



Flue gas temperature measurements of a slow heat release appliance, a sauna stove and a roomheater.

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Ministry of the Environment

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Assignment Measurements of flue gas temperatures from a slow heat release appliance, a sauna stove and a roomheater.

Introduction The goal of the measurements was to find out what is the flue gas temperature during the nominal heat output, safety test and firing with additional fuel batch and higher flue draught. Flue gas temperatures were measured according to different standards using a suction pyrometer.

All appliances represent their class but are not more clearly identified for confidential reasons. Firing has been done according to manufacturer's instructions in all cases. All tests have been carried out using birch wood logs fulfilling the requirements of all standards. Moisture content was about 15%.

Measurements of a slow heat release appliance

The slow heat release appliance was measured following the standard EN15250 (Slow heat release appliances fired by solid fuel – Requirements and test methods).

The used appliance represents normal SHRA appliance having a weight of about 1500 kg. The width is 1140 mm, height 1862 mm and depth 585 mm. The exemption is that it was a model having a by-pass valve which allows flue gases to flow from the firebox directly to the chimney if open. It is intended to use as the aid of starting the fire easier.

The appliance was so called top-model meaning that vertical chimney starts at the top of the fireplace. According to the CE-marking test, flue gas temperature is 206 °C, total heat output 55 kWh and efficiency 82%.

The amount of fuel used is recorded in table 1.

The test results relate only to the sample tested.

Table 1. Fuel batches used in SHRA tests.

		Amount of fuel in kg.
Nominal heatoutput test	batch 1	5.012 + some wood for ignition
	batch 1	5.002
	batch 2	4.991
Safety test		
	batch 3	5.006
	batch 4	4.995
	batch 5	5.000
Additional firing	batch 6	9.038
Total amount of fuel		30

To get an indication of fuel batches, a batch of 4.855 kilos is shown in figure 1.



Figure 1. A wood log batch of 4.855 kilos.

The test results relate only to the sample tested.

Fuel was 33 cm long birch wood logs, moisture content about 15%.

The appliance was fired according to the manufacturer's instructions. First three batches of wood are the same which are used during the nominal heat output test. Totally three times 5 kg. The average flue gas temperature of this period is calculated and used in calculating the flue gas losses or the efficiency of the appliance. The average flue gas temperature was 235 °C and the maximum temperature 320 °C. The graph of the flue gas temperature is shown in Appendix 1. Appendix 1 includes also the flue gas temperatures of the safety test(max. 435 °C) and additional firing(max. 530 °C).

The place where flue gas temperature is measured is the same for all standards. It is shown in Appendix 2.

Measurements of a sauna stove

A sauna stove was measured in the sauna test room built in accordance with the Sauna Standard, EN15821 (Multi-firing sauna stoves fired by natural wood logs - Requirements and test methods). Here flue gas temperature is also measured using a suction pyrometer.

The sauna stove represented a common sauna stove, which is according to the manufacture suitable for sauna rooms having the volume of 8 – 20 m³. This is also the basis for testing. Nominal heat output test should be carried out using 20 m³ sauna room volume and safety test using 8 m³ sauna room volume. The sauna stove had following dimensions: width 430 mm, depth 510 mm and height 760 mm. The weight was 60 kg and the recommended stone capacity of 40 kg. Flue outlet was from the top of the appliance.

Firstly the stove was ignited using 9 pieces of small birch wood logs (2.5 kg) to get a good basic firebed. After that first adding of 4.8 kg of wood logs was done. The maximum flue gas temperature was 562 °C. However, the sauna room temperature after burning of this fuel was a little lower than the requirement of the standard, which is 90 °C. The average temperature between the start and the temperature of the flue gas when sauna room temperature has been reached 90 °C is used for calculating the efficiency. In this case it was about 350 °C. So there is a difference of about 214 K between the maximum flue gas temperature and the average flue gas temperature.

Next addition was also 4.8 kg. Draught was increased to -15 Pa, which is used during the safety test. With this fuel batch the temperature of the sauna room reached 110 °C, which is required in the safety test. Maximum flue gas temperature reached the value of 617 °C. After that one further batch of 6.1 kg was added when the sauna room temperature was about 100 °C already. At the same time draught was increased to – 20 Pa. Maximum flue gas temperature was 658 °C. These measurements were done also in 20 m³ sauna room instead of 8 m³. However, the size of the sauna room does not have essential effect to the flue gas temperature, only to the safety distances.

The test results relate only to the sample tested.

Flue gas temperature starting from the nominal heat output until the additional firing is shown in Appendix 3.

Measurements of a roomheater

Roomheater used in the tests was a normal intermittent roomheater fired by wood logs. Measurements were carried out according to the standard EN13240 (Roomheaters fired by solid fuel – Requirements and test methods).

The roomheater had following dimensions: width 550 mm, depth 402 mm and height 935 mm. The weight was 56 kg. Flue outlet was from the top of the appliance. According to the CE-marking, average flue gas temperature is 304 °C, nominal heat output 6 kW and total efficiency 73 %.

Nominal heat output test was carried out using wood batches of 2.1 kg (4 logs). Fuel was 30 cm long birch wood logs.

2.1 kilos of wood logs inside the roomheater is shown in figure 2.



Figure 2. 2.1 kilos amount of wood logs inside the roomheater.

Draught was – 12 Pa. According to the standard, the appliance has to be first heated up to the steady-state condition and the basic firebed has to be reached. This is indicated in Appendix 4 after ignition phase and first batch combustion. Next two batches are regarded as nominal heat output test. Average temperature of the nominal heat output test (batches II and III) was 336 °C while the maximum temperature was 387 °C (during the second batch).

The test results relate only to the sample tested.

Safety test of a roomheater is carried out using a little higher draught (-15 Pa), different fuel (50x50 mm fir timber), different fuel batch and all combustion air regulators open. In this case all fuel batches were 2.2 kg. Totally six batches were burned until the trihedron wall temperatures did not rise anymore. Safety test fuel batch is shown in figure 3.

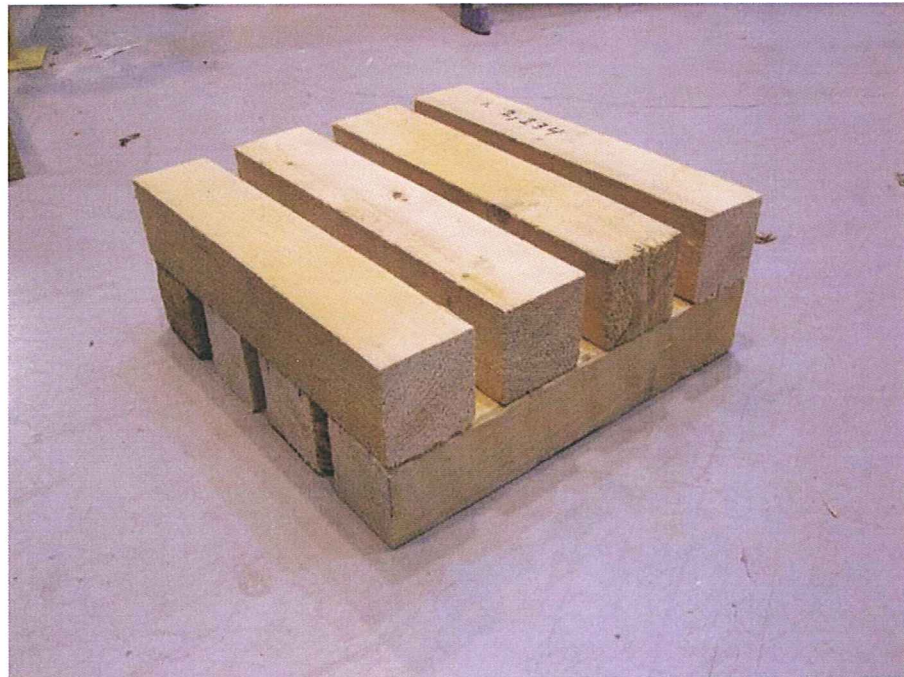


Figure 3. Safety test fuel batch. Wood is 50x50 mm fir timber. Total weight is 2.2 kg.

Flue gas temperatures are shown in Appendix 5. Highest flue gas temperature was 729 °C.

After that two additional big batches were burned using still higher flue draught (-20 Pa). In this case fuel was same birch wood logs that were used in the nominal heat output test, but the weight of a batch was about the double, 4.5 kilos. During this test, flue gas temperature was 814 °C at the highest. This behaviour can also be seen in Appendix 5.

Jyväskylä, 13.12.2011

Heikki Oravainen
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Product Manager



Appendices

6 pieces

Distribution

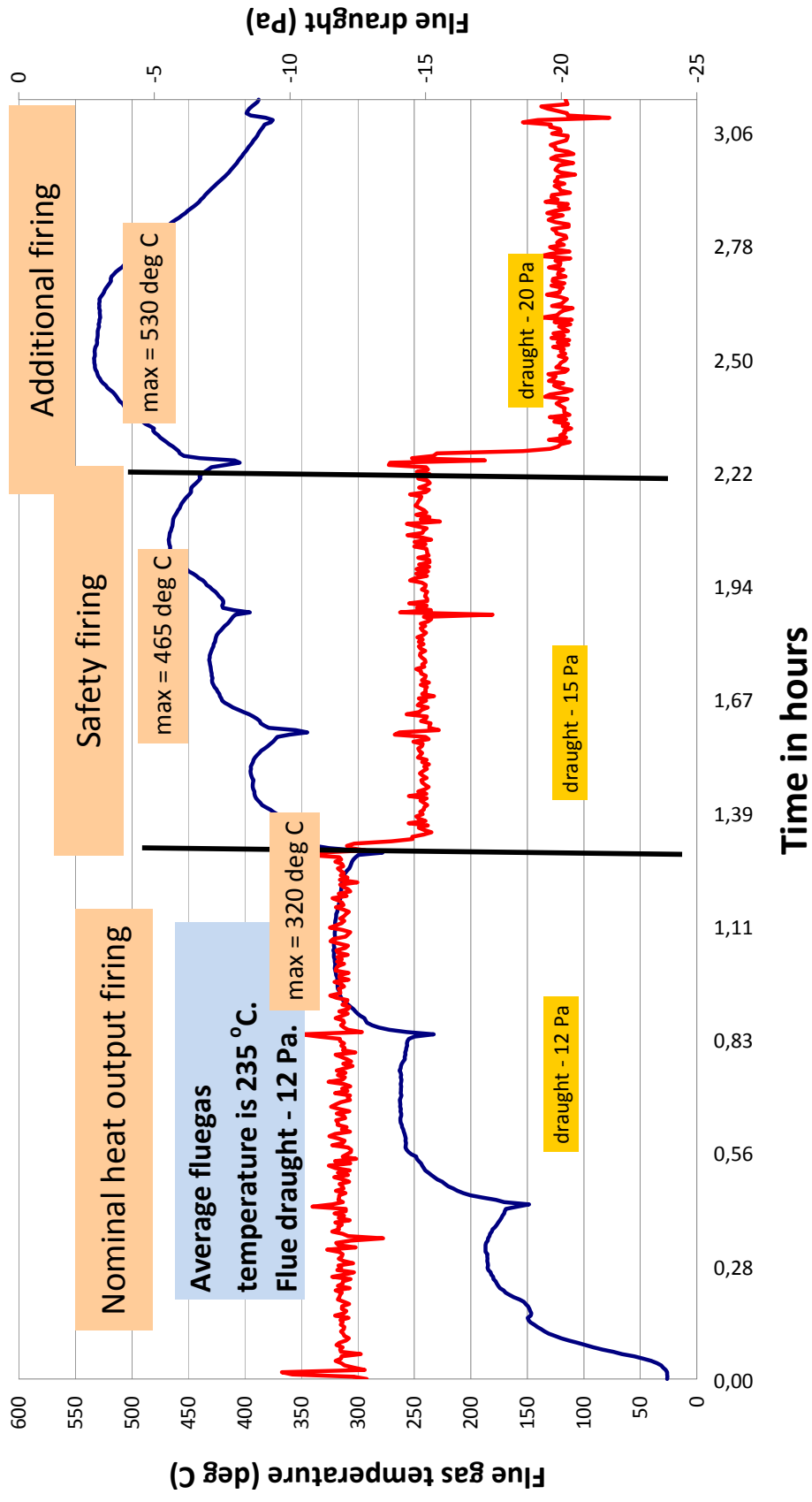
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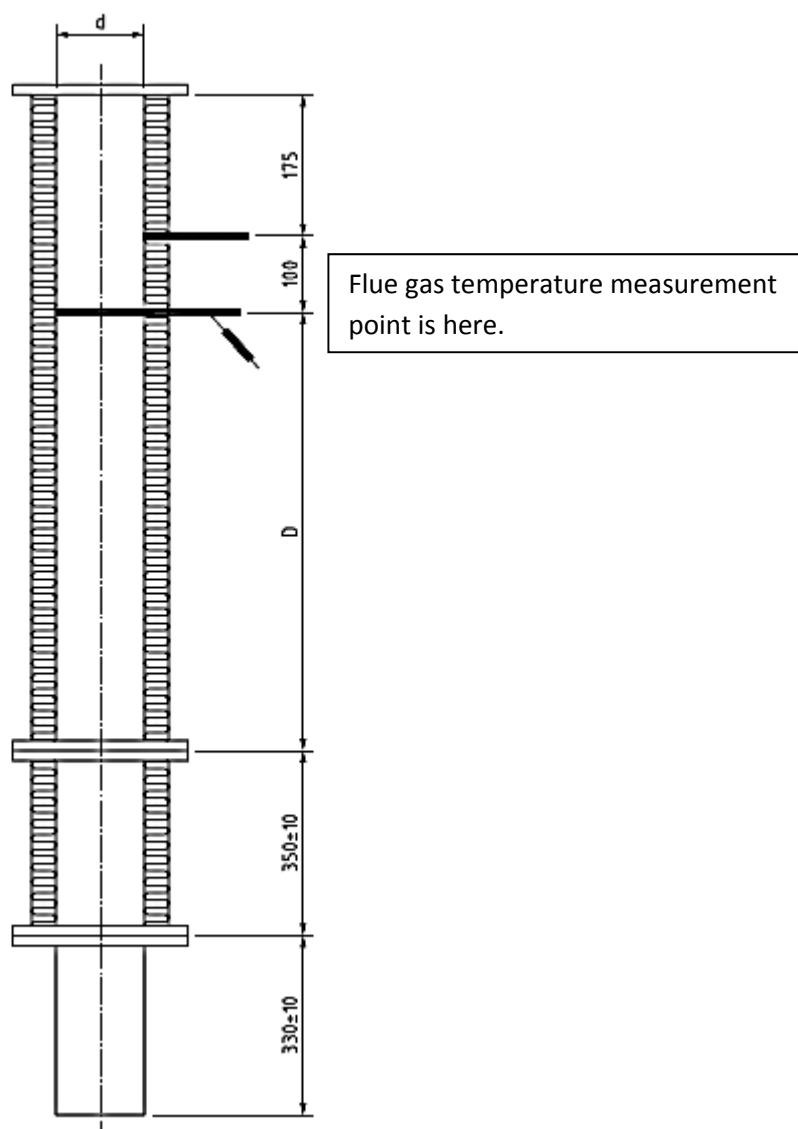
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The test results relate only to the sample tested.

APPENDIX 1

NOMINAL HEAT OUTPUT, SAFETY AND ADDITIONAL FIRING OF A SLOW HEAT RELEASE APPLIANCE





Dimensions of measurement section

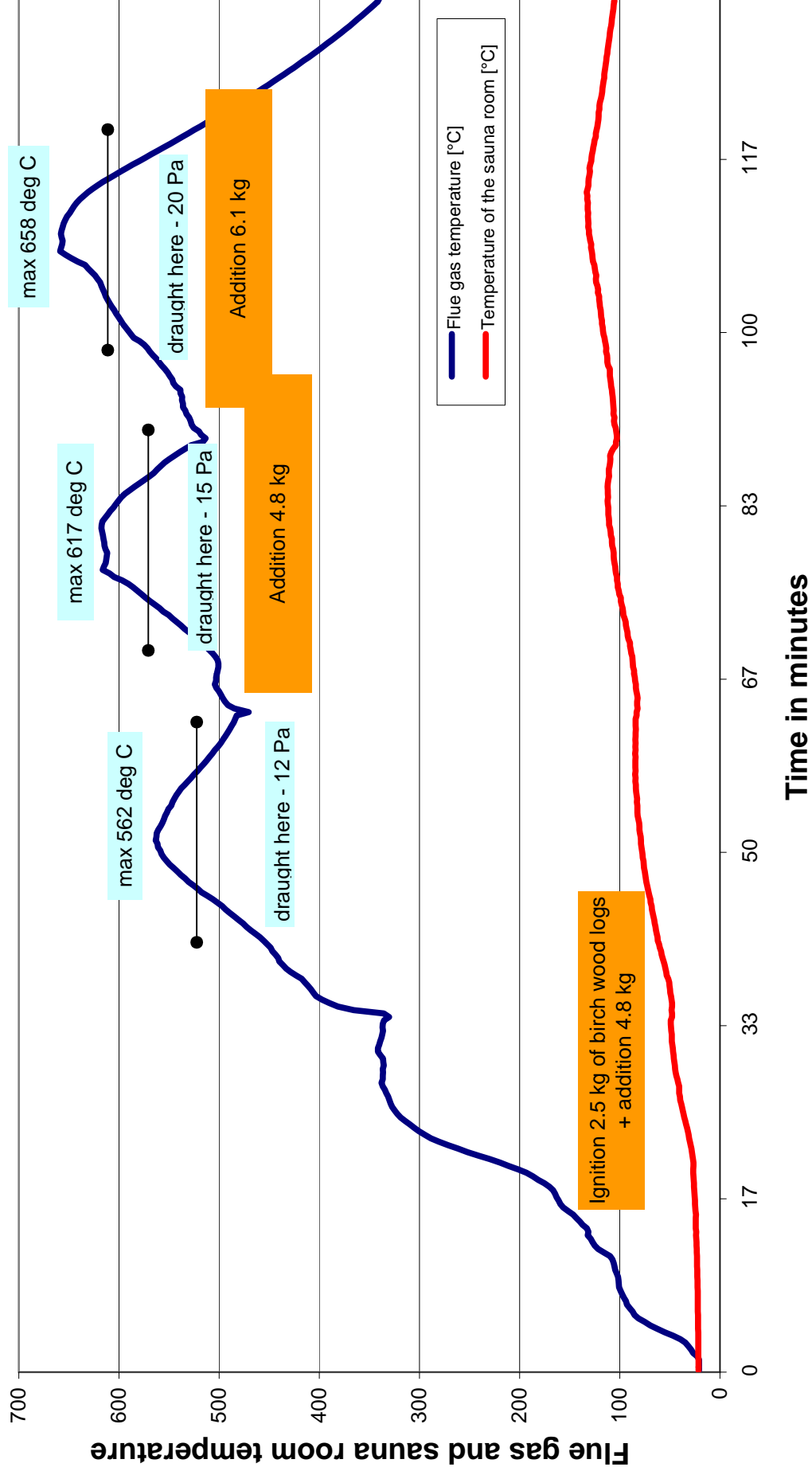
Flue spigot socket diameter Ø	d	D
≤ 180	150	750
$180 < \text{Ø} \leq 250$	200	1000
> 250	300	1500

Dimensions in millimetres

Details and dimensions of measurement section for vertical flue outlet. All appliances have been tested using this configuration. Diameter of the flue pipes were 150 mm (small d) in all cases and D in accordance to the standards, 750 mm.

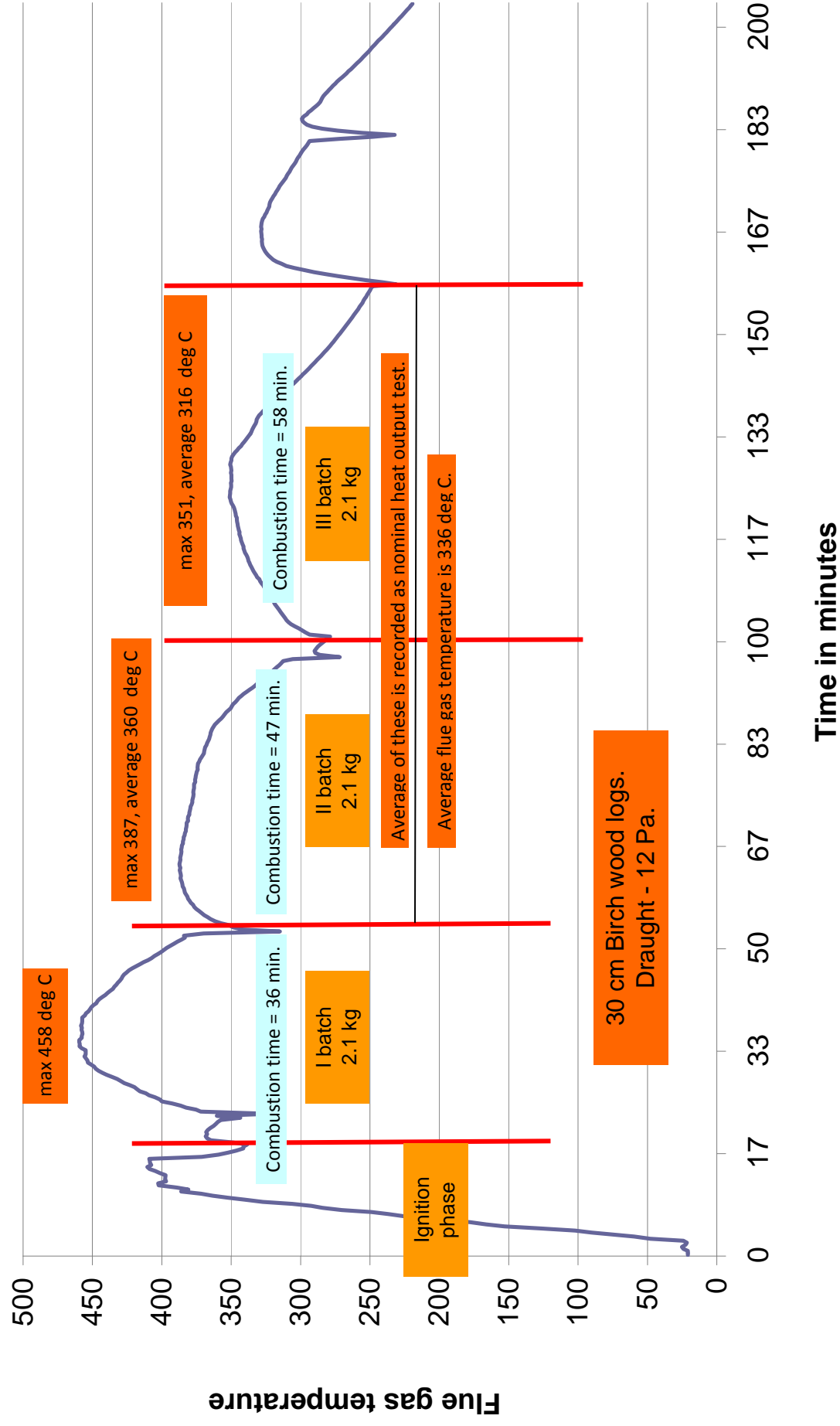
FLUE GAS AND SAUNA ROOM TEMPERATURE

APPENDIX 3



FLUE GAS TEMPERATURE OF A ROOM HEATER

APPENDIX 4



SAFETY TEST OF A ROOM HEATER

APPENDIX 5

Safety test + additional two batches

