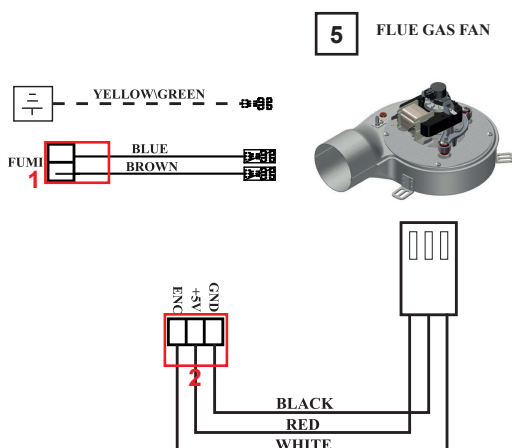


## ELECTRICAL WIRING DIAGRAM

For Francesca 2015, Nicole, Rv80 Ceramica and Rv100 classic



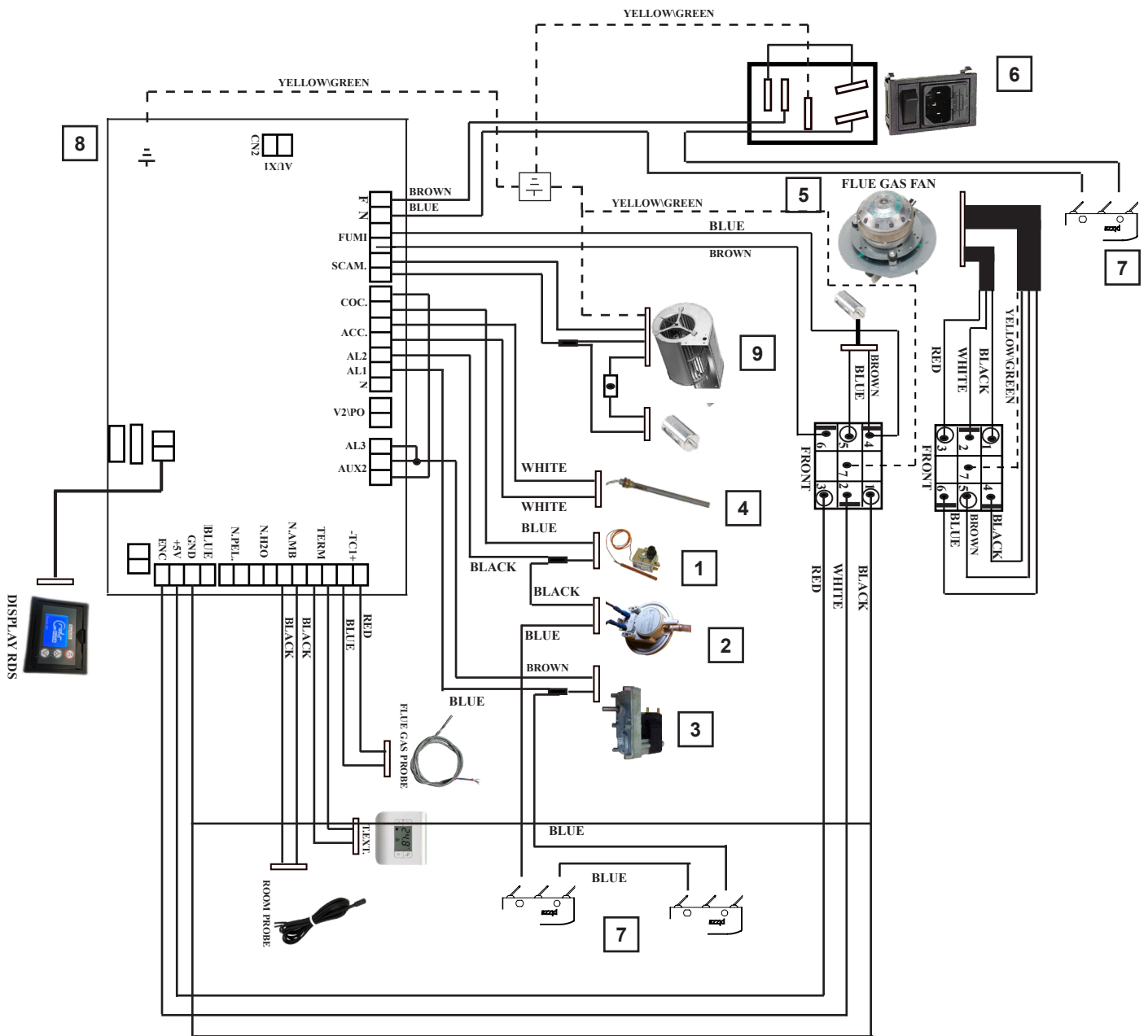
Alternative component (only for Francesca 2015, Nicole, Rv80 Ceramica)



### LEGEND:

- 1- Safety temperature switch
- 2- Safety pressure switch
- 3- Gearmotor
- 4- Igniter
- 5- Flue gas fan
- 6- Power cord plug; Main switch
- 7- Proximity switch
- 8- Motherboard
- 9- Room fan

The electrical wiring diagram for Roma



**LEGEND:**

- 1- Safety temperature switch
- 2- Safety pressure switch
- 3- Gearmotor
- 4- Igniter
- 5- Flue gas fan
- 6- Power cord plug; Main switch
- 7- Proximity switch
- 8- Motherboard
- 9- Room fan

## MAINTENANCE



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

Before carrying out any maintenance operation on the stove, please take the following precautions:

- Make sure that all the parts of the stove are cold
- Make sure that the ashes are completely extinguished
- Make sure that the general switch is in the zero position (off)
- Make sure that the plug is disconnected from the socket, thus avoiding accidental contacts.



Please follow the instructions for cleaning shown below carefully! Failure to observe them may lead to problems in the functioning of the stove AND FIRE HAZARD.

### **Cleaning the surfaces**

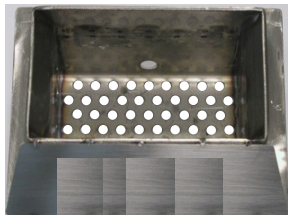
To clean the surfaces on the painted metal parts, use a wet cloth in water or at the most, water and soap.



The use of aggressive detergents or diluents can damage the surfaces of the stove.

### **Cleaning the fire pot before each ignition**

You must check that the fire pot, where the combustion takes place, is clean and that no waste or residue blocks the holes, in order to always guarantee excellent combustion of the stove, thus avoiding possible overheating, which could cause changes in the colour of the paint or flaking of the door, as well as failing to light the stove.



Clean fire pot with all the holes clearly visible



Fire pot needing cleaning with the holes blocked by ashes

Only a clean fire pot guarantees that the pellet stove functions without problems. During functioning deposits may be formed. It is easy to see when the fire pot has to be cleaned! It only needs a glimpse, each day, before switching on. For minor cleansing, it can be left in the stove, but if the residue is difficult to remove, it has to be extracted from its housing and the waste scraped out. The residue of ash depends on the quality of pellets used. Important: even with a new batch of pellets, although using the same brand, there may be differences during combustion and therefore they may dirty to a greater or lesser extent. Correct cleaning, done on a daily basis, allows the stove to burn optimally and to have a good yield, avoiding malfunctioning which in the long term could require technical assistance to reset the stove.



After each maintenance operation, make sure that the fire pot is positioned correctly in its seat.

### ***Cleaning the FIREX 600***



All Ravelli products have a combustion chamber made with FIREX 600, a material based on vermiculite, the result of research and development by Ravelli. The main features of FIREX 600 are resistant to heat, its lightness and excellent insulating capacities, improving the combustion and performance of the stove.

During combustion, FIREX 600 turns white, due to an effect called PYROLYSIS, making the flame clear and shining. If the combustion is regulated in an optimal way, the FIREX 600 interior always remains clean and white.

The condition of FIREX 600 is therefore a thermometer to understand whether the combustion is good or not.

FIREX 600 LIGHT – GOOD COMBUSTION

FIREX 600 DARK – POOR COMBUSTION

Firex 600 does not require special maintenance, it only has to be dusted with a soft brush to remove the ash that is deposited during combustion.

Abrasive sponges to clean to most resistant waste should not be used as they could compromise the thickness of the FIREX600 panel, creating critical points of breakage.

The tube of the vacuum cleaner should not be used in direct contact with FIREX 600.

Wet cloths should not be used to clean FIREX 600.

FIREX 600 is resistant to heat but not to knocks; handle with care if moved.

FIREX 600 may show a slight abrasion after a few hours of functioning, this is perfectly normal as the flame creates microgrooves in the panel without compromising it.

The duration of FIREX 600 depends only on how maintenance is carried out.

The pellet stove is a generator of heat with a solid fuel and as such requires servicing by qualified personnel at least once a year at the start of the season. This maintenance has the purpose of ascertaining and ensuring the perfect efficiency of all the components. We recommend you draw up an annual contract for maintenance of the product with your installer/dealer.

## **WARRANTY**

### ***Certificate of warranty***

Ravelli thanks you for the trust granted with the purchase of one of its products and invites the purchaser to:

- read the installation, use and maintenance instructions for the product;
- read the warranty conditions contained below.

### ***Warranty conditions***

The warranty for the Customer is acknowledged by the Dealer under the terms of law.

The Dealer acknowledges the warranty only if the product has not been tampered with and only if it has been installed in accordance with the Manufacturer's instructions.

The limited warranty covers manufacturing material defects, as long as the product has not broken due to an incorrect use, negligence, incorrect connection, tampering, installation errors.

The warranty becomes null and void even if only one requirement in this manual is not complied with.

The following are not covered by warranty:

- the combustion chamber refractory stones;
- the door glass;
- the gaskets;
- the paint job;
- the stainless steel or cast iron combustion grille;
- the resistance;
- the Majolica cladding;
- the aesthetic parts;
- any damages caused by unsuitable installation and/or use of the product and/or shortcomings on the part of the customer.

The use of poor quality pellet or any other unauthorised fuel may damage the product's components, cause its warranty to be voided and as a result eliminate the connected manufacturer liability.

It is therefore recommended to use good quality pellet that fulfils the requirements listed in the dedicated chapter.

All damages caused by transportation are not recognised, for this reason it is recommended to carefully check goods upon receipt, immediately warning the reseller of any damage.

### ***Registration of warranty***



To activate the warranty, it is necessary to register the product on the Guarantee Portal on the website [www.ravelligroup.it](http://www.ravelligroup.it), by entering your data and the purchase receipt.

### ***Info and problems***

Dealers authorised by Ravelli use a trained Technical Service Centre network to meet the Customer's requirements. For any information or request for assistance, please contact your Dealer or the Technical Service Centre.





**Aico S.p.A.**

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Aico S.p.A. does not assume any responsibility for any errors in this booklet and considers itself free to make any variations to the features of its products and to the present manual without notice.



## CAUTION / AVERTISSEMENT:

**HOT WHILE IN OPERATION. DO NOT TOUCH, KEEP CHILDREN, CLOTHING AND FURNITURE AWAY. CONTACT MAY CAUSE SKIN BURNS SEE NAME-PLATE AND INSTRUCTIONS. / CHAUD LORSQU'EN FONCTIONNEMENT NE PAS TOUCHER, GARDER LES ENFANTS, LES VÊTEMENTS ET MEUBLES HORS DE PORTÉE. LE CONTACT PEUT CAUSER DES BRÛLURES À LA PEAU. VOIR NOM DE LA PLAQUE ET LES INSTRUCTIONS**

## SAFETY LABEL / ÉTIQUETTE DE SÉCURITÉ

Listed Solid Fuel Room Heater/Pellet. Also suitable for Mob. Home installation. / *Granulé de bois/Appareil e chauffage autonome pour combustible solide répertorié. Convient également aux installations pour maisons mobiles.*

Standard met / Norme respectée: CFR EPA Title / Titre 40, Part / Partie 60, Subpart / Sous-partie AAA. Tested to / Testé : ASTM E1509-12, UL-C-S627-00, UL 1482-11 Room Heating Pellet Burning Type / Type appareil de chauffage autonome à granule de bois. Particulate emissions / Émissions de particules: ASTM E2779-10 (integrated run / course intégrée) ; ASTM E2515-11 methods / méthodes 28R and ASMT E2515.

Date of production / Date de production : 03/2017

Electrical Rating / Service nominal électrique: 120VAC, 60Hz, 5amps

Serial number/  
Numéro de série

Route power cord away from unit. do not route cord under or in front of appliance.

**DANGER:** Risk of Electric Shock. Disconnect power before servicing / *Risque de choc électrique. Débrancher l'alimentation électrique avant d'effectuer l'entretien ou la réparation.* **CAUTION / ATTENTION:** Moving parts may cause injury. Do not operate unit with external panels removed. Hot parts. Do not operate unit with external panels removed. Replace glass only with ceramic glass original spare parts available from your dealer. To start set thermostat above room temperature, the stove will light automatically. To shutdown, set thermostat below room temperature. For further instructions refer to owner's manual. / *bouger les parties peut causer des blessures. Ne pas allumer l'appareil avec des habillages manquantes. Endroits chauds. Pour commencer, régler le thermostat au-dessus de la température ambiante, la poêle s'allumera automatiquement. Pour la éteindre, régler le thermostat au-dessous de la température de la chambre. Pour de plus amples informations se référer au manuel du propriétaire.* **OPERATE ONLY WITH DOORS CLOSED. / FAIRE FONCTIONNER AVEC LES PORTES FERMÉES.** Never touch the door handle when the stove is running, you can burn your self. Do not obstruct the space beneath the heater / Ne jamais toucher la poignée de la porte quand le poêle est en marche, pour ne pas encourir de risque de brûlure. Ne pas obstruer l'espace en dessous de l'appareil de chauffage.

### PREVENT HOUSE FIRES / PRÉVENIR LES INCENDIES DE MAISON

Install and Use Only in Accordance With (Aico SpA) Installation And Operating Instructions. Contact Local Building or Fire Officials About Restrictions and Installation Inspection in Your Area. / *Installer et utiliser uniquement en conformité avec (Aico SpA) Installation et instructions pour le fonctionnement. Contacter l'immeuble ou les officiers pompiers à propos des restrictions et l'inspection de l'installation dans votre région.*

This wood pellet 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. / *Ce poêle à granulés de bois nécessite d'entretien périodique pour le nettoyage. Consultez le manuel dédié pour plusieurs d'informations. Nous prions de suivre les instruction du manuel car opérer de façon différent c'est contre le réglementation fédérale.*

**WARNING FOR MOBILE HOMES / AVERTISSEMENT POUR LES MAISONS MOBILES :** Do not install appliance in a sleeping room. Combustion air opening are not to be obstructed. An outside combustion air inlet must be provided. The structural integrity of the mobile home floor, ceiling and walls must be maintained. If installed on a combustible floor, provide a non combustible floor protection. Use only original Ravelli components for replacement. / *Ne pas installer l'appareil dans une chambre à coucher. Il ne faut pas que les ouverture d'air de combustion soient obstruées. Il faut fournir une entrée externe d'air de combustion. Il faut maintenir l'intégrité structurale du plancher, du plafond et des murs de la maison mobile. Si l'appareil est installé sur un plancher combustible, fournir une protection de plancher non combustible couvrant la zone sous le radiateur et s'étendant jusqu'à au moins 450 mm (18") sur le côté du feu et 200 mm (8") sur les autres côtés.*

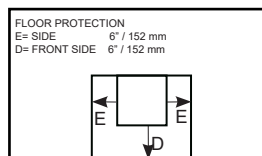
**When constructing floor protection for your pellet appliance, any part or materials used must be non-combustible. For Use Only With Pelletized Wood Fuel. Do not use any other type of fuel than wood pellet. / Lors de la construction protection de plancher pour votre poêle à granulés, toutes les pièces et matériaux utilisés doivent être incombustibles. Utilisez uniquement avec du bois de chauffage en granulés. Ne pas utiliser avec des types de carburants autres que le granulé de bois.**

Refer to manufacturer's instructions and local codes for precautions required for passing chimney through a combustible wall or ceiling. Inspect and clean vent system frequently in accordance with manufacturer's instructions. / *Se rapporter aux instructions du fabricant et aux codes locaux afin de prendre connaissance des précautions nécessaires pour faire passer la cheminée à travers un mur ou un plafond combustible. Inspecter et nettoyer fréquemment le réseau de tuyaux de ventilation conformément aux instructions du fabricant.*

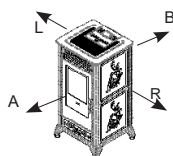
**DO NOT connect this unit to a chimney flue serving other appliances. / Ne pas raccorder cet appareil sur un conduit de fumée desservant d'autres appareils.**

Use a 3 or 4inch(76-102mm) diameter type "L" or "PL" venting system. / *Utiliser un réseau de ventilation secondaire «L» ou «PL» d'un type de diamètre de 3 ou 4 pouces (76-102mm).*

### Minimum Clearances to combustible materials / Dégagement minimal pour les matériaux de combustion



R = RIGHT SIDE / CÔTÉ DROIT	4"/ 102 mm
L = LEFT SIDE / CÔTÉ GAUCHE	4"/ 102 mm
B = BACK SIDE / CÔTÉ ARRIÈRE	4"/ 102 mm
A = FRONT SIDE / CÔTÉ AVANT	39,4"/ 1000 mm



**U.S. ENVIROMENTAL PROTECTION AGENCY**

**Certified to comply with 2020 particulate emission standards using pellet wood.**

<b>Emission Rate (g/hr)</b>	<b>Heating Efficiency (% Overall)</b>	<b>1st hour Emission Rate (g/hr)</b>	<b>CO emission gr/hr</b>
<b>0.70</b>	<b>80.20%</b>	<b>0.67</b>	<b>2.72</b>

**Made in Italy DO NOT REMOVE THIS LABEL**

## APPENDIX 8: Photographs of test set up

**Dilution picture Dia 6 no. EG-030**

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



Velocity ports at 90 degrees and tunnel temperature sensor location

Particulate sample extraction ports located 48 inches under (requirement  $4D=24$  inches minimum) velocity ports and 16 inches above downstream Tee. (Requirement  $2D=12$  inches minimum)

Adjustable damper for flow adjustments

Extraction blower



Last elbow from horizontal run

6 inches diameter stainless steel pipe

Velocity ports located 132 inches downstream of the last elbow (requirement  $8D=48$  inches minimum) and 48 inches upstream of the sampling ports (requirement  $4D=24$  inches minimum)

Total length between hood and sampling port : 22 feet.



60 inches horizontal run between two elbows. Mixing section, No mixing baffle. 6 inches diameter pipe

Two 6 inches elbow with horizontal mixing section.

Hood diameter 32 (requirement  $4D=24$  inches minimum) inches and height of 24 inches (requirement  $3D=18$  inches minimum)

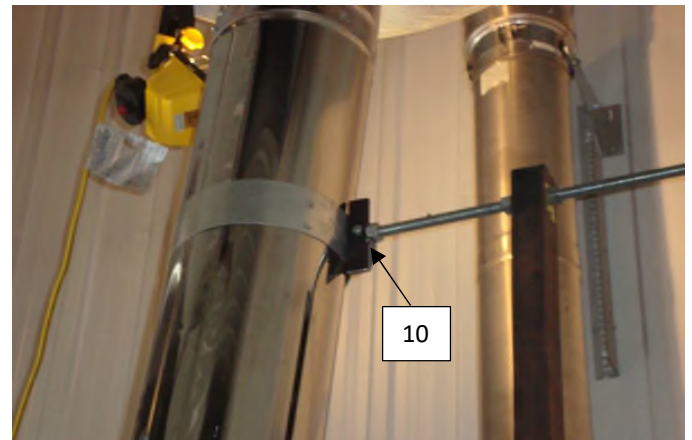
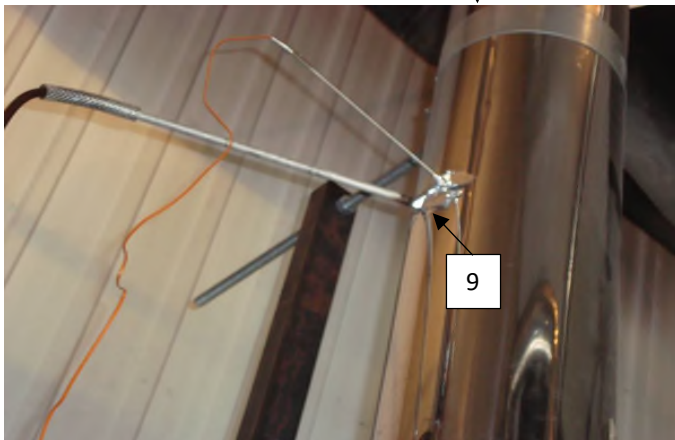
All pipe joints are sealed.

Stack sampling



Gas analysis and temperature probe

chimney support



**9** : Temperature and gas analyser sampling ports located 9 feet above platform

**10** : Exhaust system support bracket

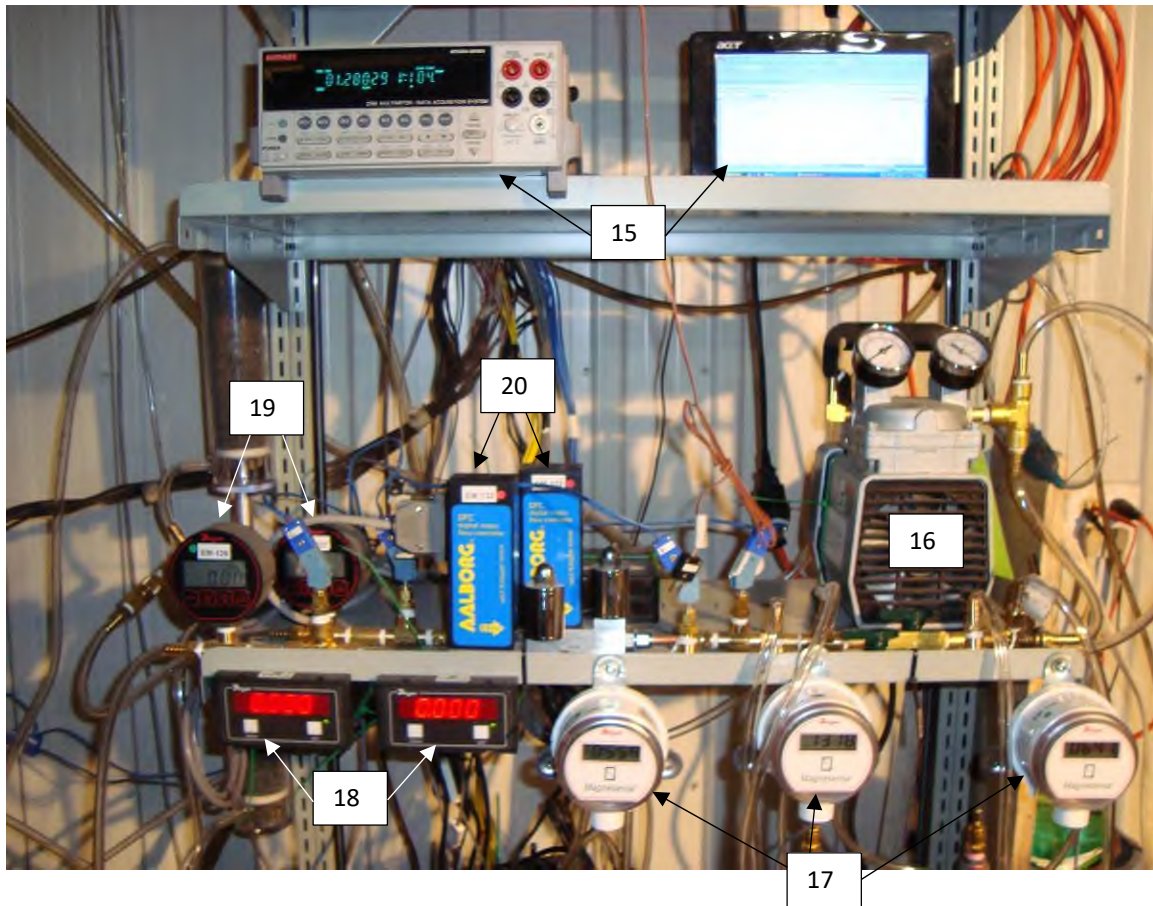


Draft sampling



**14** : Draft sampling port located 6 in. from the flue outlet

Equipment's

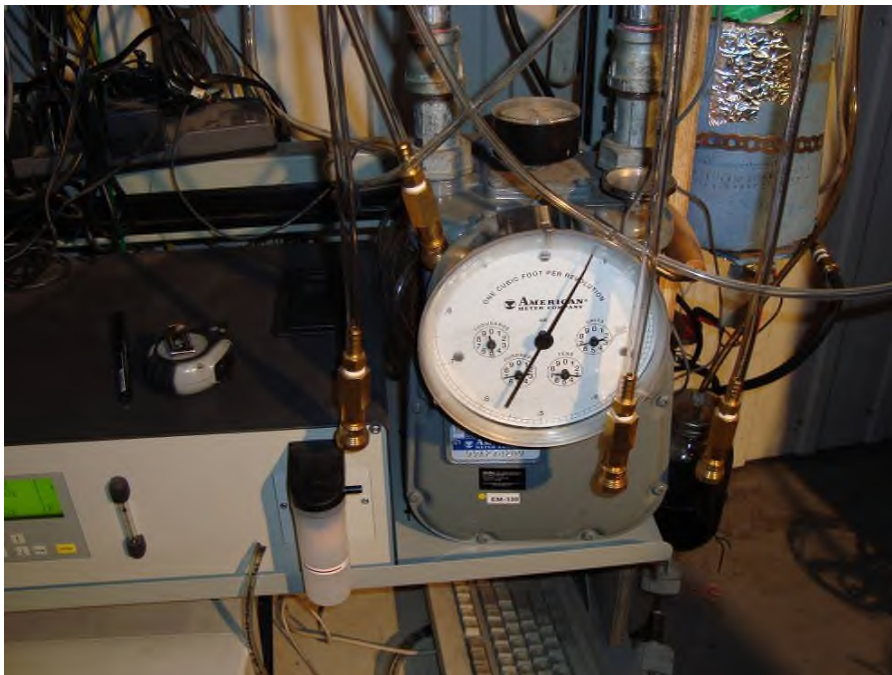


- 15 : Acquisition system
- 16 : Vacuum pump
- 17 : Digital manometer
- 18 : Digital read out for mass flow meter
- 19 : Digital vacuum gage
- 20 : Mass flow meter

Gaz analyser



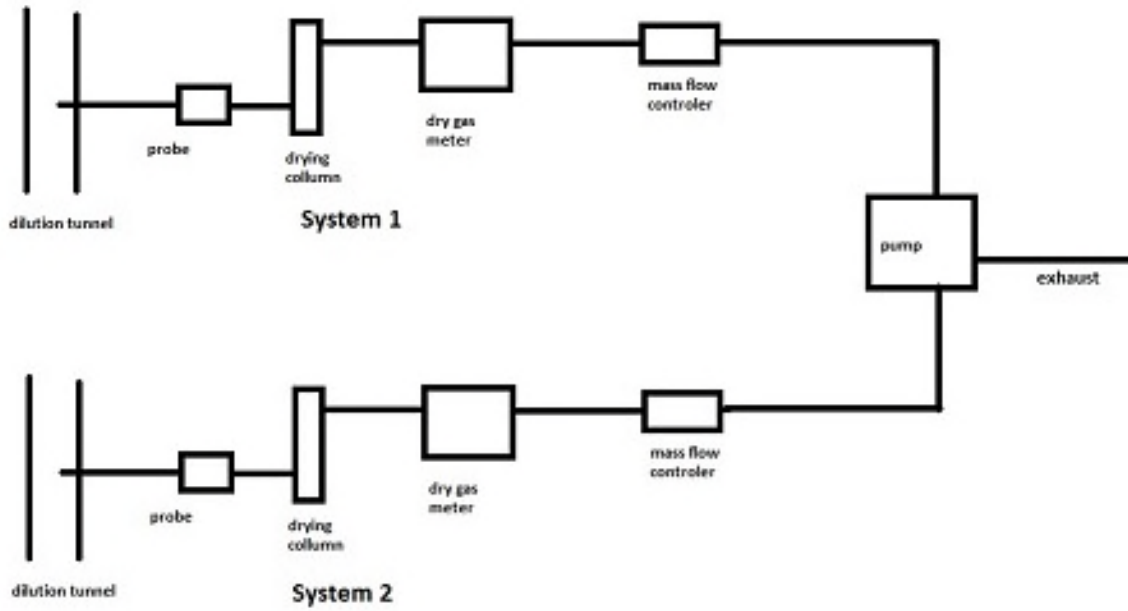
Reference dry gas meter



Dry gas meter for train 1, train 2 and room filter.



Dilution tunnel sample system



Dilution tunnel

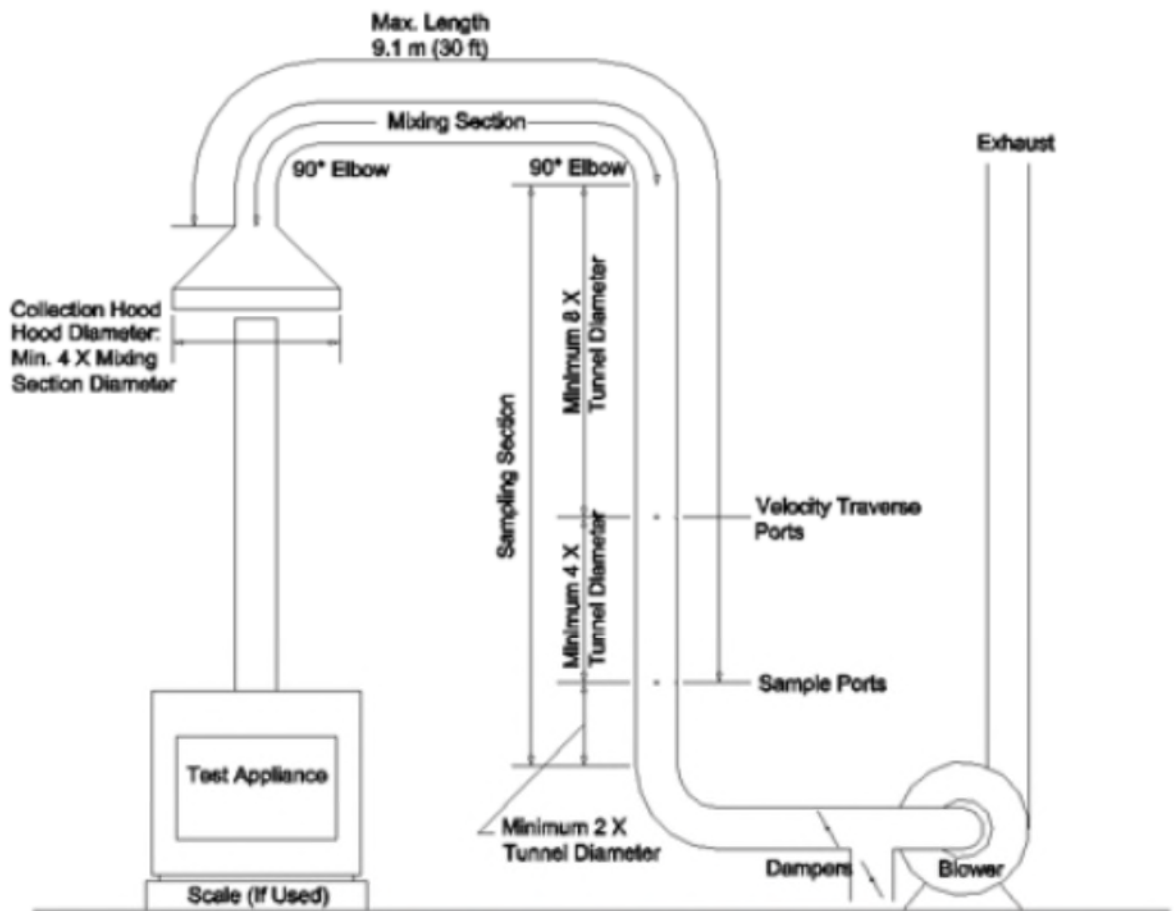


FIG. 3 Steel-Constructed Dilution Tunnel Apparatus

## APPENDIX 9: Test load photographs

Run 1





## 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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## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

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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## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

### 2. Calibrate analyzers as follows:

NOTE : Prior to proceeding with calibration, make sure to use NIST tracable 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 nitrogene, 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.

# POLYTESTS Services inc.

## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

- 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.)

# POLYTESTS Services inc.

## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

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.

# POLYTESTS Services inc.

## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

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.



# POLYTESTS Services inc.

## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

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

# POLYTESTS Services inc.

## SFBA EMISSIONS AND EFFICIENCY TESTING LABORATORY OPERATING PROCEDURE

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 two (2) hour intervals until weight change between weighings is less than 0.5 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**

$W_{WD}$	15,36 lbs
$\theta$	360 min
$\%M_W$	5,57 %

**Calculation**

BR	1,097 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

$V_m$	65,31 dcf
$Y$	0,99005
$P_{bar}$	30,08 in Hg
$\Delta H$	-0,8598 in Hg
$T_m$	538,0 R

#### Calculation

$V_{m(std)}$	61,93 dscf
--------------	------------

## 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

$F_1$	0,0038 g
$F_2$	0,000 g
$\Delta PF$	0,001 g

#### Calculation

$m_n$	4,700 mg
-------	----------

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

$m_n$	4,700 mg
$V_{m(\text{std})}$	61,93 dscf

#### Calculation

$C_s$	0,000076 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

$m_r$	0,200 mg
$V_{mr(std)}$	34,92 dscf

#### Calculation

$C_r$	0,000006 g/dscf
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

$V_{strav}$	0,0547
$V_{scent}$	0,0595

#### Calculation

$F_P$	0,919328
-------	----------

## 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: $34.97 \text{ m/sec} \left[ \frac{(\frac{\text{g}}{\text{g-mole}})(\text{mm Hg})}{(^{\circ}\text{K})(\text{mm H}_2\text{O})} \right]^{1/2}$ For English units: $85.49 \text{ ft/sec} \left[ \frac{(\frac{\text{lb}}{\text{lb-mole}})(\text{in Hg})}{(^{\circ}\text{R})(\text{in H}_2\text{O})} \right]^{1/2}$
$C_p$	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
$F_p$	0,919
$(\sqrt{\Delta P})_{avg}$	0,2445 in H <sub>2</sub> O <sup>1/2</sup>
$P_{bar}$	30,08 in Hg
$P_g$	0,24 in H <sub>2</sub> O
$P_S$	30,09 in Hg
$M_S$	28,78 lb/lb-mol
$t_S$	92,14 F

$T_s$  552,14 R

**Calculation**

$V_s$  15,1916 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, $\text{K}$ ( $\text{R}$ ), or $273 + t_s$ for metric units, $460 + t_s$ 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
$V_S$	15,192
$A$	0,196 $\text{ft}^2$
$T_{std}$	528 R
$T_S$	552,14 R
$P_S$	30,094 in Hg
$P_{std}$	29,92 in Hg

#### Calculation

$Q_{std}$	168,70 dscf/min
-----------	-----------------

## 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

$C_S$	0,000076 g/dscf
$C_r$	0,000006 g/dscf
$Q_{std}$	168,70 dscf/min

#### Calculation

E	0,01 g/min
E	0,71 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

$C_S$	0,000076 g/dscf
$C_r$	0,000006 g/dscf
$Q_{std}$	168,70 dscf/min
$\theta$	360 min

#### Calculation

E	4,26 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: $34.97 \text{ m/sec} \left[ \frac{(\frac{g}{g\text{-mole}})(\text{mm Hg})}{(^{\circ}\text{K})(\text{mm H}_2\text{O})} \right]^{1/2}$ For English units: $85.49 \text{ ft/sec} \left[ \frac{(\frac{\text{lb}}{\text{lb-mole}})(\text{in Hg})}{(^{\circ}\text{R})(\text{in H}_2\text{O})} \right]^{1/2}$
$C_p$	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>	
$F_p$	0,919	$F_p$	0,919
$K_p$	85,49	$K_p$	85,49
$C_p$	0,99	$C_p$	0,99
$\Delta p_i$	0,059 in H <sub>2</sub> O	$\Delta p_i$	0,059 in H <sub>2</sub> O
$T_{si}$	566,3 R	$T_{si}$	566,2 R
$P_s$	30,09 in Hg	$P_s$	30,09 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>	
$v_{si}$	15,31 ft/sec	$v_{si}$	15,25 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		
$\theta$	360	min	$\theta$	360	min
$\theta_i$	1	min	$\theta_i$	1	min
$V_m$	63,74	dcf	$V_m$	61,96	dcf
$V_{mi(std)}$	0,178	cuft	$V_{mi(std)}$	0,1744	cuft
$V_S$	15,20	ft/sec	$V_S$	15,20	ft/sec
$V_{Si}$	15,317	ft/sec	$V_{Si}$	15,317	ft/sec
$T_m$	537,6	R	$T_m$	538,0	R
$T_{mi}$	534,29	R	$T_{mi}$	534,43	R
$T_S$	552,14	R	$T_S$	552,14	R
$T_{Si}$	566,3	R	$T_{Si}$	566,3	R

#### Calculation

train=1		train=2	
PR	103,1 %	PR	103,8 %



## 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

$V_{mL}$	0,172 dcf
$F_A$	0,0116 ft <sup>2</sup>

#### Calculation

$FV_{max}$	14,82 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	4,22 g
Train 2	4,25 g

#### Calculation

Dual train precision	0,39 %
----------------------	--------

## 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

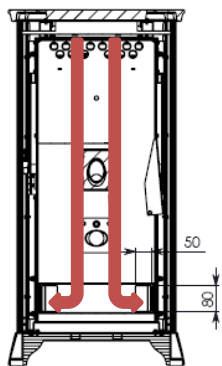
## APPENDIX 13: Operating instruction

# Operating instruction for RV 100 Classic, Ravelli

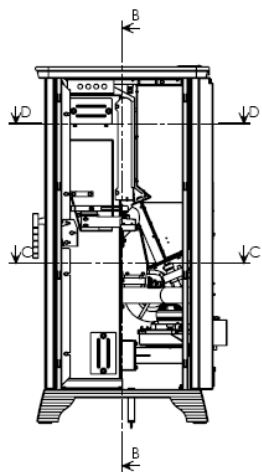
Run at power 5 for at least 1 hour to preheat the pellet stove

- For maximum output run at power 5
- For medium output run at power 2
- For minimum output run at power 1

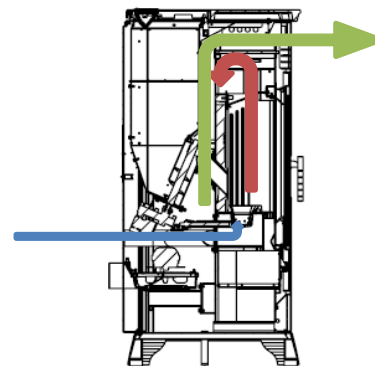
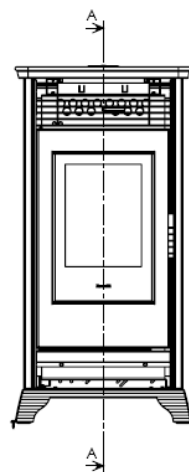
## APPENDIX 14: Drawing Air flow pattern



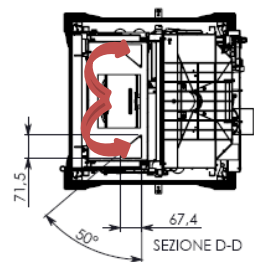
SEZIONE B-B



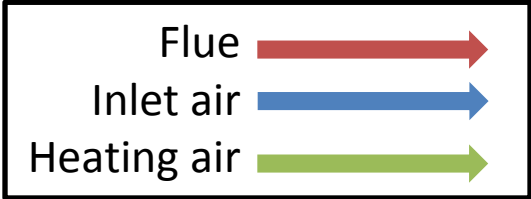
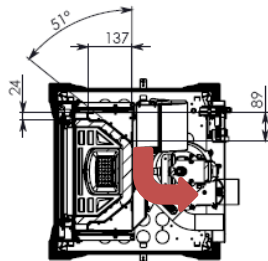
SEZIONE C-C



SEZIONE A-A



SEZIONE D-D



Mod.	DESCRIZIONE	Data	Dis.	Appr.
<b>MODIFICHE</b>				
TOLLERANZE GENERALI PER QUOTE LINEARI, ANGOLARI, SMUSI E RACCORDI, CLASSE FINE UNI EN 22765-1, DOVE NON INDICATE		MODIFICARE SOLO SU CAD CAD DRAWING HANDLING ON CAD SYSTEM ONLY		
DENOMINAZIONE (DENOMINATION)	SCALA (SCALE) <b>1:10</b>	FORMATO (SHEET) A2	MATRICE	
COMPLESSIVO STUFA	MATERIALE (MATERIAL)			
	TRATTAM. SUPERFICIALE			
	DIS. (DESIGNER) <b>M.Tengatini</b>	CONTR. (CHECKED) GH		
	DATA (DATE) <b>giovedì 23 giugno 2016</b>	PESO Kg (WEIGHT) <b>41,056</b>		
	N. DISEGNO (DRWS NR.) <b>100-00-004A-CSA</b>			MOD.

**Ravelli**<sup>®</sup>

il fuoco intelligente  
Via Kupfer 250M Palazzolo S/O - BRESCIA - ITALY

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## APPENDIX 15: WHA/ CoC/ 30-day notice/ others

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
30-DAY NOTIFICATION FORM  
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**

**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 60.533 and 60.5475. This document may be revised periodically without public notice. 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).

- ▶ 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:**

**RAVELLI SRL**

<b>Appliance Type (Circle One):</b>	Adjustable Burn Rate Wood Heater	<b>Pellet Stove</b>	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 Type:</b>	Crib	<b>Pellet</b>	Cordwood	Other:		

**Model Name and Number:**

**RV 100 Classic**

**Catalyst: Yes \_\_\_\_\_ No x \_\_\_\_\_**

**Mailing Address:**

**Via Kupfer 31**

**Street Address:**

**Via Kupfer 31**

<b>City:</b> Palazzolo s/O (BS)	<b>State:</b> ITALY	<b>ZIP Code:</b> 25036
<b>Phone:</b> +39 030 7402939	<b>Fax:</b> +39 030 7302026	<b>Web Site:</b> <a href="http://usa.ravelligroup.it/">http://usa.ravelligroup.it/</a>

**Address of Manufacturing Facility:**

**Via Kupfer 31**

<b>City:</b> Palazzolo s/O (BS)	<b>State:</b> ITALY	<b>ZIP Code:</b> 25036
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**EPA APPROVED TEST LABORATORY**

**Name and Title of Authorized Representative:**  
**Danick Power**

**Company:**  
**Polytests Services Inc.**

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
30-DAY NOTIFICATION FORM  
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**

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- ▶ 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>Phone:</b> 450.741.3636	<b>E-mail:</b> dpower@polytests.com	<b>Fax:</b>
<b>City:</b> St-Jean-sur-Richelieu	<b>State:</b> Québec, CANADA	<b>ZIP Code:</b> J3B 7S7

**EPA APPROVED THIRD-PARTY CERTIFIER**

**Name and Title of Authorized Representative:**  
Ken Martin

**Company:**  
CSA Group

<b>Phone:</b> (514) 428-2489	<b>E-mail:</b> ken.martin@csagroup.org	<b>Fax:</b>
<b>City:</b> Pointe-Claire (Montréal)	<b>State:</b> Québec, CANADA	<b>ZIP Code:</b> H9R 5E8

**COMPLIANCE TEST INFORMATION**

**Test Method(s):**  
Method 28R

**Date(s) of Proposed Test:**  
May 25<sup>th</sup> and after

**Testing Location:**  
Polytests Services Inc.  
695 B rue Gaudette, St-Jean-sur-Richelieu Québec, Canada, J3B 7S7

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
30-DAY NOTIFICATION FORM  
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**

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- ▶ This notice must be received by the EPA at least 30 days before the start of testing.

Giovanni Scarlini, CEO  
Print Name and Title of Authorized Official

  
Signature

2016-4-20  
Date

Remarks:

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
 CERTIFICATION OF CONFORMITY  
 PURSUANT TO 40 CFR PART 60 SUBPARTS AAA AND QQQQ  
 2015 STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW  
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**GENERAL INFORMATION**

**Manufacturer's Name: Ravelli SRL (AICO Spa.)**

<b>Heater Type (Circle One):</b>	Adjustable Burn Rate Wood Heater	<b>Pellet Stove</b>	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 Type:</b>	Crib	<b>Pellet</b>	Cordwood	Other:		

**Model Name and Number: RV100 Classic**

**Catalyst: Yes** \_\_\_\_\_ **No**

**Mailing Address:  
Via Kupfer 31**

**Street Address:  
Via Kupfer 31**

<b>City</b> Palazzolo, s/O	<b>State:</b> ITALY	<b>ZIP Code:</b> 25036
<b>Phone:</b> +39 030 7402939	<b>Fax:</b> +39 030 7302027	<b>Web Site:</b> <a href="http://usa.ravellogroup.it/">http://usa.ravellogroup.it/</a>

**Address of Manufacturing Facility:  
Via Kupfer 31**

<b>City:</b> Palazzolo, s/O	<b>State:</b> ITALY	<b>ZIP Code:</b> 25036
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**EPA APPROVED THIRD PARTY CERTIFIER**

**Authorized Representative: Nick Shrewsbury-Gee, P.Eng**

**Company: CSA GROUP**

<b>Phone:</b>	<b>E-mail:</b> Nick.shrewsburygee@csagroup.org	<b>Fax:</b>
<b>City: Toronto</b>	<b>State: On</b>	<b>ZIP Code: M9W 1R3</b>

**Position: Certifier**

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
 CERTIFICATION OF CONFORMITY  
 PURSUANT TO 40 CFR PART 60 SUBPARTS AAA AND QQQQ  
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<b>Report Number:</b> PI-20129	<b>Date of Tests:</b> May 25 <sup>th</sup> 2016	<b>Date of Report:</b> June 1 <sup>ST</sup> 2016
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<b>Quality Assurance Plan included?:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	<b>Wood Heater/Hydronic Heater/Forced-Air Furnace Application Included:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	<b>Remarks:</b>
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**Affected Source Data Summary**

<b>Wood Burning Heater</b>	<b>Hydronic Heater</b>	<b>Forced-Air Furnace</b>
Weighted particulate emission average of <b>1</b> test runs: <b>0.7</b> grams per hour	Maximum Output Rating: _____ Weighted particulate emission average: X Lb/MMbtu output	Particulate emission average: X Lb/MMbtu output
Weighted average HHV efficiency of <b>1</b> test runs: <b>80.2%</b>	Annual Efficiency Rating: _____	Overall thermal efficiency (HHV): X%
	Particle Emissions: _____	Overall Delivered Heat Efficiency: X%

**AFFIRMATIONS**

- The above-named affected source has been tested by a laboratory qualified to test and report on the emissions of this type of product under 40 CFR Part 60, Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces (2020 Standards).
- The Test Report No. PI-20129, prepared by Danick Power, P.Eng and dated June 1st, 2016, has been reviewed by Nick Shrewsbury-Gee, P.Eng and was found to be complete and to have used the correct procedures in accordance to the 2020 NSPS Standards.
- The emissions levels measured in the Test Report and listed above comply with the relevant particulate matter limits established by the 2020 NSPS Standards.
- The model listed above was tested to Particulate emissions: ASTM E2779-10 (section 9.4.1 integrate test run); ASTM E2515-11 methods 28R as referred into 40 CFR Part 60 Subpart AAA, CO emission & Efficiency: CSA B415.1-10 (Test method(s)).
- The permanent label and owner's manual meets the requirements of 40 CFR § 60.536 and/or § 60.5478.
- The above-named manufacturer, on the effective date of this certificate, was operating under a quality assurance plan, per 40 CFR § 60.533(m) and/or § 60.5475(m), that has been reviewed and approved by Nick Shrewsbury-Gee, P.Eng
- The above-named manufacturer has contracted CSA GROUP to conduct regular (at least annual) unannounced audits of the manufacturing facility, affected source, and quality assurance plan pursuant to 40 CFR § 60.533(m) and/or § 60.5475(m).

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
CERTIFICATION OF CONFORMITY  
PURSUANT TO 40 CFR PART 60 SUBPARTS AAA AND QQQQ  
2015 STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW  
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Nick Shrewsbury-Gee, P.Eng - Certifier  
Print Name and Title



\_\_\_\_\_  
Signature of Authorized Third-Party Representative

July 6th 2021  
Date

**This is a certification of conformity to certify that the bearer has successfully completed the requirements pursuant to the 2020 NSPS Standards.**

Third-party EPA approval expiration date: Nov 2025

V1

Remarks:  
Initial Revision of CoC

St-jean-sur-Richelieu, September 8<sup>th</sup> 2021

Att.: Rafael Sanchez, Steffan Johnson

Subject: TYPO, mixing baffle in template report

In our report template we forgot to remove the reference of the mixing baffle in the dilution tunnel in the description section 3.1 and in the drawing in appendix 8 for our report template. This TYPO will can be found in most of our EPA reports. In reality the mixing baffles has been removed from the tunnel in 2015 when the E.P.A. review the regulation and refer to the ASMT E2515 for sampling standard. Our Iso 17025 accreditor (IAS) has audited Polytests for the ASMT E2515 and other testing method in March 2015 and found the dilution tunnel compliant to the standard (no mixing baffle in place). Moreover, we have been audited every two years by the EPA proficiency testing and dilution tunnel have been dismantling and inspected by the auditor and no mixing baffle was in the dilution tunnels. In order to fix this issue, reports are updated to remove the TYPO and updated the drawing of the dilution tunnel in appendix 8.

Thank you  
Best regards,



Danick Power  
**Polytests services inc.**  
695-B Gaudette  
St-jean-sur-richelieu  
J3B 7S7  
Phone. : 450 741-3636  
e-mail: [infos@polytests.com](mailto:infos@polytests.com)

Regards  
Marvin



Marvin Evans, LET, OBT1, G2  
Technical Oversight Specialist,  
Special Inspections / Field Evaluations – Fuel Burning Appliances  
Certification - Oil and Solid Fuel Burning Appliances

178 Rexdale Blvd  
Toronto, ON M9W 1R3  
T 416 747 2342  
C 437 996 5424  
[marvin.evans@csagroup.org](mailto:marvin.evans@csagroup.org)  
[csagroup.org](http://csagroup.org)



## IAS Laboratory Assessment Report

File or TL No.: File 2014-12-10

Laboratory Name: Services Polytests, Inc.

Laboratory Address: 695B Gaudette, St. Jean-sur-Richelieu, Quebec, J3B 7S7, Canada

Name and Title of Laboratory Contact: Gaetan Piedalue, P. Eng.; President

Name of Assessor: Douglas Sickles, P.E.

Date(s) of Assessment: March 16-20, 2015

*Use this space to record names and titles of persons present at opening meeting:*

Services Polytests : Gaetan Piedalue, P. Eng.; President ; Danick Power, VP,  
Operation Manager; Marie-Josée Brudeau, Quality Manager

IAS: Douglas Sickles, P.E.

*Use this space to record names and titles of persons present at closing meeting:*

Services Polytests : Gaetan Piedalue, P. Eng.; President ; Danick Power, VP,  
Operations Manager

IAS: Douglas Sickles, P.E.

Signature of Laboratory Representative:

Signature of Assessor:

*Reviewer Comments:*

Reviewed by:

Date:

<u>Report</u>	<u>Date</u>	<u>Client</u>	<u>Product</u>	<u>Standards</u>	<u>Tested By:</u>	<u>Reviewer</u>
P-1164	12-2012	ICC	Chimney Liner	ULC S640, UL 1777	Alain Lefebvre	Danick Power
P-1223	10-2014	ICC	Flexible Liner	ULC S640, UL 1777	Alain Lefebvre	Danick Power
P-1231	12-2014	ESIM	Automatically fed pellet/wood chip fired boiler	CSA B366.1 CSA B415.1 UL 2523 EPA Method 28 WHH ASTM 2515A	Maxime Martin	Danick Power
P-1246	11-2014	JA Roby	Wood Stove	UL 1482, ULC S627		Danick Power

### **TEST METHODS DEMONSTRATED AND REVIEWED:**

**Test methods demonstrated:** (many tests shared between standards)

<b>Test Standard/Method</b>	<b>Title</b>
ANSI/UL 1482	Solid Fuel Type Room Heaters
CAN/ULC S627	Standard for Space Heaters for use with Solid Fuels
ASTM E1509	Standard Specification for Room Heaters, Pellet Fuel Burning type
CAN/CSA B366.1	Solid Fuel Fired Heating Appliances
CAN/CSA B415	Performance Testing of Solid Fuel Burning Heating Appliances
ASTM E2515	Determination of particulate matter collected by a dilution tunnel

**Test methods that involved interviews and equipment review:**

<b>Test Standard/Method</b>	<b>Title</b>
ULC S628	Fireplace Inserts
ANSI/UL 2523	Solid Fuel Fired Hydronic Heating Appliances, Water Heaters and Boilers
CAN/ULC S610	Standard for Factory Built Fireplaces
ANSI/UL 127	Factory Built Fireplaces
ANSI/UL 391	Solid Fuel and Combination Fuel Central and Supplementary Furnaces"
CAN/ULC S632	Standard for Heat Shields
ANSI/UL 1618	Wall protectors, floor protectors and hearth extensions
EPA 40 CFR Part 60, Subpart AAA, Method 28R	Certification and Auditing of Wood Heaters
EPA 40 CFR Part 60, Subpart QQQ, Method 28WHH	Measurement of Particulate Emissions and Heating Efficiency of Wood-Fired Hydronic Heating Appliances
E2558,E2618, E2779, E2780	Particulate Matter Emissions for Wood, heaters, Pellet heaters, Boilers, Wood Fireplaces
ULC S604	Standard for Factory-Built type A Chimneys
ULC S629	Standard for 650°C Factory-Built Chimneys
UL 103	Factory-Built Chimneys for Residential type and Building Heating Appliances
ULC S640	Standard for Lining Systems for New Masonry Chimneys
ULC S641	Standard for Factory-Built Chimney connectors and wall pass-through assemblies
UL 1777	Chimney Liners
ULC S635	Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
 CERTIFICATION OF CONFORMITY  
 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**

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**GENERAL INFORMATION**

**Manufacturer's Name:** AICO SPA (Ravelli)

<b>Heater Type (Circle One):</b>	Adjustable Burn Rate Wood Heater	Pellet Stove	Single Burn Rate Heater	Hydronic Heater	Forced Air Furnace	Other: Pellet Insert
<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 Type:</b>	Crib	Pellet	Cordwood	Other:		

**Model Name and Number:**  
 • RV 100 Classic

**Catalyst:** No

**Mailing Address:** Via Consorzio Agrario, 3/D Chiari, Italy

**Street Address:** Via Consorzio Agrario

<b>City:</b> Chiari	<b>State:</b> Brescia	<b>ZIP Code:</b> 25032
<b>Phone:</b> + 39 030 74 02 939	<b>Fax:</b> N/A	<b>Web Site:</b> <a href="http://usa.ravelligroup.it/">http://usa.ravelligroup.it/</a>

**Address of Manufacturing Facility:**  
 Jotul Poland Sp z o.o.  
 ul. Ks. Jerzego Popieluszki 17  
 Kaŕy Wrocławskie, Lower Silesian 55 080  
 Poland

<b>City:</b> Kaŕy Wrocławskie	<b>State:</b> Kaŕy Wrocławskie	<b>ZIP Code:</b> 55 080
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**EPA APPROVED THIRD PARTY CERTIFIER**

**Authorized Representative:** Aaron Reesor

**Company:** CSA Group

<b>Phone:</b> 416 747-2652	<b>E-mail:</b> <a href="mailto:aaron.reesor@csagroup.org">aaron.reesor@csagroup.org</a>	<b>Fax:</b> N/A
<b>City:</b> Toronto	<b>State:</b> Ontario, Canada	<b>ZIP Code:</b> M9W 1R3

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
 CERTIFICATION OF CONFORMITY  
 PURSUANT TO 40 CFR PART 60 SUBPARTS AAA AND QQQQ  
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**Position:** Certifier – Fuels Group

<b>Report Number:</b> Polytest Test Report: PI-20129	<b>Date of Tests:</b> May 25 <sup>th</sup> 2016	<b>Date of Report:</b> REPORT DATE: June 1ST 2016 Revision 1: February 16th 2022 Revision 2: July 7th 2022 Project number: PI-20129
<b>Quality Assurance Plan included?:</b> Yes	<b>Wood Heater/Hydronic Heater/Forced-Air Furnace Application Included:</b> NO	<b>Remarks:</b> N/A

**Affected Source Data Summary**

<b>Wood Burning Heater</b>	<b>Hydronic Heater</b>	<b>Forced-Air Furnace</b>
Weighted particulate emission average of 1 test runs: <b>0.7</b> grams per hour	Maximum Output Rating: _____ Weighted particulate emission average: X Lb/MMbtu output	Particulate emission average: X Lb/MMbtu output
Weighted average HHV efficiency of 1 test runs: <b>80.2%</b>	Annual Efficiency Rating: _____	Overall thermal efficiency (HHV): X%
	Particle Emissions: _____	Overall Delivered Heat Efficiency: X%

**AFFIRMATIONS**

- The above-named affected source has been tested by a laboratory qualified to test and report on the emissions of this type of product under 40 CFR Part 60, Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces (2015 Standards).
- The Test Report No. PI-20129, prepared by Danick Power and dated July 10<sup>th</sup> 2022, has been reviewed by Aaron Reesor and was found to be complete and to have used the correct procedures in accordance to the 2015 NSPS Standards.
- The emissions levels measured in the Test Report and listed above comply with the relevant particulate matter limits established by the 2015 NSPS Standards.
- The model listed above was tested to Particulate emissions: ASTM E2779-10 (section 9.4.1 integrate test run); ASTM E2515-11 as referred into 40 CFR Part 60 Subpart AAA, CSAB415.1-10 (for efficiency only) (Test method(s)).
- The permanent label and owner's manual meets the requirements of 40 CFR § 60.536 and/or § 60.5478.
- The above-named manufacturer, on the effective date of this certificate, was operating under a quality assurance plan, per 40 CFR § 60.533(m) and/or § 60.5475(m), that has been reviewed and approved by Aaron Reesor.
- The above-named manufacturer has contracted CSA Group to conduct regular (at least annual) unannounced audits of the manufacturing facility, affected source, and quality assurance plan pursuant to 40 CFR § 60.533(m) and/or § 60.5475(m).

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
 CERTIFICATION OF CONFORMITY  
 PURSUANT TO 40 CFR PART 60 SUBPARTS AAA AND QQQQ  
 2015 STANDARDS OF PERFORMANCE FOR NEW RESIDENTIAL WOOD HEATERS, NEW  
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**Aaron Reesor – CSA Group – Certifier – Fuels Group  
 Print Name and Title**

*Aaron Reesor*

**Signature of Authorized Third-Party Representative**

**July 10<sup>th</sup> 2022  
 Date**

**This is a certification of conformity to certify that the bearer has successfully completed the requirements pursuant to the 2015 NSPS Standards.**

**Third-party EPA approval expiration date: July 2027**

**V1**

**Remarks:**

Revision 1 February 16th 2022

- Moisture in the tunnel assume change section 3.6
- Table 2.6 updated with deviation in g/Kg
- Appendix 1 molecular weight updated to 29 for all runs
- Appendix 1 updated with data and preburn data
- The section 3.4 p.11 updated for runs Anomalies, Validity and appropriateness detail.
- Updated Section 1.4 p.6 conditioning was done week of May 17th 2016.
- Additional letter for TYPOs about mixing baffle in the original report.
- ☑ Table 2.1 additional emission number in gr/Mj

Revision 2: July 7th 2022

- Section 3.4 update : Pellet on ENplus program
- The section 3.4 p.11 updated for back filter negative weight addressed.
- ☑ Appendix 7 manual updated to meet requirements

<b>Test Report Problems or Irregularities</b>	<b>Regulatory Citation</b>	<b>Information Needed to Address Problems or Irregularities</b>	<b>Answers</b>
Incomplete Information – Efficiency Sample Calculations.	40 C.F.R. §60.533(b)(5)	In the revised test report include the required sample efficiency calculations.	All data from efficiency calculation can be found in appendix 1. CSAB415.1 spreadsheet calculation have been used for calculation. Already addressed in revision 1 February 14 <sup>th</sup> 2022
Missing Information - Pellet Fuel Certification.	40 C.F.R. §60.532(e), 40 C.F.R. §60.533(b)(5)	In the revised test report include information documenting that the pellet fuel used was a quality certified fuel using either the Pellet Fuel Institute (PFI) program or the ENPlus program.	Section 1.4 and 3.4 updated to mentioned ENplus program pellet have been used for aging and testing
Incomplete Information – Discussion of Negative Filter Weights.	40 C.F.R. §60.533(b)(5)	In the revised test report include discussion of proper handling of negative filter weights with calculations both corrected to zero and uncorrected.	section 3.4 of report commented for negative weight back filter
Missing Information in Owner’s Manual.	40 C.F.R. §60.536(g)	In the revised test report include a revised Owner's Manual with: (1) Proper draft recommendations when operating the appliance; (2) Recommendations on fuel selection or type of pellet to be used in the appliance; (3) Fuel selection and warnings; what fuels not to use, such as unseasoned wood, treated wood, colored paper, cardboard, solvents, trash, and garbage; (4) Proper use of air controls; (5) Proper ash removal; (6) How to get replacement parts; (7) The required Federal warnings, and (8) Recommendation for use of smoke and carbon monoxide detectors.	Appendix 7 operation manual updated in revision 3

**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:** Ravelli

<b>Heater Type (Circle One):</b>	Adjustable Burn Rate Wood Heater	<u>Pellet Stove</u>	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	<u>Pellet</u>	Cordwood	Wood Chips	Other:	

**Test Method(s):** ASTM E2779-10 integrated run      **Catalyst:** No

**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):**

RV100 Classic

<b>Physical Address (Street number and Address, not P.O. Box):</b> Via Kupfer 31	<b>Mailing Address:</b> Via Kupfer 31
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<b>City:</b> Palazzolo s/O (BS)	<b>State:</b> Italy	<b>ZIP Code:</b> 25036
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<b>Phone:</b> +39 030 7402939	<b>Email:</b> g.scarlini@ravelligroup.it	<b>Website:</b> http://usa.ravelligroup.it/
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**EPA Submission Date of 30 day Notice:** yes

**MANUFACTURER'S AUTHORIZED REPRESENTATIVE INFORMATION**

**Name:** Giovanni Scarlini

**Position/Title:** CEO

**Address:** Via Kupfer 31

<b>City:</b> Palazzolo s/O (BS)	<b>State:</b> Italy	<b>ZIP Code:</b> 25036
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<b>Phone:</b> +39 030 7402939	<b>E-mail:</b> g.scarlini@ravelligroup.it	<b>Website:</b> http://usa.ravelligroup.it/
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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

**ZIP Code:**J3B 7S7

**Phone:**450 741-3636

**Email:**  
infos@polytests.com

**Website:**  
www.polytests.com

**Remarks:**

**EPA-Approved Third Party Certifier**

**Name of Certifier Entity:** CSA Group

**Name of Person Authorized or Responsible for Reviewing Test Report and/or Issuing Certification of Conformity:**  
Ken Martin

**Position/Title:**  
Certification project manager

**Address:**865 avenue Ellingham

**City:**pointe-Claire

**State:**Quebec

**ZIP Code:**H9R 5E8

**Phone:**514-428-2489

**Email:**  
Ken.martin@CSAgroup.org

**Website:**  
www.csagroup.org

**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.

**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.

**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.**

**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).

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**Print Name and Title:** GIOVANNI SCARLINI, CEO **Date:** 17 October 2016

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.

***A. SUMMARY RESULTS – PELLET HEATERS***

Run Number	Date	Relative Humidity (%)		Run Time (Min.)	Heat Output (Btu/hr)	1st Hour Emissions (g/hr)	Integrated Total(g/hr)	CO Emissions (g/hr)	Overall CO Emissions (g/hr)	Heating Efficiency (% HHV)	Overall Heating Efficiency(% HHV)
		Setting	BR								
1	May 25 <sup>th</sup> 2016	H	2.31	60	34 500	0.67	0.7	3.55	2.72	77.97	80.2
		M	1.12	120	17 400			3.76		80.8	
		L	0.68	180	10 750			2.92		82.1	
		OA	1.1	360	16 900			2.72		80.2	

**U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)  
 CERTIFICATION OF CONFORMITY  
 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**

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**GENERAL INFORMATION**

**Manufacturer's Name:** AICO SPA (Ravelli)

<b>Heater Type (Circle One):</b>	Adjustable Burn Rate Wood Heater	<b>Pellet Stove</b>	Single Burn Rate Heater	Hydronic Heater	Forced Air Furnace	Other: Pellet Insert
<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 Type:</b>	Crib	<b>Pellet</b>	Cordwood	Other:		

**Model Name and Number:**  
 • RV 100 Classic

**Catalyst:** No

**Mailing Address:** Via Consorzio Agrario, 3/D Chiari, Italy

**Street Address:** Via Consorzio Agrario

<b>City:</b> Chiari	<b>State:</b> Brescia	<b>ZIP Code:</b> 25032
<b>Phone:</b> + 39 030 74 02 939	<b>Fax:</b> N/A	<b>Web Site:</b> <a href="http://usa.ravelligroup.it/">http://usa.ravelligroup.it/</a>

**Address of Manufacturing Facility:**  
 Jotul Poland Sp z o.o.  
 ul. Ks. Jerzego Popiełuszki 17  
 Kały Wrocławskie, Lower Silesian 55 080  
 Poland

<b>City:</b> Kały Wrocławskie	<b>State:</b> Kały Wrocławskie	<b>ZIP Code:</b> 55 080
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**EPA APPROVED THIRD PARTY CERTIFIER**

**Authorized Representative:** Aaron Reesor

**Company:** CSA Group

<b>Phone:</b> 416 747-2652	<b>E-mail:</b> <a href="mailto:aaron.reesor@csagroup.org">aaron.reesor@csagroup.org</a>	<b>Fax:</b> N/A
<b>City:</b> Toronto	<b>State:</b> Ontario, Canada	<b>ZIP Code:</b> M9W 1R3

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**Position:** Certifier – Fuels Group

<b>Report Number:</b> Polytest Test Report: PI-20129	<b>Date of Tests:</b> May 25 <sup>th</sup> 2016	<b>Date of Report:</b> REPORT DATE: June 1ST 2016 Revision 1: February 16th 2022 Revision 2: July 7th 2022 Revision 3: August 9th 2022 Project number: PI-20129
<b>Quality Assurance Plan included?:</b> Yes	<b>Wood Heater/Hydronic Heater/Forced-Air Furnace Application Included:</b> NO	<b>Remarks:</b> N/A

**Affected Source Data Summary**

<b>Wood Burning Heater</b>	<b>Hydronic Heater</b>	<b>Forced-Air Furnace</b>
Weighted particulate emission average of <b>1</b> test runs: <b>0.7</b> grams per hour	Maximum Output Rating: _____ Weighted particulate emission average: X Lb/MMbtu output	Particulate emission average: X Lb/MMbtu output
Weighted average HHV efficiency of <b>1</b> test runs: <b>80.2%</b>	Annual Efficiency Rating: _____	Overall thermal efficiency (HHV): X%
	Particle Emissions: _____	Overall Delivered Heat Efficiency: X%

**AFFIRMATIONS**

- **The above-named affected source has been tested by a laboratory qualified to test and report on the emissions of this type of product under 40 CFR Part 60, Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces (2015 Standards).**
- **The Test Report No. PI-20129, prepared by Danick Power and dated August 9<sup>th</sup> 2022, has been reviewed by Aaron Reesor and was found to be complete and to have used the correct procedures in accordance to the 2015 NSPS Standards.**
- **The emissions levels measured in the Test Report and listed above comply with the relevant particulate matter limits established by the 2015 NSPS Standards.**
- **The model listed above was tested to Particulate emissions: ASTM E2779-10 (section 9.4.1 integrate test run); ASTM E2515-11 as referred into 40 CFR Part 60 Subpart AAA, CSA B415.1-10 (for efficiency only) (Test method(s)).**
- **The permanent label and owner's manual meets the requirements of 40 CFR § 60.536 and/or § 60.5478.**
- **The above-named manufacturer, on the effective date of this certificate, was operating under a quality assurance plan, per 40 CFR § 60.533(m) and/or § 60.5475(m), that has been reviewed and approved by Aaron Reesor.**
- **The above-named manufacturer has contracted CSA Group to conduct regular (at least annual) unannounced audits of the manufacturing facility, affected source, and quality assurance plan pursuant to 40 CFR § 60.533(m) and/or § 60.5475(m).**

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**Aaron Reesor – CSA Group – Certifier – Fuels Group  
 Print Name and Title**

  
 \_\_\_\_\_  
**Signature of Authorized Third-Party Representative**

**August 11<sup>th</sup> 2022  
 Date**

**This is a certification of conformity to certify that the bearer  
 has successfully completed the requirements pursuant to  
 the 2015 NSPS Standards.**

**Third-party EPA approval expiration date: Aug 2027**

**V1**

**Remarks:**

Revision 1 February 16th 2022

- Moisture in the tunnel assume change section 3.6
- Table 2.6 updated with deviation in g/Kg
- Appendix 1 molecular weight updated to 29 for all runs
- Appendix 1 updated with data and preburn data
- The section 3.4 p.11 updated for runs Anomalies, Validity and appropriateness detail.
- Updated Section 1.4 p.6 conditioning was done week of May 17th 2016.
- Additional letter for TYPOs about mixing baffle in the original report.
- Table 2.1 additional emission number in gr/Mj

Revision 2: July 7th 2022

- Section 3.4 update : Pellet on ENplus program
- The section 3.4 p.11 updated for back filter negative weight addressed.
- Appendix 7 manual updated to meet requirements

Revision 3: August 9th 2022

- include negative filter weights with calculations both corrected to zero and uncorrected in appendix 1.