SGS Nederland BV
Environmental Services
P.O. Box 5252
NL-6802 EG ARNHEM
Tel : +31 (0) 26 - 38 44 500
Fax : +31 (0) 26 - 44 29 410
BTW : NL 00 44 0 77 26 B01
R.C. Rotterdam : 24226722
www.SGS.com

Test report of the smoke emission of THORNHILL TURBO MEDIUM of Thornhill Eco Design Ltd.

SGS registration	
Our reference	EZKA/11/057-3
Revision	1
Date report	July 28, 2011
Author report	J. Dekker

All orders are executed only in accordance with the latest version of our conditions filed at the Rotterdam District Court or the General Cargo Survey and Inspection Conditions, last version, filed at the Rotterdam District Court and at the Chamber of Commerce in Rotterdam. Upon request the conditions will be sent to you.

Revision history		
Rev.	**Date**	**Changes**
0	July 28, 2011	
1		
2		
3		

At revision the prior editions of this report are to be discarded.

Project managment data

General

Company name	Thornhill Eco Design Ltd
Address	Charing Cottage, Garlinge Green, Canterburry, Kent, CT45RS UK
Contact person	Mr G. Thornhill
Email address	www.cosi.co.uk
Reference number customer	-
Reference number SGS	EZKA/11/057-3

Appliance

Name	Thornhill Turbo Medium
Category	Space heating appliance fired by solid fuel.
Material	Steel body, combustion chamber and baffle made of vermiculite.

Measurement information

Test category	Determining smoke emission.
Method	NEN EN 13240: 2001- 2004 / BS 3841-2 : 1994
Period	July 2011
Measurement technician	R. van den Berg

Authentication

Consultant	Manager Environmental Services
J. Dekker	J. Boot

Disclaimer

Unless otherwise agreed, orders are executed in accordance with the latest version of the SGS Nederland BV General Conditions. Upon simple request the conditions will again be sent to you. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.
Any holder of this document is advised that information contained hereon reflects the company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Table of contents

1 Introduction

This is a test report of a freestanding appliance fired by wood in accordance with BS 3841-2: 1994. Test procedures are based on the European Standard EN13240.

The aim of the tests is to verify if it is likely that the appliance meets the requirements of guideline PD 6434:1969 when installed and operated as prescribed by the manufacturer.

This report describes the results of the dust emission measurements at different heat outputs and control settings of the appliance Micro/4kW of Thornhill Eco Design Ltd when burning wood.

Laboratory Name, address	SGS Nederland BV Leemansweg 51 6827 BX Arnhem The Netherlands
Notified under EC number	0608
Manufacturer Name, address	Thornhill Eco Design Ltd Charing Cottage, Garlinge Green, Canterburry Kent CT45RS UK
Appliance	Thornhill Turbo Micro
Nominal heat output	8 kW
Recommended fuel	Wood logs.
Test category	Determining the smoke emission at different burning rates and settings when burning wood.

2 Description of the room heater

Room heater Thornhill Turbo Medium is a steel plate stove. The combustion chamber of the stove is equipped with a double glazed front window door and is insulated with vermiculite. The air supply is adjustable with one regulator at the low end of the door. The appliance is equipped with two baffle plates. The flue gas connection is located at the top of the appliance.

Picture of the room heater

3 Test procedure

3.1 General

The tests are carried out according to European standard EN13240. Tests are executed at different heat outputs and control settings. For each test approximately the same weight of test fuel (beech) is used.

During each test period emitted particles are sampled by using the dilution tunnel method. The emission of dust is quantified by using the gravimetric method. The optical density of the smoke is measured by using the scattered light method.

By UK customary practice the permitted average smoke emission is related to the heat output of the appliance. Test work to EN 13240 showed that the stove, operating at an output of 4.6 kW has an efficiency of 86%. As most appliances are designed to have the best performance at nominal heat output the efficiency and thus the output, differs at lower and higher settings. Therefore the test laboratory chooses to monitor and report all parameters of EN13240 of each separate test.

3.2 Dust measurement

The emission of dust was determined by using the two following methods.

Gravimetric method
The flue gas from the top of the test chimney is mixed with ambient air in a dilution tunnel. The diluted flue gas is sampled by using a sampling train in which the particulate matter is collected on a glass fibre filter. The diluted flue gas was iso-kinetic sampled. The filters are conditioned and weighed before and after the tests. The dilution rate was determined by monitoring the CO_2 concentration in both the test chimney and the dilution tunnel. More information about the procedure can be found in annex C. A drawing of the test rig can be found in annex D.

Optical method
The flue gas is continuously monitored by an optical device using the scattered light method. The relation between the output of this device (SI, no dimension) and the obscuration of the emitted smoke (Ringelmann) is defined by SGS and the results are placed in annex A.

3.3 Settings

After positioning the appliance on the test rig, pre-tests were carried out to determine the behaviour of the appliance at different settings.

The combustion air enters the fire chamber through various holes at the sides of the appliance. The amount of combustion air can be regulated by one controller positioned at the low end of the appliance. When this slide is in its minimum position there is still air entering the combustion chamber.

For the characteristics when burning wood at nominal heat output the results of the initial type tests (SGS, 2008) are used. There are no optical measurements available but based on the emissions of dust and CO high levels of smoke are not likely.

The used settings were maintained during the whole burning period. Occasionally the amount of combustion air was increased for a short period to lid the fire after refuel. Information about the used settings is placed in the table below.

Table 3.3: Used settings

Setting of air slide	Burning rate		
	Low	Nominal	High
- Controller	0%	40%	100%

4 Measurements

The following paragraphs contain the results of the measurements. The specification of the fuel used during the tests is followed by the results of the smoke emission tests at the different burning rates. Results of the optical measurements (graphs) are given in annex A.

4.1 Test fuel specification

Analytical information of the test fuel in accordance to EN13240 (as fired)

Test fuel	moisture %	ash %	Volatile matter % dry, ash free	H %	C %	S %	Hu kJ/kg	Size, length cm
Beech	13.4	1.16	84.2	4.7	43.6	0.03	16,086	35
Beech	13.0	1.17	84.24	4.76	43.9	0.03	16,430	35

4.2 Nominal heat output

Results at nominal heat output (SGS, EZ/08/2467/01)

		Clause	Test 1	Test 2	Test 3	**Mean of 3 tests**	Approved
Date			11-28-08	11-28-08	11-28-08		
Test fuel		Tab. B1	Beech	Beech	Beech	**Beech**	
Total mass	kg	A.4.2	1.74	1.70	1.68	**1.71**	
<u>Settings of controls for:</u> - primary/secondary air			"2"	"2"	"2"	**"2"**	
Mean flue draught	Pa	6.4	12.0	12.0	12.0	**12.0**	yes
Mean flue spigot temperature	℃		280	276	266	**274**	
Mean flue gas temperature	K		188	185	174	**183**	
Mean CO_2 concentration	%		10.39	10.75	10.20	**10.45**	
Mean CO concentration	%		0.20	0.13	0.16	**0.16**	
Mean CO concentration at 13% O_2	vol%	6.2	0.15	0.09	0.12	**0.12**	yes
Mean CO_2 concentration at the dust measurement	vol%		11.30	11.65	11.01	**11.33**	
Dust concentration	mg/m_0^3		26	13	7	**16**	
Dust concentration at 13% O_2	mg/m_0^3		18	9	5	**11**	
Combustion time Dev. from required combustion time	h %	A.4.7.3	0.85 13.3	0.77 2.4	0.71 -5.0	**0.78** **3.6**	yes
Theoretical combustion time	h	A.4.7.3	0.84	0.81	0.81	**0.82**	
Thermal heat losses	%		13.4	12.9	12.6	**13.0**	
Chemical heat losses	%		1.2	0.8	1.0	**1.0**	
Heat losses due to combustible constituents in the residue	%		0.5	0.5	0.5	**0.5**	
Efficiency	%	6.7.3	84.9	85.5	85.9	**85.5**	yes
Mean nominal heat to space	kW	6.7	7.9	8.4	9.1	**8.4**	yes
Theoretical heating output	kW	A.4.7.3	8.9	8.6	8.6	**8.8**	
Flue gas mass flow	g/s		5.2	5.4	6.1	**5.6**	
Boiler							n/a

Calculation to grams per hour.

Dust concentration	mg/Nm^3		26	13	7	16
Dust concentration at 13% O_2	mg/Nm^3		18	9	5	11
Stack gas volume at 13% O_2	Nm^3/h		21.5	22.7	24.5	22.9
Dust emission	g/h		0.4	0.2	0.1	0.2
PD6434 permitted	g/h		7.6	7.8	8.0	7.8

Note: Controller position "2" of the appliance tested in 2008 is the same as 40% of its maximum of the appliance tested in 2011.

4.3 Low heat output (1)

		Test 1	Test 2	Test 3	**Mean of 3 tests**
Date (dd-mm-yy)		11-07-11	11-07-11	11-07-11	
Test fuel		beech	beech	beech	
Total mass	kg	1.83	1.84	1.70	**1.79**
Setting of: - Controller		0%	0%	0%	**0%**
Mean flue draught	Pa	12.3	12.4	11.8	**12.2**
Mean flue gas temperature	K	224	224	222	**223**
Mean CO_2 concentration	vol%	13.72	15.20	13.76	**14.18**
Mean CO concentration at 13% O_2	vol%	0.21	0.35	0.31	**0.29**
Efficiency	%	85.2	85.4	84.8	**85.1**
Mean nominal heat to space	kW	10.8	12.6	9.7	**10.9**
Stack gas volume DT	Nm^3/h	192	197	171	**186**
Diameter DT	m	0.15	0.15	0.15	**0.15**
Speed DT	m/s	3.02	3.09	2.69	**2.93**
Nozzle diameter	mm	9	9	9	**9**
Surface Nozzle	m^2	6.36E-05	6.36E-05	6.36E-05	**6.36E-05**
Speed nozzle	m/s	3.38	3.90	3.74	**3.68**
Iso-Kinetics	%	1.12	1.26	1.39	**1.26***
Duration	h	0.65	0.57	0.67	**0.63**
Sampled volume	Nm^3	0.556	0.556	0.632	**0.581**
Sampling flow rate	Nm^3/h	0.77	0.89	0.86	**0.84**
Dust mass	mg	3.8	5.3	10.6	**7**
Dust concentration	mg/Nm^3	7.6	10.5	18.5	**12.2**
Dilution ratio	-	11.8	11.7	11.8	**11.8**
Dust concentration	mg/Nm^3	90	123	218	**145**
Dust concentration at 13% O_2	mg/Nm^3	50	61	120	**78**
Stack gas volume at 13% O_2	Nm^3/h	29.3	34.1	26.5	**29.9**
Dust emission	g/h	1.5	2.1	3.2	**2.3**
PD6434 permitted	g/h	8.6	9.2	8.2	**8.6**
% of time above Ringelmann 2	%	0	0	0	**-**

* over iso-kinetic.

4.4 Low heat output (2)

		Test 4	Test 5		**Mean of 2 tests**
Date (dd-mm-yy)		11-07-11	11-07-11		
Test fuel		beech	beech		
Total mass	kg	1.83	1.84		**1.79**
Setting of: - Controller		0%	0%		**0%**
Mean flue draught	Pa	11.8	12.4		**12.1**
Mean flue gas temperature	K	219	221		**220**
Mean CO_2 concentration	vol%	14.91	13.80		**14.32**
Mean CO concentration at 13% O_2	vol%	0.38	0.40		**0.39**
Efficiency	%	85.2	84.2		**84.7**
Mean nominal heat to space	kW	10.6	9.4		**9.9**
Stack gas volume DT	Nm^3/h	172	163		**167**
Diameter DT	m	0.15	0.15		**0.15**
Speed DT	m/s	2.70	2.57		**2.63**
Nozzle diameter	mm	9	9		**9**
Surface Nozzle	m^2	6.36E-05	6.36E-05		**6.36E-05**
Speed nozzle	m/s	7.57	5.39		**6.48**
Iso-Kinetics	%	2.80	2.10		**2.45***
Duration	h	0.65	0.73		**0.69**
Sampled volume	Nm^3	1.257	1.000		**1.129**
Sampling flow rate	Nm^3/h	1.73	1.24		**1.48**
Dust mass	mg	7	11.9		**9**
Dust concentration	mg/Nm^3	6.2	13.2		**9.7**
Dilution ratio	-	11.9	11.8		**11.9**
Dust concentration	mg/Nm^3	74	156		**117**
Dust concentration at 13% O_2	mg/Nm^3	37	85		**62**
Stack gas volume at 13% O_2	Nm^3/h	28.7	25.7		**27.2**
Dust emission	g/h	1.1	2.2		**1.7**
PD6434 permitted	g/h	8.5	8.1		**8.3**
% of time above Ringelmann 2	%	4	0		**-**

* over iso-kinetic.

4.5 High heat output (1)

		Test 1	Test 2	Test 3	**Mean of 3 tests**
Date (dd-mm-yy)		11-07-11	11-07-11	11-07-11	
Test fuel		beech	beech	beech	
Total mass	kg	1.90	1.85	2.00	**1.92**
Setting of: - Controller		100%	100%	100%	**100%**
Mean flue draught	Pa	12.0	11.6	11.7	**11.8**
Mean flue gas temperature	K	263	261	276	**266**
Mean CO_2 concentration	vol%	10.37	11.91	13.88	**11.88**
Mean CO concentration at 13% O_2	vol%	0.15	0.24	0.17	**0.19**
Efficiency	%	79.3	81.0	82.6	**80.8**
Mean nominal heat to space	kW	10.0	11.3	14.8	**11.8**
Stack gas volume DT	Nm^3/h	167	172	185	**174**
Diameter DT	m	0.15	0.15	0.15	**0.15**
Speed DT	m/s	2.63	2.70	2.91	**2.74**
Nozzle diameter	mm	10	10	10	**10**
Surface Nozzle	m^2	7.85E-05	7.85E-05	7.85E-05	**7.85E-05**
Speed nozzle	m/s	2.88	3.02	3.04	**2.98**
Iso-Kinetics	%	1.09	1.12	1.05	**1.09**
Duration	h	0.67	0.59	0.49	**0.58**
Sampled volume	Nm^3	0.595	0.555	0.465	**0.538**
Sampling flow rate	Nm^3/h	0.81	0.85	0.86	**0.84**
Dust mass	mg	4.2	3.3	4.0	**3.8**
Dust concentration	mg/Nm^3	7.8	6.5	9.5	**7.9**
Dilution ratio	-	7.8	8.4	8.0	**8.0**
Dust concentration	mg/Nm^3	60	55	76	**63**
Dust concentration at 13% O_2	mg/Nm^3	45	35	43	**41**
Stack gas volume at 13% O_2	Nm^3/h	29.0	32.1	41.5	**34.2**
Dust emission	g/h	1.3	1.1	1.8	**1.4**
PD6434 permitted	g/h	8.3	8.8	9.9	**8.9**
% of time above Ringelmann 2	%	0	0	0	**-**

* over iso-kinetic.

4.6 High heat output (2)

		Test 4	Test 5		**Mean of 2 tests**
Date (dd-mm-yy)		11-07-11	11-07-11		
Test fuel		beech	beech		
Total mass	kg	1.85	1.90		**1.88**
Setting of: - Controller		100%	100%		**100%**
Mean flue draught	Pa	12.2	12.3		**12.2**
Mean flue gas temperature	K	285	279		**282**
Mean CO_2 concentration	vol%	12.72	11.77		**12.19**
Mean CO concentration at 13% O_2	vol%	0.24	0.18		**0.20**
Efficiency	%	80.5	80.1		**80.3**
Mean nominal heat to space	kW	12.8	10.4		**11.5**
Stack gas volume DT	Nm^3/h	169	150		**159**
Diameter DT	m	0.15	0.15		**0.15**
Speed DT	m/s	2.66	2.36		**2.50**
Nozzle diameter	mm	10	10		**10**
Surface Nozzle	m^2	7.85E-05	7.85E-05		**7.85E-05**
Speed nozzle	m/s	2.81	2.92		**2.86**
Iso-Kinetics	%	1.06	1.24		**1.15**
Duration	h	0.52	0.65		**0.58**
Sampled volume	Nm^3	0.449	0.595		**0.522**
Sampling flow rate	Nm^3/h	0.79	0.83		**0.81**
Dust mass	mg	11.3	8.6		**10.0**
Dust concentration	mg/Nm^3	27.6	16.0		**21.8**
Dilution ratio	-	7.6	7.7		**7.6**
Dust concentration	mg/Nm^3	211	123		**162**
Dust concentration at 13% O_2	mg/Nm^3	127	80		**101**
Stack gas volume at 13% O_2	Nm^3/h	36.9	30.0		**33.5**
Dust emission	g/h	4.7	2.4		**3.4**
PD6434 permitted	g/h	9.3	8.5		**8.8**
% of time above Ringelmann 2	%	0	0		**-**

5 Evaluation of the results

5.1 Conclusion

The average dust emission at different heat outputs and settings of appliance Thornhill Turbo Medium of Thornhill Eco Design Ltd. was determined by using the dilution tunnel method based on British Standard BS 3841-2:1994. By comparing the test results of the gravimetric dust measurements with the maximum acceptable dust emission described in PD 6434:1969 it can be concluded that, when the appliance is operated as described by the manufacturer the maximum permitted dust emission is not exceeded. No individual gravimetric smoke measurement was greater than the permitted mean result of the tests.

During all tests the optical density of the smoke was determined by the use of an optical device. Occasionally the smoke emission reached an objectionably high level. Because of the short period this occurred, which is less than 10% of the whole burning period, this is acceptable.

Test	Mean heat output to space	Dust emission		Optical density		Approved
		Measured	PD6434 permitted*	Time above Ringelmann 2	Permitted	
-	kW	g/h	g/h	%	%	-
Nominal 1	7.8	0.4	7.6	-	-	**yes**
Nominal 2	8.3	0.2	7.8	-	-	**yes**
Nominal 3	9.1	0.1	8.0	-	-	**yes**
Low 1	10.8	1.5	8.6	0	10	**yes**
Low 2	12.6	2.1	9.2	0	10	**yes**
Low 3	9.7	3.2	8.2	0	10	**yes**
Low 4	10.6	1.1	8.5	4	10	**yes**
Low 5	9.4	2.2	8.1	0	10	**yes**
High 1	10.0	1.3	8.3	0	10	**yes**
High 2	11.3	1.1	8.8	0	10	**yes**
High 3	14.8	1.8	9.9	0	10	**yes**
High 4	12.8	4.7	9.3	0	10	**yes**
High 5	10.4	2.4	8.5	0	10	**yes**

*** Calculation of permitted smoke emission: 5.0 g/h + 0.1 g/h per 0.3 kW**

5.2 Recommendations

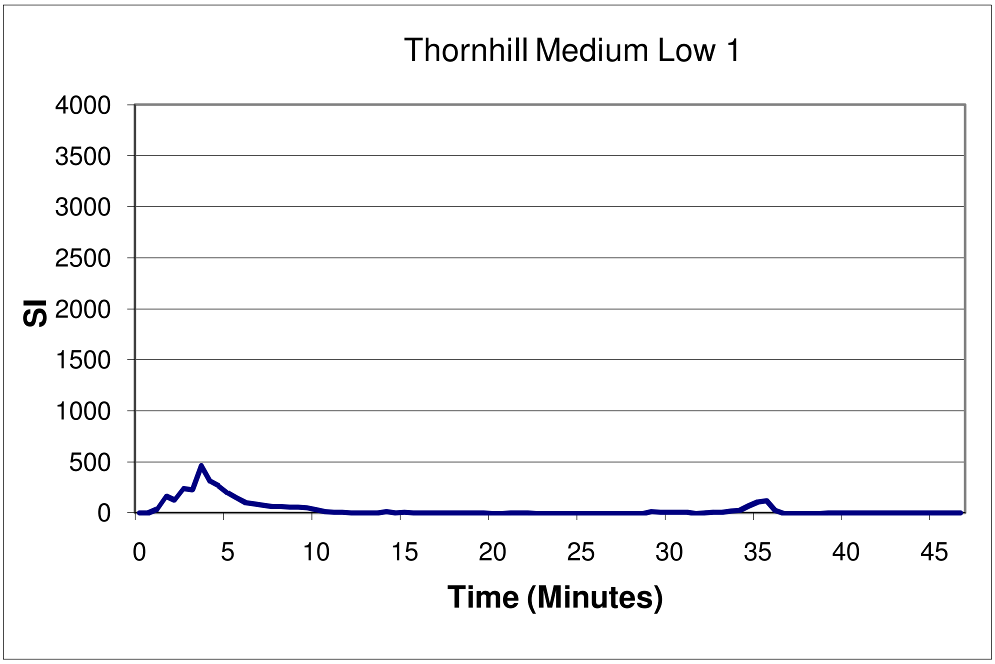
As the customary practice in the UK requires that an exempted fireplace has to be constructed or adapted in such manner that it is impractical to operate it in a way whereby significant smoke will be emitted, we recommend keeping the air inlet as it is on the tested proto type.

Annex A

Graphs

Graph A-01

Condition	Low heat output
Test number	1 of 5
Setting of: - controller	0%



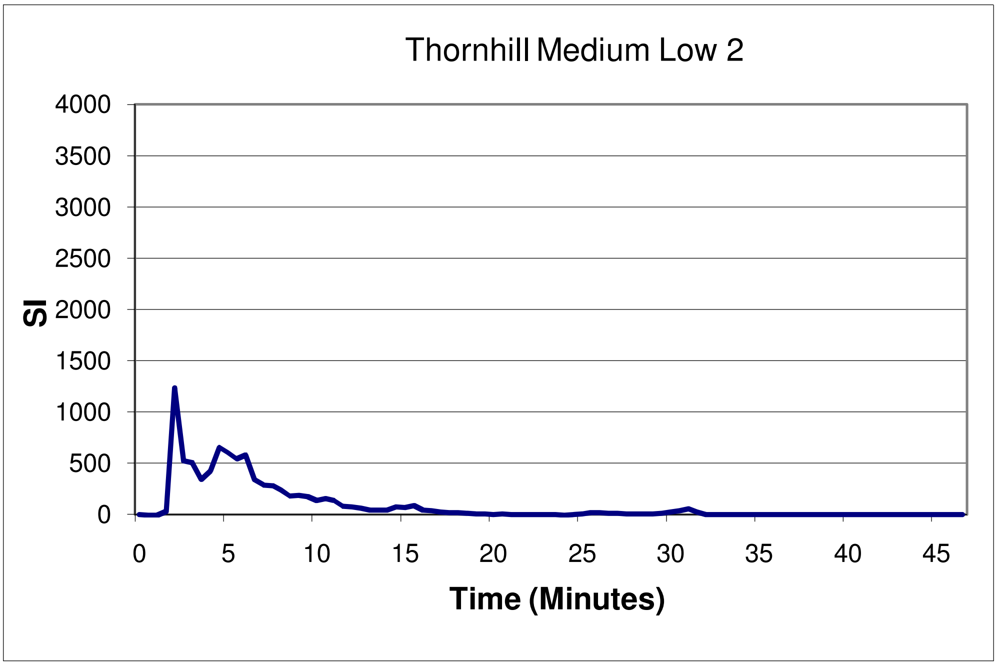
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-02

Condition	Low heat output
Test number	2 of 5
Setting of: - controller	0%



The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-03

Condition	Low heat output
Test number	3 of 5
Setting of: - controller	0%

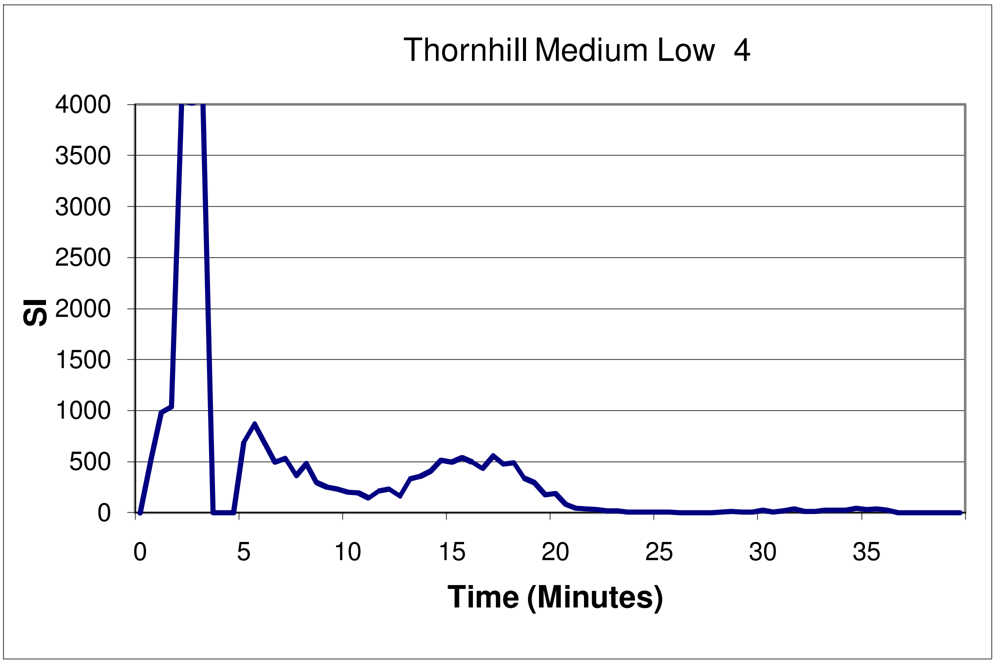
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-04

Condition	Low heat output
Test number	4 of 5
Setting of: - controller	 0%



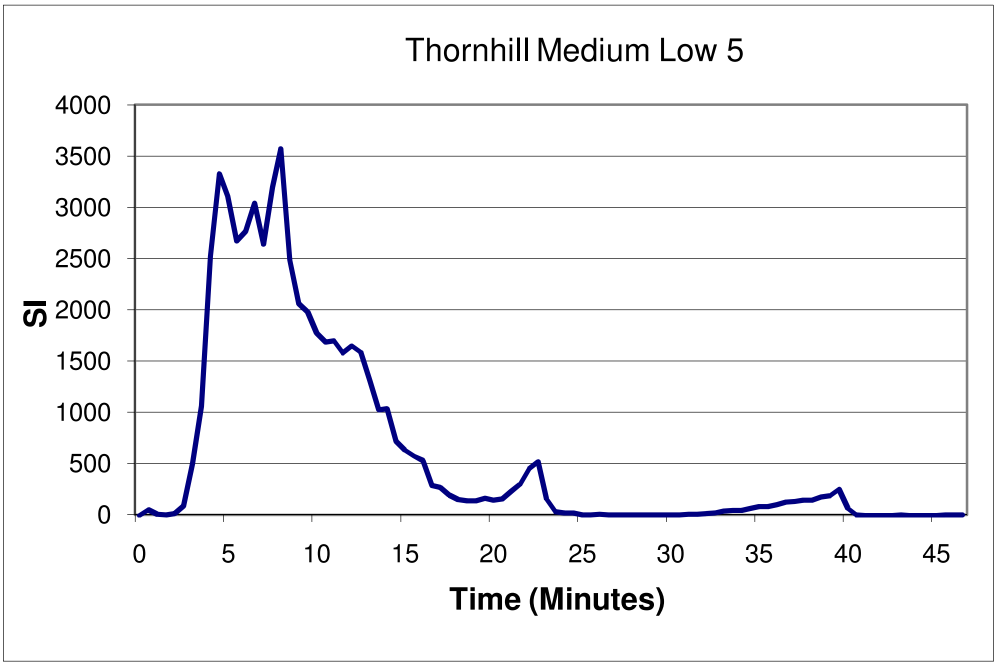
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 4% (maximum permitted; 10%)

Graph A-05

Condition	Low heat output
Test number	5 of 5
Setting of: - controller	0%



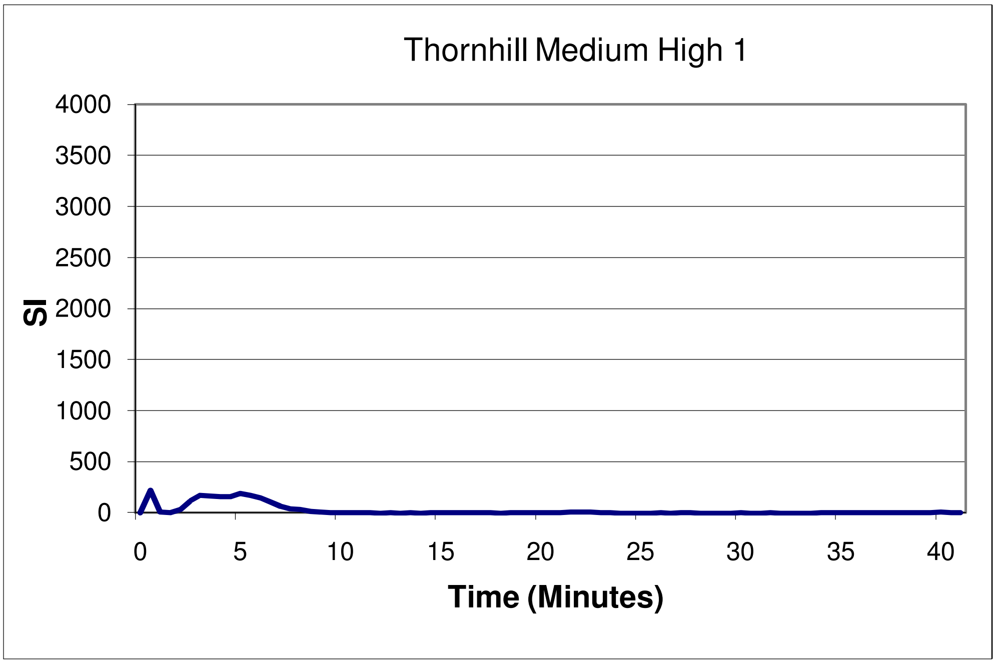
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-06

Condition	High heat output
Test number	1 of 5
Setting of: - controller	100%



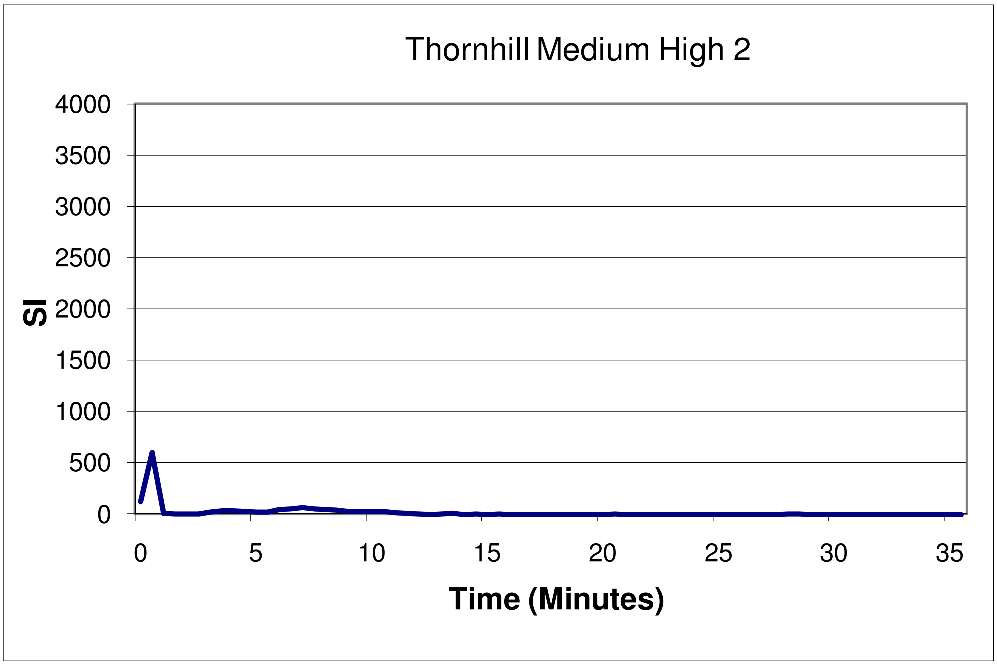
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-07

Condition	High heat output
Test number	2 of 5
Setting of: - controller	 100%



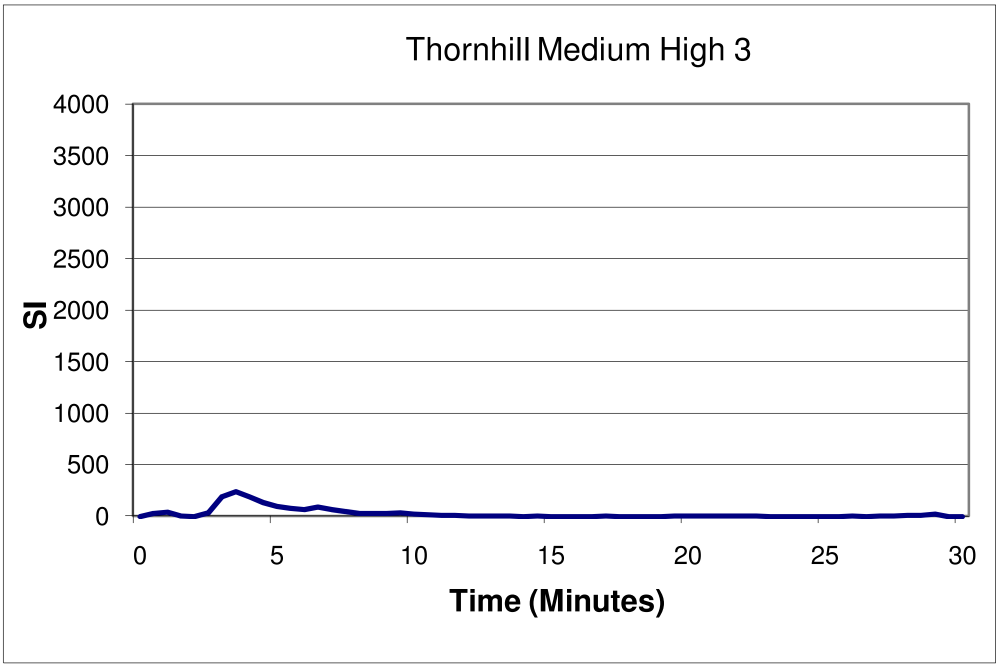
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-08

Condition	High heat output
Test number	3 of 5
Setting of: - controller	100%



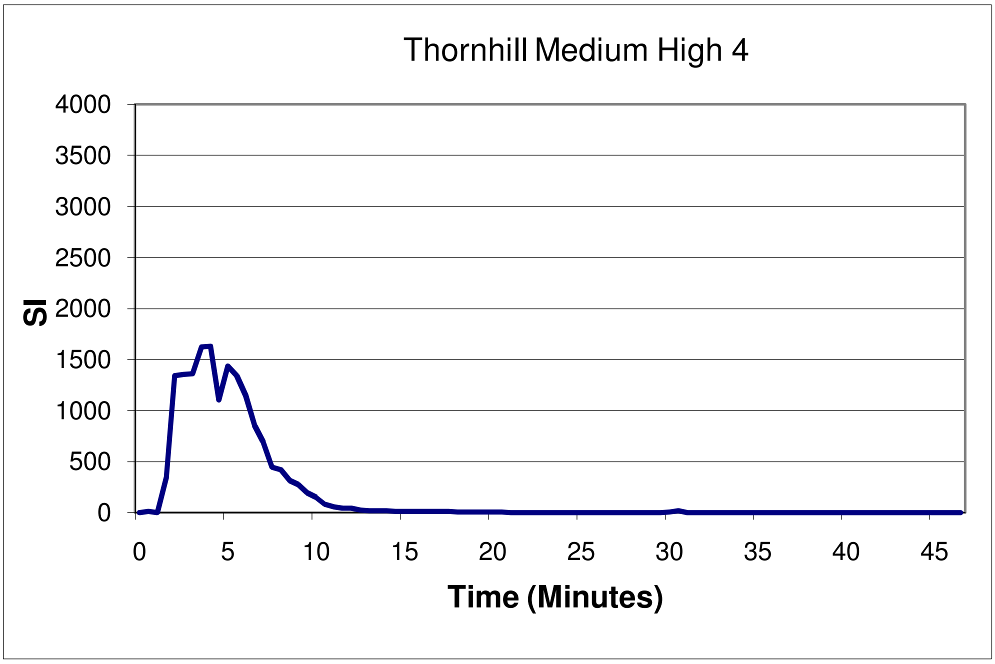
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-09

Condition	High heat output
Test number	4 of 5
Setting of: - controller	100%



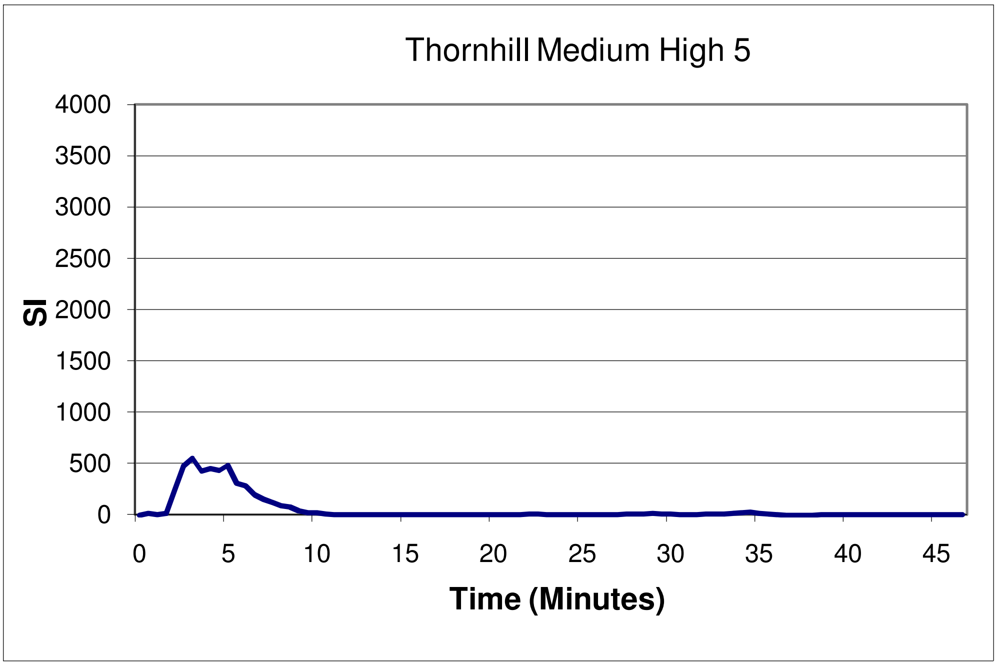
The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

Graph A-10

Condition	High heat output
Test number	5 of 5
Setting of: - controller	 100%



The output of optical instrument type Dust Hunter of Sick Maihak (SI, no dimension) is related to the optical density as described in the table below.

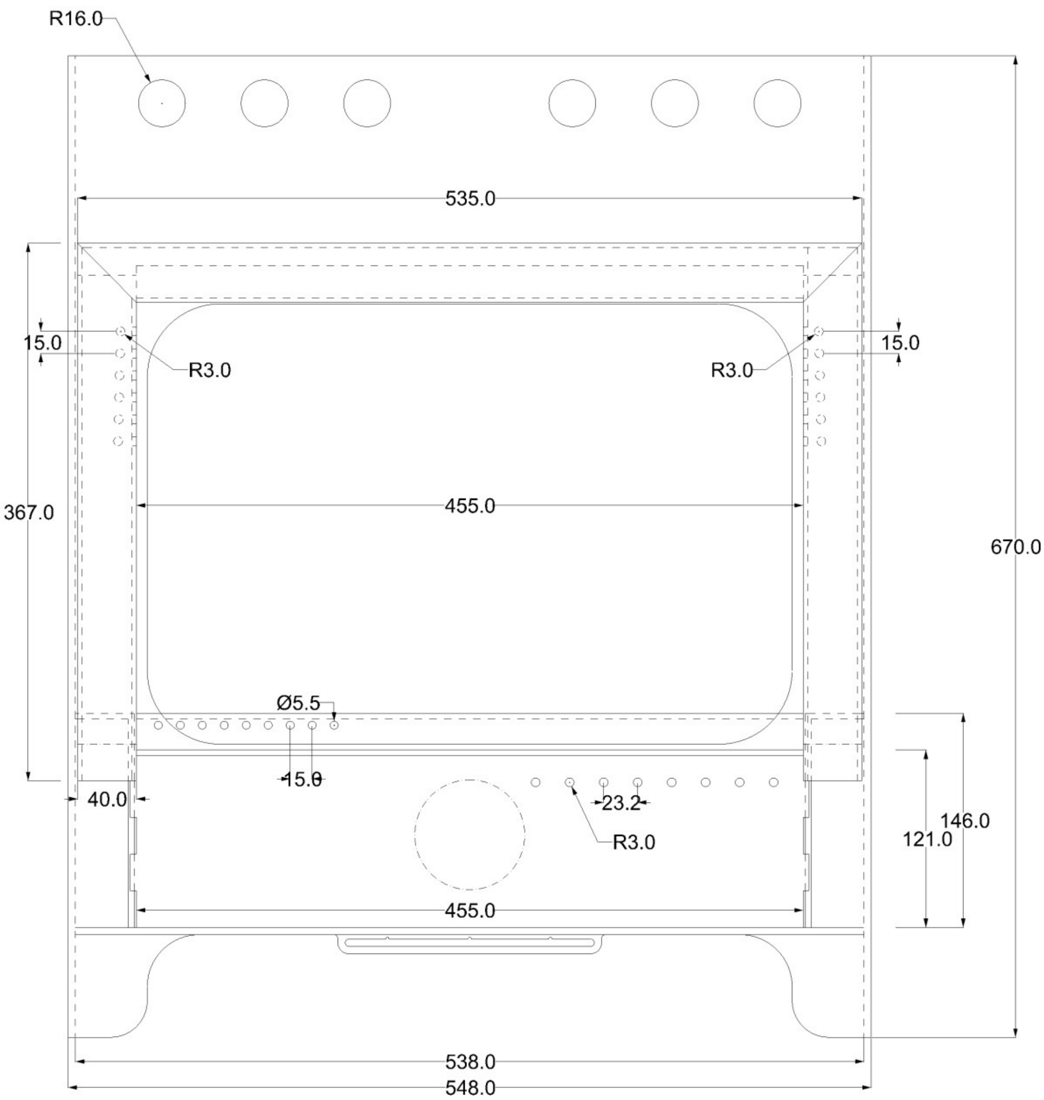
SI	Observation	Ringelmann (-)
<400	Not clearly visible	0
1.000	20% obscuration	1
4.000	40% obscuration	2

% of time above Ringelmann 2 = 0% (maximum permitted; 10%)

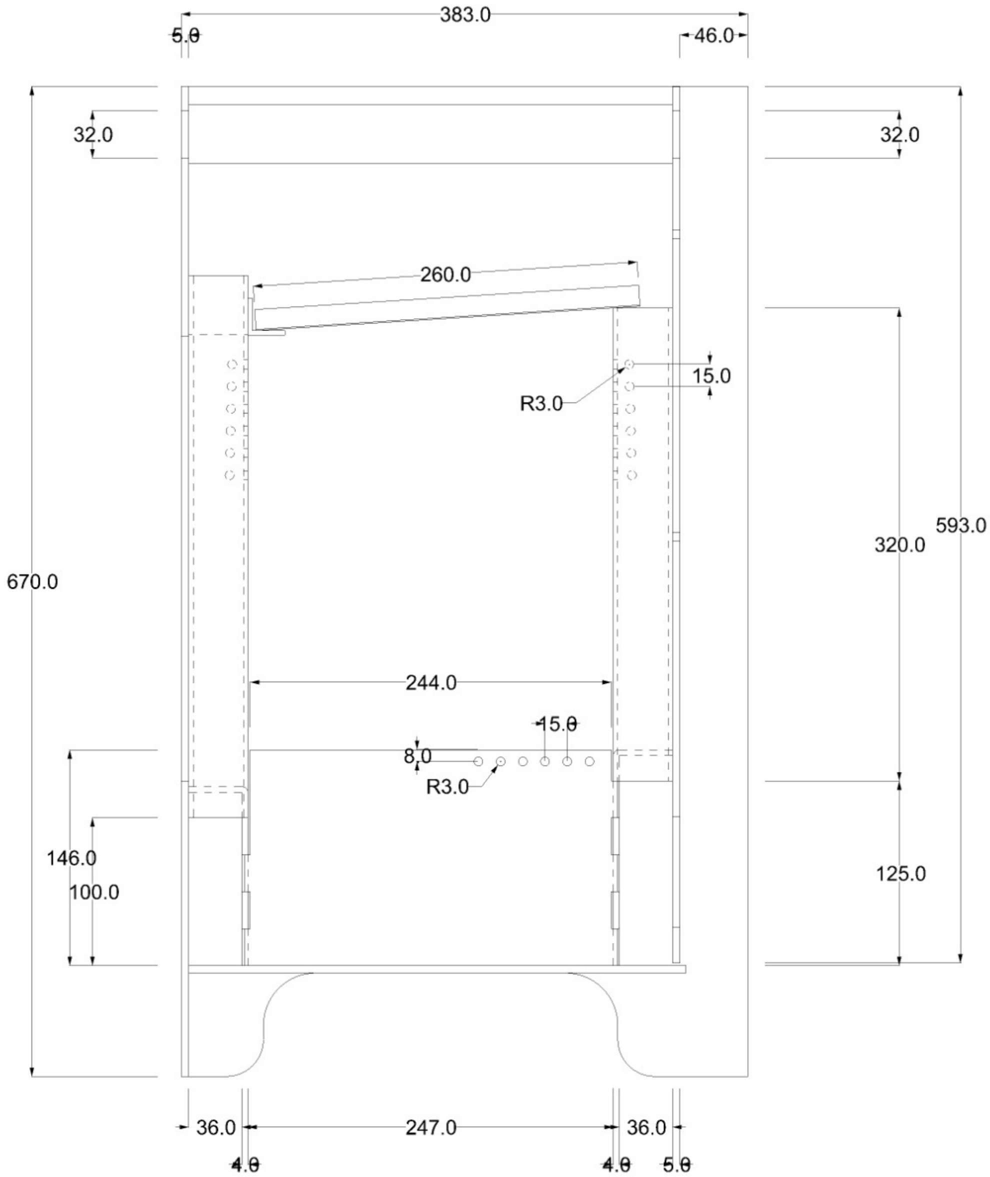
Annex B

Drawings of the appliance

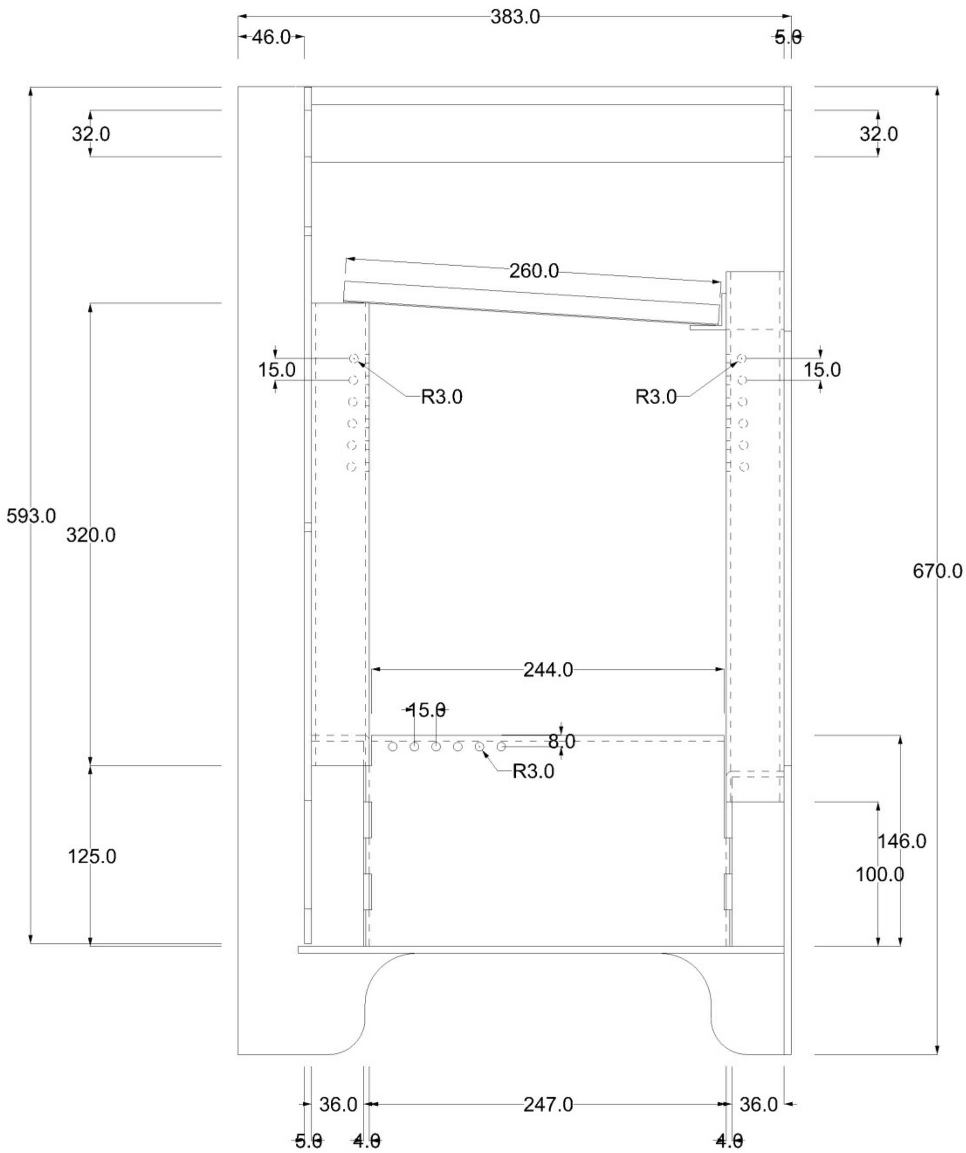
Front



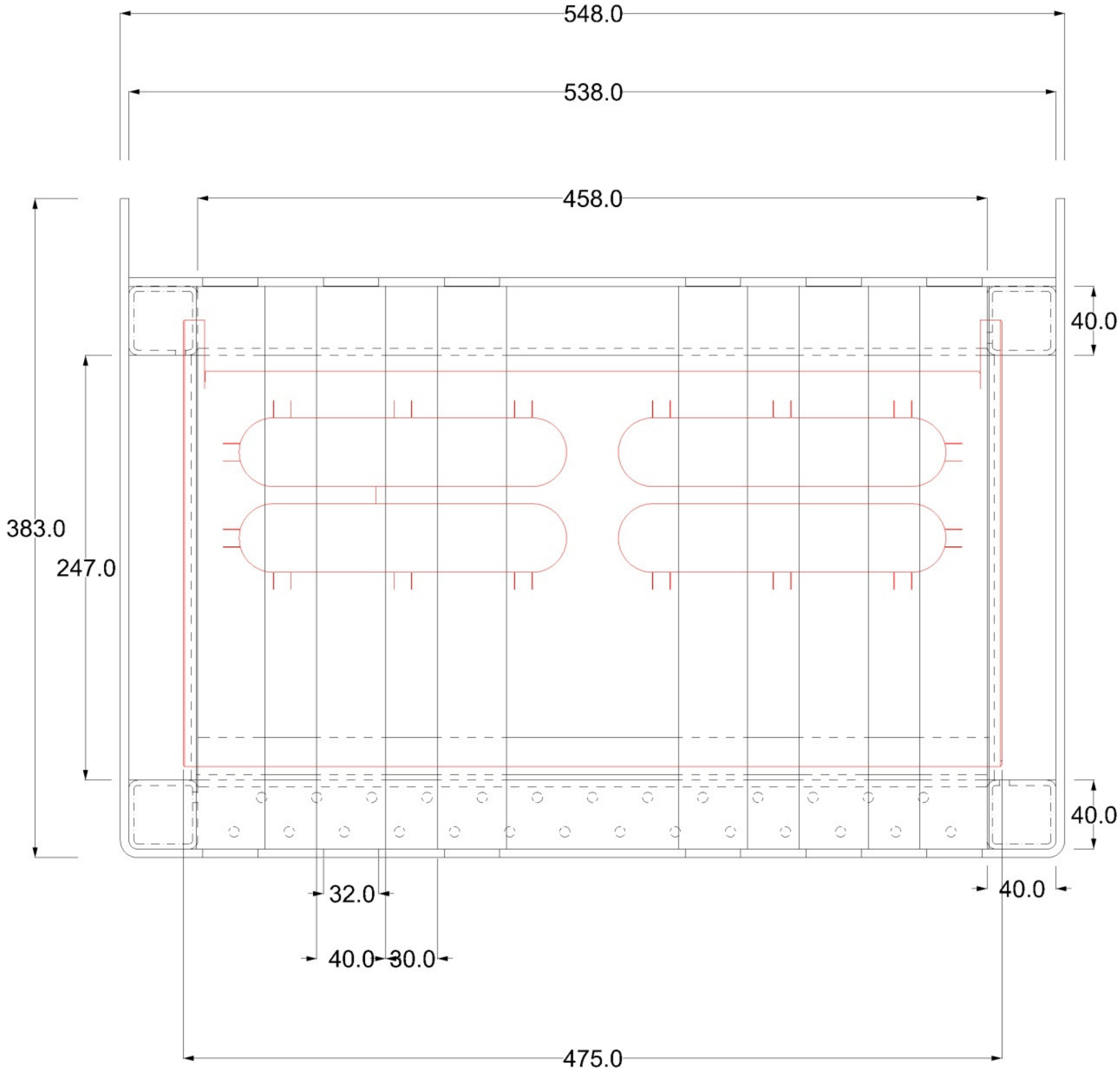
Left


383.0
5.0
46.0
32.0
32.0
260.0
15.0
R3.0
593.0
320.0
670.0
244.0
15.0
8.0
R3.0
146.0
100.0
125.0
36.0
247.0
36.0
4.0
4.0
5.0

Right


383.0
46.0
5.0
32.0
32.0
260.0
15.0
R3.0
R3.0
15.0
593.0
320.0
670.0
244.0
15.0
8.0
R3.0
146.0
125.0
100.0
36.0
247.0
36.0
5.0
4.0
4.0

Top

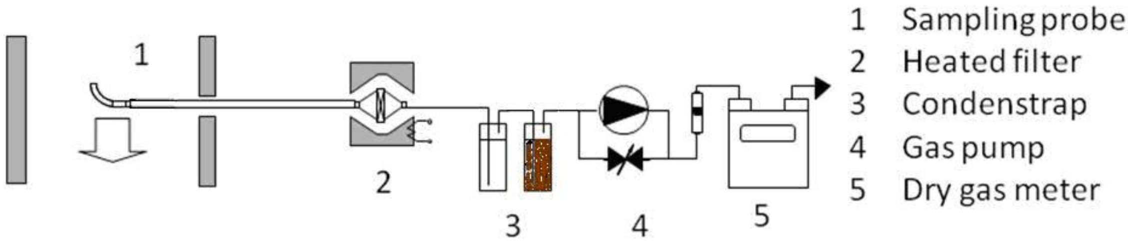


Annex C

Brief description of dust measurement method

Before sampling:
Sampling is being done on a quartz fiber plane filter with a pore size of 0.2 µm and a diameter of 47 mm. The quartz filter is dried at 180 °C for approx. 1 h, weighed on a micro scale with an accuracy of ± 0.05 mg and stored in an identical numbered container. Just before sampling starts the filter is placed in the stainless steel filter holder using a pair of tweezers.
The flue gas static and dynamic pressure is measured by a pitot tube and a micro manometer. The retrieved data is used to calculate the iso kinetic sampling velocity.

The sampling point is situated at the centre point of the flue gas channel. The filter holder is heated to 70 °C. This temperature is maintained during the sampling. The probe is positioned in the flue gas channel in such a way that the nozzle is at the centre point of the flue gas channel. The nozzle is pointed in the opposite direction of the flue gas stream. See figure.



The setup is tested for any leakage by blocking the nozzle and measuring the sample flow at – 0.8 bar suction pressure. The setup is considered leak tight when the flow rate is less than 0.03 l/min.

Sampling:
The volume reading on the gas meter and the start time is noted. The sampling is started directly after loading of the woodstove. The gas pump suction speed is set according to the calculated isokinetic flue gas velocity by means of a flow regulator. During the sampling the gas meter temperature is noted.
Sampling ends when the basic fire bed has been reached. Volume reading on the gas meter is noted.

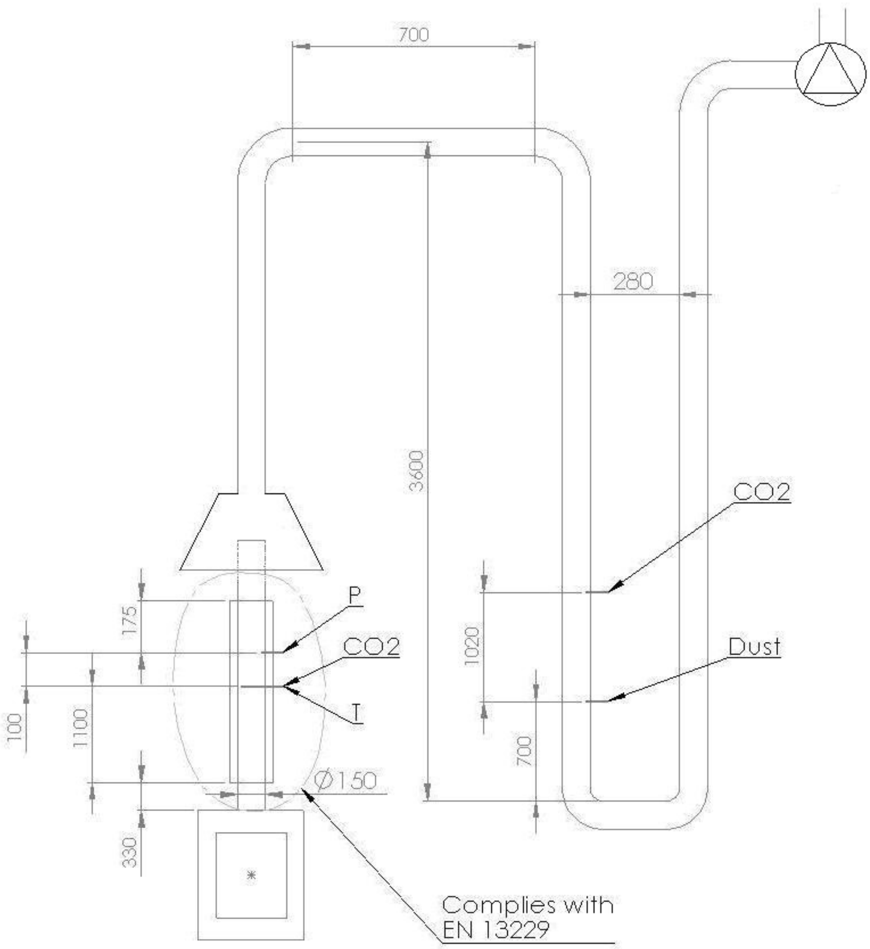
After sampling:
The filter is removed from its holder and temporarily kept in a glass container. In an analytical laboratory the filter is dried again at 160 °C for approx. 1 h and weighed on a micro scale. The sampled dry volume is calculated by taking the start and end volume readings and corrected to standard conditions (273.15 K, 1013 hPa). The sampled volume is also corrected with a calibration factor, which is determined every year with a calibrated precision gas flow meter.
The amount of sampled dust is calculated by extracting the start weight of the filter from the end weight of the filter.

Determination of the dilution factor:
The dilution factor is measured using 2 infrared continuous CO_2 analyzers with range 0 – 25 vol% and 0 – 5 % respectively. Prior to, and after, the measurements both analyzers are calibrated and adjusted using certified gas mixtures. The flue gas from the diluted and non-diluted flue gas stream is simultaneously sampled, dried by a cool trap and led through the analyzer.

The CO_2 concentration is continuously monitored and the data is automatically stored on a computer every 20 seconds. Afterwards the dilution factor is calculated by dividing the average concentrations upon each other.

Annex D

Drawing of the test rig including dilution tunnel



Annex E

Measurements uncertainties

Sampling/analysis methods used, measuring standards and uncertainties. All measurements mentioned in this table are covered by EN-ISO 17025 certification. Measurements marked with an asterisk are also accredited by RvA Testing under no. L-092.

No.	Component	SGS Procedure/Standard	Uncertainties [1)]
	Determination of the particulate concentration (gravimetric)	ENVI/L/05, dilution tunnel	< ± 14% of measured value higher than 5 mg/m^3, when fluctuations in gas flow > 10% may occur < ± 30%.
*	Determination of the CO_2 concentration (nondispersive infrared)	EMM-006, 007, 030 conform NEN-ISO 12039	< ± 8%.
*	Determination of the CO concentration (nondispersive infrared)	EMM-006, 008, 009, 013, 030 conform NEN-EN 15058	< ± 8%.
*	Determination of the gas temperature (thermocouple)	ENVI/L/03 conform ISO 8756, VDI/VDE 3511, VDI/VDE 3512 Blatt 2	< ± 0.75% of the measured value or ± 1.5 ℃ (largest value)

1) The stated uncertainties refer to the 95% confidence interval (2 sigma). The stated percentages are related to the actual measurement results, unless indicated otherwise.