



# TEST REPORT

Date: 2014.03.31

Report no.: 300-ELAB-2042

Page 1 of 17

Init.: TNJ/RSL/APOD/LSHA

Order number: 584079

No. of appendices: 6

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**Requested by:** Contact person: Jannich Hansen

Company: Nordjysk Bioenergi ApS      www.nordjysk-bioenergi.dk

Address: Brinken 10      Email: jannich@nbe.dk

Town: DK-9750 Øster Vrå      Tel.: +45 8820 9230

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**Product:** Automatic biofuel boiler

Manufacturer: NBE Production A/S      Type: RTB 10

Nominal output: 10,5 kW      Fuel: C1 (wood pellets)

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**Deadlines:** Date of receipt: 2013.12.12

Date of testing: 2013.12.12- 2014.02.19

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**Procedure:** Testing of biofuel boiler according to DS/EN 303-5:2012.

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**Result:** Requirements according to DS/EN 303-5:2012 Class 5 were met.

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**Remarks:** See page 2. This is a translation of test report originally dated 2014.03.31. In case of doubt, the Danish version of the test report prevails.

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**Terms:** Testing has been carried out on the conditions stated overleaf in compliance with the guidelines laid down for the laboratory by DANAK (Danish Accreditation) and in compliance with DTI's General Terms and Conditions Regarding Commissioned Work Accepted by the Danish Technological Institute (DTI), February 2013. The test results apply to the tested samples only. This test report may be reproduced in extracts only if the laboratory has approved the extract in writing.

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**Place:** Danish Technological Institute, Energy Laboratory

**Signature:**   
Torben Nørgaard Jensen  
B.Sc.



## **Appendices:**

- a) Drawings of the biofuel boiler: A1342A (2014.03.11), Auger 160mm (2014.02.21), PRT\_001113 (2014.03.11), A1342A\_Flipped (2014.02.11), R4166 (2014.03.11), 85001671 (2014.02.14), Burner RTB10 (Approved 2014.03.11)
- b) Photos of the biofuel boiler and steering: 15 pcs. of boiler and 5 pcs. of steering.
- c) User's instructions, installation manual: RTB Ready to Burn, approberet 2014.02.25
- d) Technical information: Approved 2014.03.24
- e) Dataplate: RTB10 / RTB16, verified 2014.02.25
- f) Risk assessment 2014.03.24

The appendices are kept separately.

## **1 Remarks**

It is noticed that the top insulation during testing was performed in soft Rockwool. However, the boiler will be produced with an Isover GV glass wool plate.

Control of the welded steel sheet boiler, electrical safety and EMC are not included in this report (see paragraph 4).

Determination of particle emission at in-stack sampling with turbular filter device. Drying was carried out before and after sampling at 105 °C for minimum 4 hours.

## **2 Description of the biofuel boiler**

The Ready To Burn boiler is a compact fully automatic stoker boiler for stoking with dispersed solid fuel. The fuel is transported by means of an inclined auger from the storage hopper further on via a drop chute to an internal auger in the burner. Combustion takes place during supply of primary and secondary air.

RTB is performed with electrical ignition, compressor cleaner and compressor.

The boiler is not suited for wood burning.

The regulation system is fully modulating. Measurements on smoke- and flow temperature are continuously carried.

The boiler is a welded steel sheet boiler with a convection part consisting of a pass with two flue gas turbulators.

The unit is equipped with ascending auger feeding and a drop chute larger than 250 mm to secure against back burning in the fuel supply.

Report no.:  
Date:  
Init.:  
File:

300-ELAB-2042  
2014.03.31  
TNJ/RSL/APOD/LSHA

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Kedelaforvninger\Prøvningsrapporter\300-ELAB-2042 - NBE Production - RTB 10\_UK.docx



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**Safety equipment:**

Boiler thermostat type: ..... Electronic  
Safety thermostat: ..... CA-95A, set point 95 °C  
Protection against back burning: ..... drop chute security with set point 70 °C  
Protection against back burning: ..... Drop chute >250 mm

Stand-by power consumption (measured) ..... 2,8 W

**Settings on unit during testing:**

Operating thermostat (nominal): ..... 85 °C  
Operating thermostat (partial load): ..... 73 °C  
(Further information regarding settings of biofuel boiler during testing see appendix)

**Measurements, entire unit during testing:**

Depth: ..... 845 mm  
Height: ..... 1895 mm  
Width: ..... 510 mm

**Feeding system:**

Type: ..... Feeding by means of inclined auger  
Fuel engine external<sup>1</sup>: .....Linux TY60-220-8-8, 6W v. 8 o/min.  
Fuel engine internal: .....Linux TY60-220-8-8, 6W v. 8 o/min.

**Burner:**

Type: ..... aircooled hearth with fireresistant crossbar  
Width: ..... 80 mm  
Depth: ..... 123 mm  
Fan: .....SOHON, type FL085034Y-01D, 230V, 34W

**Boiler:**

Type: ..... welded steel sheet boiler  
Height: ..... 1050 mm  
Width: ..... 510 mm  
Depth: ..... 845 mm  
Water content: ..... 36 L  
Flue gas tubes: ..... ø100 mm  
Flow connection: ..... 3/4"  
Return connection: ..... 3/4"  
Weight: ..... 162 kg

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<sup>1</sup> During testing



### 3 Test equipment

Testing stand and equipment has been set up according to EN 303-5 and EN 304.

<b>Test stand 2</b>			
<b>Instrument</b>	<b>Type</b>	<b>Traceability</b>	<b>No.</b>
Water flow meter	0-2,6 m <sup>3</sup> /h	DANAK 200	270-A-1991
Water temperature sensor	Pt100 (frem)	DANAK 200	270-A-2285
Water temperature sensor	Pt100 (retur)	DANAK 200	270-A-2286
Gas meter	IGA AC-5M	DANAK 207	270-A-1475

<b>Rack A1</b>			
<b>Instrument</b>	<b>Type</b>	<b>Traceability</b>	<b>No.</b>
Datalogger	HP 34970A	DANAK 200	270-A-2435
PC	Dell	-	-
CO-gauge	Sick Maihak Sidor	-	270-A-2429
CO/CO <sub>2</sub> -gauge	Sick Maihak Sidor	-	270-A-2431
FID analyzer	Sick Maihak EuroFID		270-A-2433
NO <sub>x</sub> -gauge	ECO Physics CLD	-	270-A-2427
Pressure gauge	Autotran 700	ELAB	270-A-2441
Heated hose/probe	M&C	-	270-A-2480
Heated hose/probe	M&C	-	270-A-2481
Flue gas temperature sensor	Type K	ELAB	270-A-2485
Ambient temperature sensor	Type K	ELAB	270-A-2484

<b>Other equipment</b>			
<b>Instrument</b>	<b>Type</b>	<b>Traceability</b>	<b>No.</b>
Adiabatic calorimeter	-	IVC, Kemi	-
Spangas, C <sub>3</sub> H <sub>8</sub>	AGA	Swedac	270-A-2294
Spangas, CO/CO <sub>2</sub>	AGA	Swedac	270-A-1727
Spangas, NO/SO <sub>2</sub>	AGA	Swedac	270-A-1725
Zero gas, N <sub>2</sub>	AGA	Swedac	270-A-1731
Data collection programme	N.I. Labview	-	TI-DOP ver. II
Dust measuring equipment	Ströhlein	-	270-A-1330
Surface thermometer	Technoterm 5500	DANAK 200	270-A-976
Water gauge	ELAB	-	270-A-1759
Scale (dust)	Mettler XS 204	ELAB	ID: 7084
Scale (humidity)	Mettler PC 440	ELAB	270-A-947
Scale (fuel)	Sauter 60 kg	ELAB	270-A-484
Scale (boiler)	Mettler IND 560	ELAB	270-A-2424



## 4 Requirements for construction etc.

	Reference paragraph in EN303-5	Requirement met
<b>4.1 General requirements</b>		
Safety during normal use	4.1	Yes
<b>4.2 Requirements for documentation</b>		
Drawings	4.2.1.1	Yes
Quality manual	4.2.1.2	Yes
Data plate	7.1-7.2	Yes
Technical information	8.2	Yes
User's instructions	8.3	Yes
Risk assessment	4.3.1	Yes
<b>4.3 Requirements on welded steel sheet boiler</b>		
Execution of welding work	4.2.2.1	*
Welding seams and fillers	4.2.2.2	*
Parts of steel subject to pressure	4.2.2.3	*
Least wall thickness and tolerances	4.2.2.4	*
<b>4.4 Requirements on safety and design</b>		
Venting etc.	4.2.4.1	Yes
Cleaning of heating surfaces	4.2.4.2	Yes
Inspection of the flame	4.2.4.3	Yes
Water tightness	4.2.4.4	Yes
Spare parts	4.2.4.5	Yes
Water side connections	4.2.4.6	Yes
Thermostat pockets	4.2.4.7	Yes
Thermal insulation	4.2.4.8	Yes
Water side resistance	4.2.4.9	Yes
Storage hopper	4.2.4.10	Yes
Combustion chamber	4.2.4.11	Yes
Ash chamber	4.2.4.12	Yes
Overfeeding and disturbances in the fuel supply	4.3.4	Yes
Supply of combustion air	4.3.5	Yes
Surface temperatures of accessible parts	4.3.6	Yes
Leakage of combustion products	4.3.7	Yes
<b>4.5 Safety requirements in connection with stoking</b>		
Generally	4.3.3.1	Yes
Manual fuel supply	4.3.2	Not relevant
Automatic fuel supply	4.3.3	Yes
Thermal conduction	4.3.3.2	Yes



Back flow of inflammable combustion gasses	4.3.3.3	Yes
Spreading of fire in fuel line	4.3.3.4	Yes
Alternative solutions against back-burning	4.3.3.5	Not relevant
<b>4.6 Safety requirements at automatic stoking</b>		
Temperature control for open vented systems	4.3.8.2	Yes
Temperature control for closed vented systems	4.3.8.3	Yes
Accessories	4.3.9.1	Yes
Electric safety	4.3.9.2	*
Electromagnetic compatibility, EMC	4.3.9.3	*

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\* Not included in this report. Reference is made to the manufacturer's EU declaration of conformity.



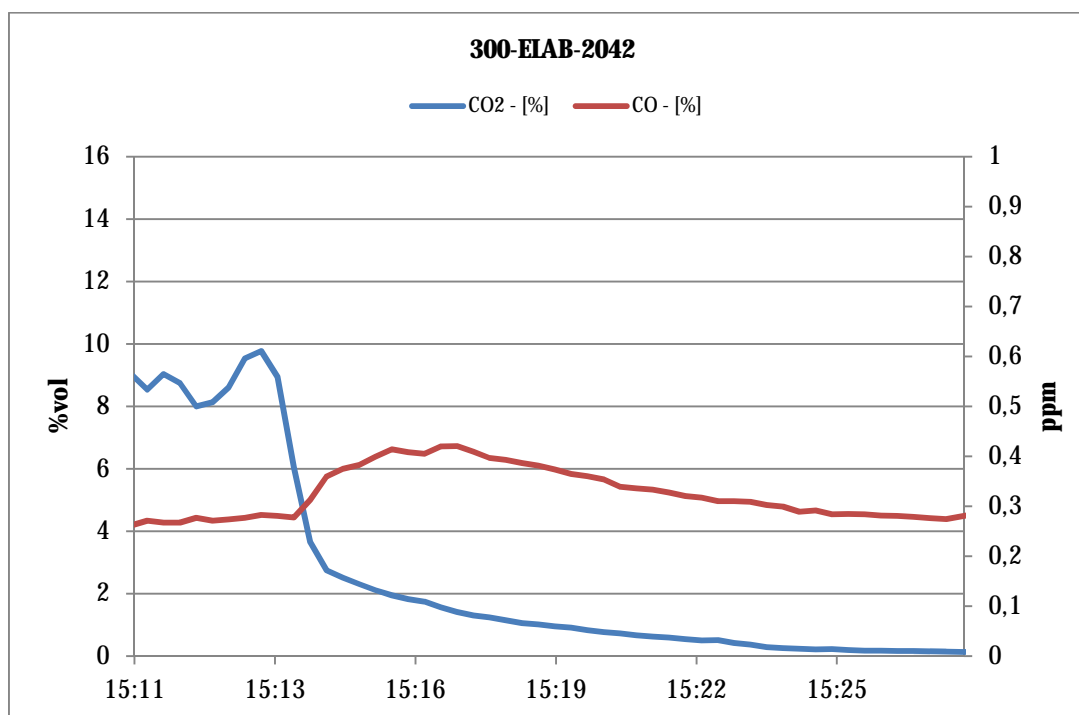
## 5 Test results

### 5.1 Water resistance

Equivalent temperature difference at nominal output	Water flow	Drop of pressure
20 K	0.5 m <sup>3</sup> /h	2.3 mbar
10 K	0.9 m <sup>3</sup> /h	7.5 mbar

### 5.2 Disconnection of air fan

	Measured CO	Allowed limit CO
Disconnection of air fan	0.4 % vol	5 % vol



### 5.3 Surface temperatures

	Measured temperature	Allowed limit
Boiler doors etc., average of 5 measurements	22 °C	+ 100 K
Boiler's underside, average of 5 measurements	28 °C	+ 65 K
Handles being touched during operation		
Metal and similar materials	-	+ 35 K
Porcelain and similar materials	-	+ 45 K
Plastic and similar materials	23 °C	+ 60 K
Boiler's average surface temperature		





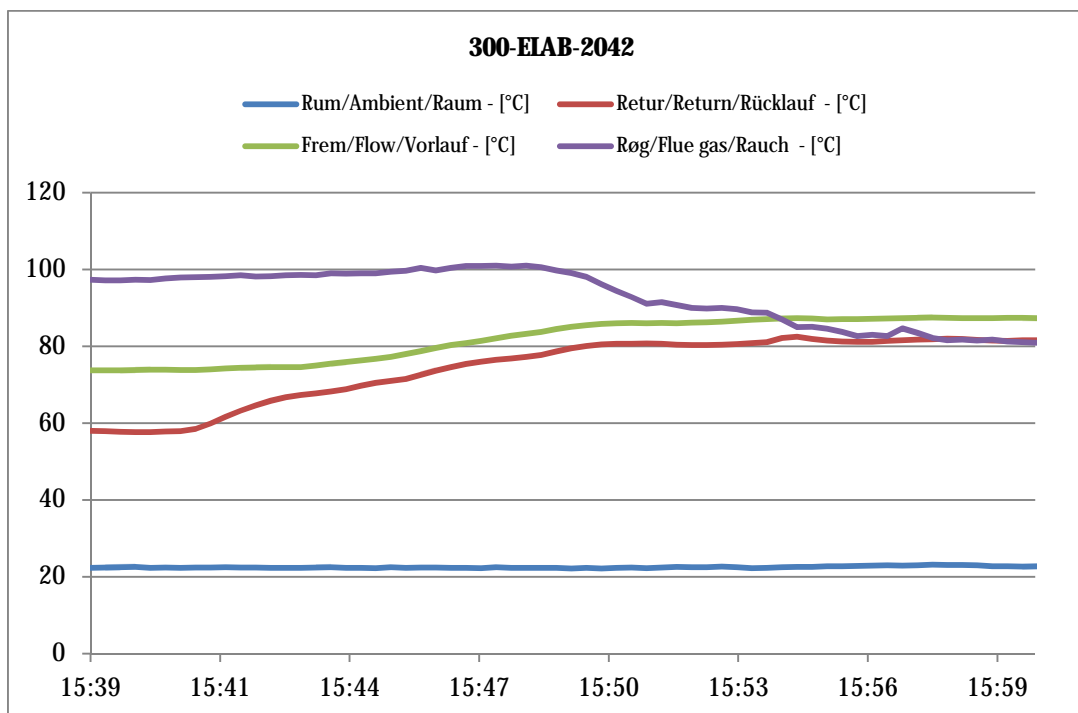
Average of 10 spot measurements	29 °C	-
Ambient temperature	22 °C	-

#### 5.4 Function control

The stoking system is completely disconnectable, DS/EN303-5 paragraph 4.3.8.3 a), and therefore the safety equipment includes an operating thermostat and a safety thermostat with manual reset device.

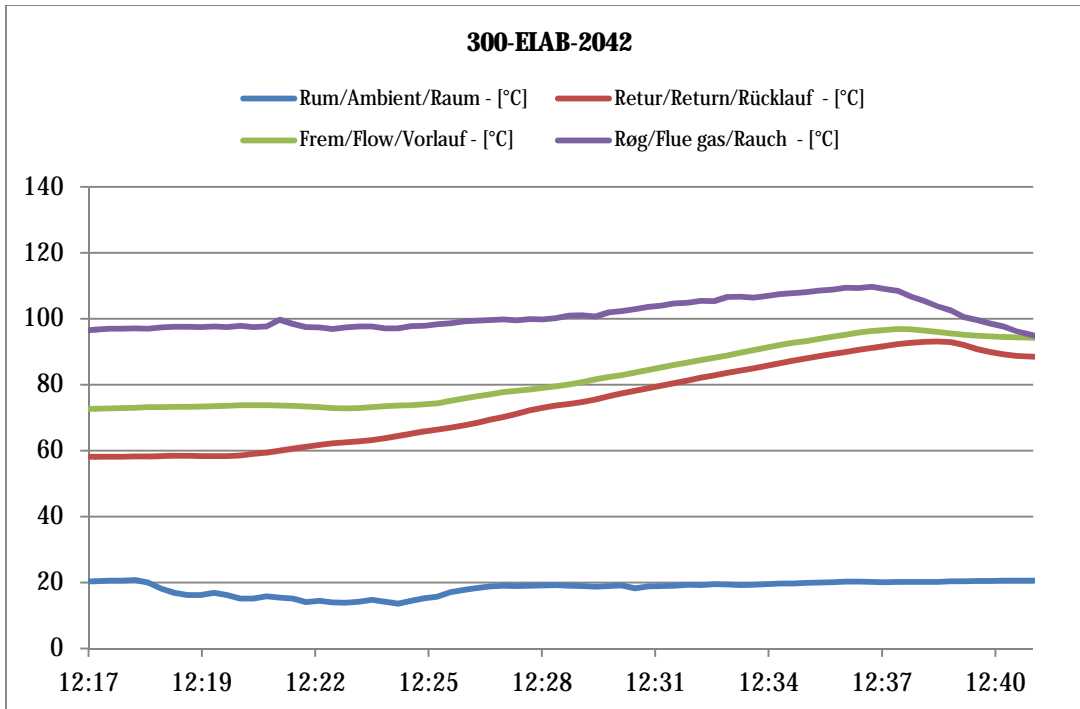
The thermostats of the boiler are tested in accordance with DS/EN303-5 paragraph 5.13. Loss of power supply and sudden lack of heat offtake are controlled in accordance with paragraph 5.14.

	Measured temperature	Allowed limit
Operating thermostat	87,4 °C	100 °C
Safety thermostat	96,8 °C <sup>2</sup>	110 °C

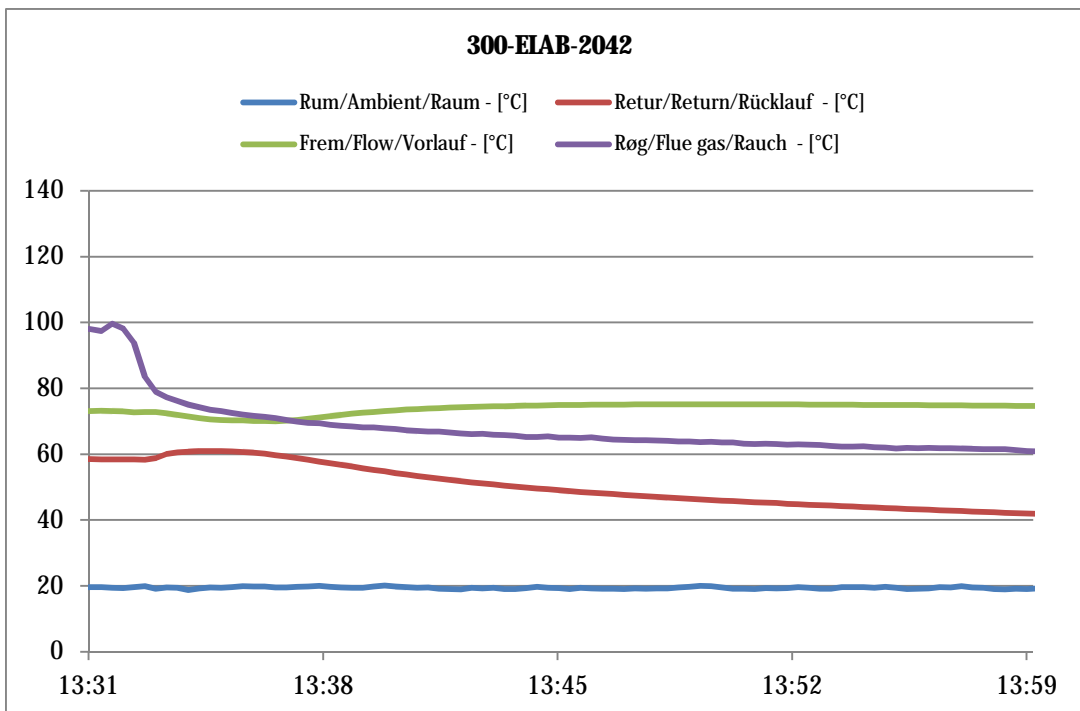


Test of operating thermostat

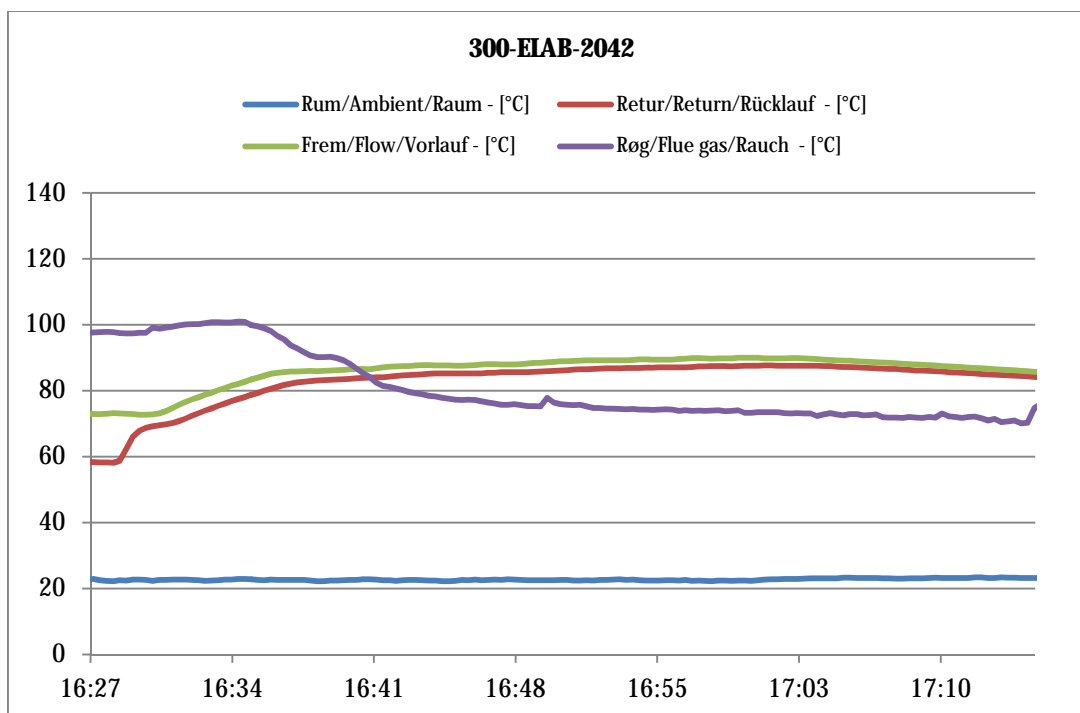
<sup>2</sup> Re-tested after adjustment, as no disengagement was registered during the first test.



Test of safety thermostat



Test of power failure



Test of loss of effect

## 5.5 Pressure test of boiler shell

The necessary tests cf. DS/EN303-5 paragraph 5.4, are carried out by the manufacturer.

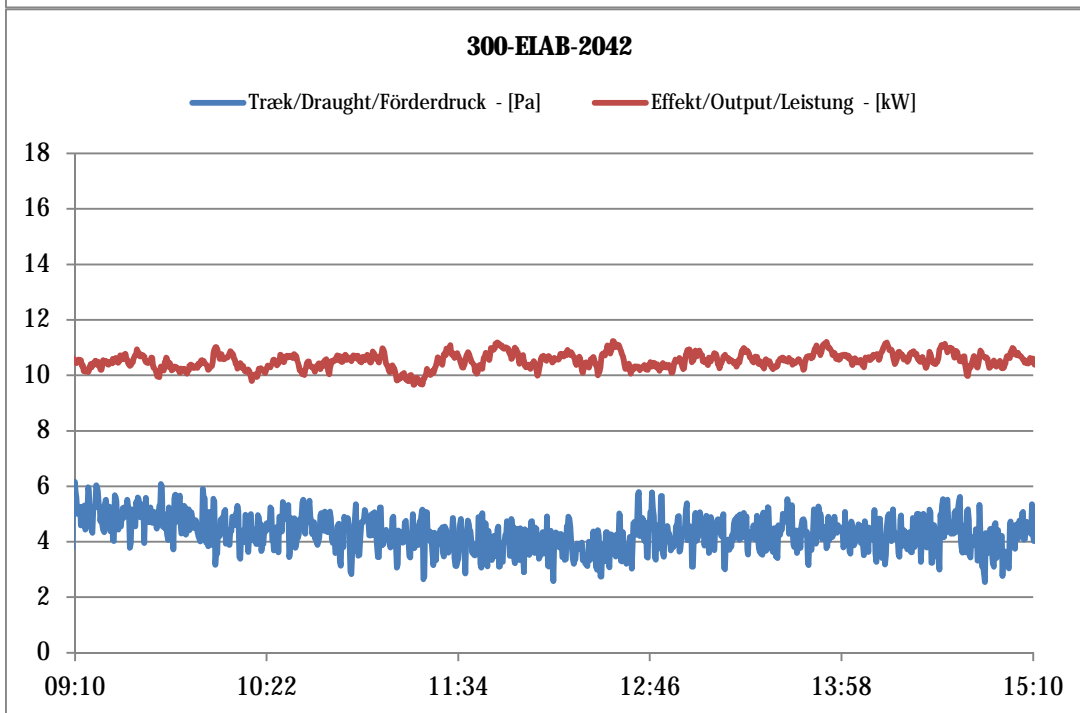
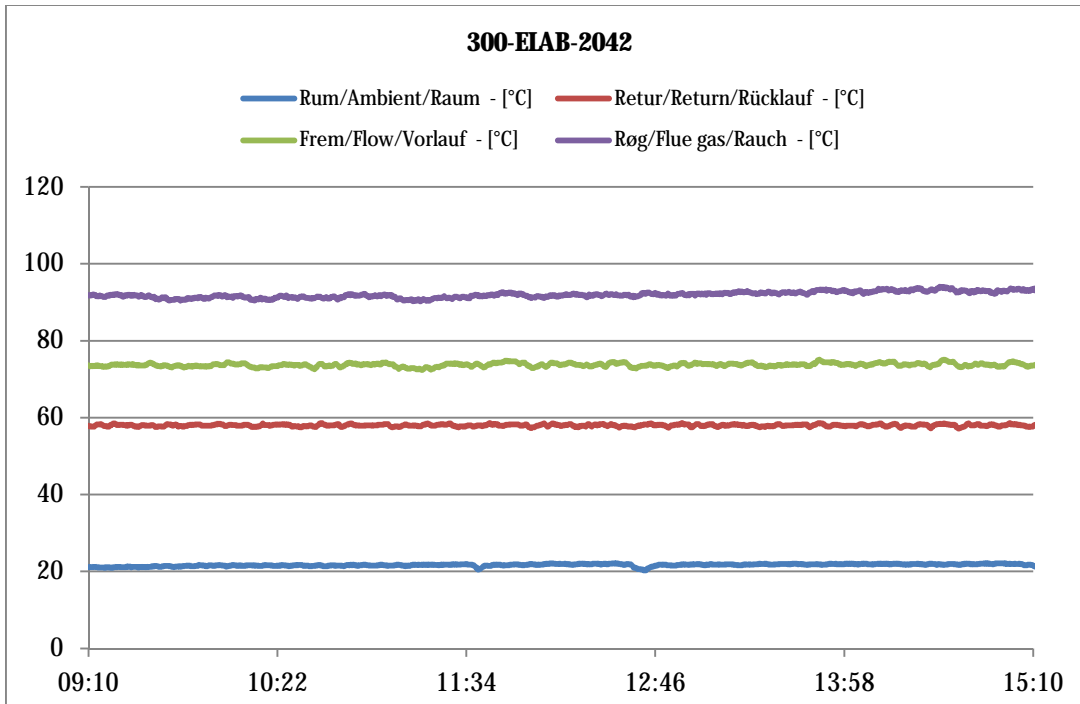


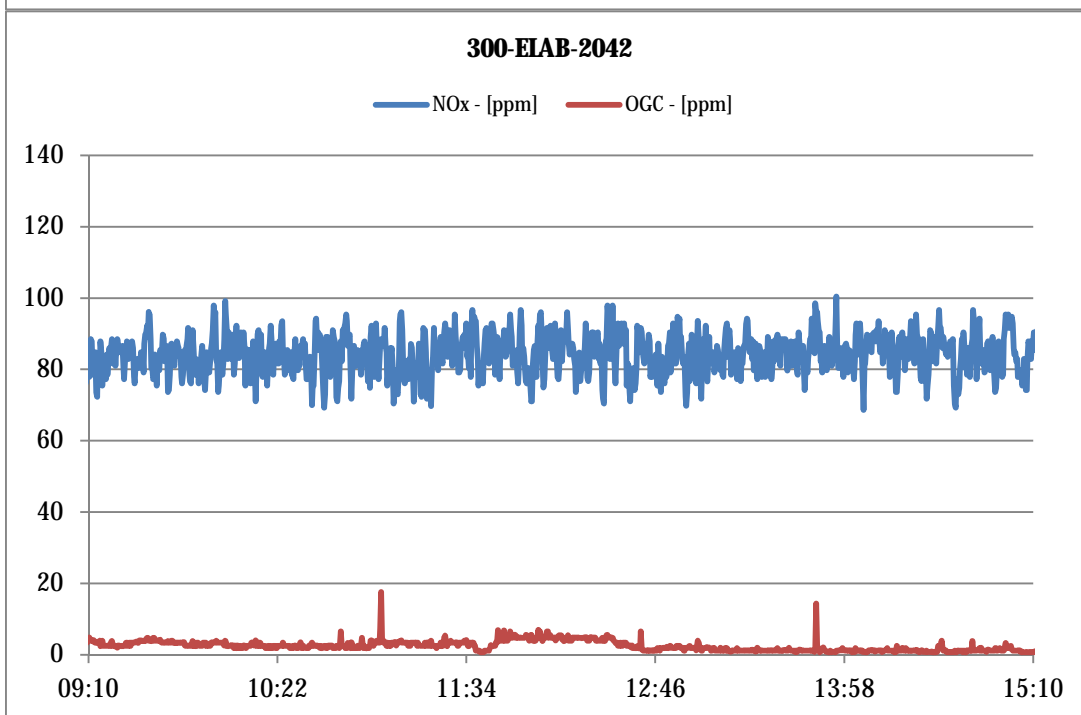
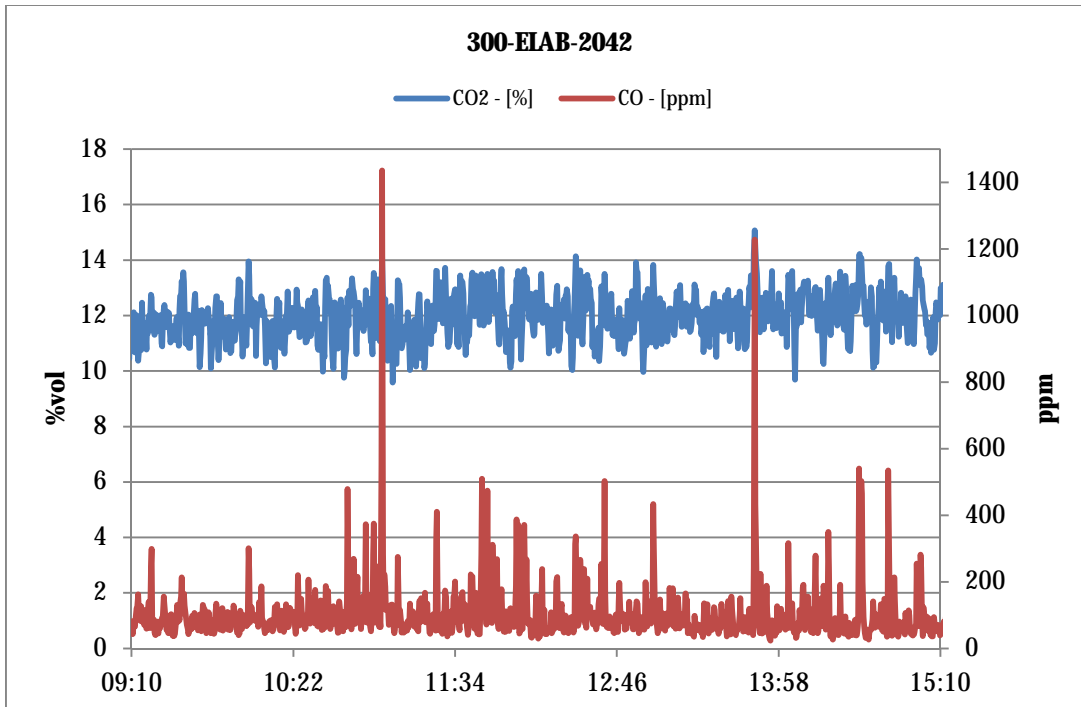
## 5.6 Test results at nominal output

Measurement	Result	Demands
Return temperature	58.00 °C	
Flow temperature	73.72 °C	
Water flow	0.58 m <sup>3</sup> /h	
Heat output	10.52 kW	
Test duration	6.00 h	
Power consumption	36.90 W	
Fuel consumption	2.31 kg/h	
Water content	6.8 %	
Calorific value	17495 J/g	
Heat input	11.20 kW	
Efficiency	93.9 %	88.0 (Class 5) 88.0 (Denmark) 80 (Austria)
Ambient temperature	22 °C	
Flue gas temperature	92 °C	
Chimney draught	4 Pa	
Flue gas volume flow	24.7 m <sup>3</sup> /h	
Flue gas mass flow	24.1 kg/h	
CO <sub>2</sub>	12.0 % <sub>vol</sub>	
Dust measured	30 mg/m <sub>n</sub> <sup>3</sup>	
Dust at 10% O <sub>2</sub>	26 mg/m <sub>n</sub> <sup>3</sup>	40 (Class 5)
Dust at 13% O <sub>2</sub>	0.019 g/m <sub>n</sub> <sup>3</sup>	0.1/0.02* (Germany)
Dust emission	12 mg/MJ	40/20* (Austria)
CO measured	0.0101 % <sub>vol</sub>	
CO at 10% O <sub>2</sub>	0.0089 % <sub>vol</sub>	
CO at 10% O <sub>2</sub>	111 mg/m <sub>n</sub> <sup>3</sup>	500 (Class 5)
CO at 13% O <sub>2</sub>	0.0806 g/m <sub>n</sub> <sup>3</sup>	0,5/0,4* (Germany)
CO at 13% O <sub>2</sub>	81 mg/m <sub>n</sub> <sup>3</sup>	300 (Switzerland)
CO emission	53 mg/MJ	250 (Austria)
NO <sub>x</sub> (NO <sub>2</sub> ) at 10% O <sub>2</sub>	0.0074 % <sub>vol</sub>	
NO <sub>x</sub> (NO <sub>2</sub> ) at 10% O <sub>2</sub>	151 mg/m <sub>n</sub> <sup>3</sup>	
NO <sub>x</sub> emission (NO <sub>2</sub> )	72 mg/MJ	150/100* (Austria)
OGC (C <sub>3</sub> H <sub>8</sub> ) at 10% O <sub>2</sub>	< 0.0004 % <sub>vol</sub>	
OGC (C) at 10% O <sub>2</sub>	< 6 mg/m <sub>n</sub> <sup>3</sup>	20 (Class 5)
OGC emission (C)	< 3 mg/MJ	30 (Austria)

All emission values are stated on the basis of dry flue gas.

\*: Limit values are valid from 01.01.2015







## 5.7 Test results at lowest output

Measurement	Result	Demands
Return temperature	57.99 °C	
Flow temperature	73.28 °C	
Water flow	0.17 m <sup>3</sup> /h	
Heat output	3.06 kW	
Test duration	15.00 h	
Power consumption	23.90 W	
Fuel consumption	0.70 kg/h	
Water content	6.9 %	
Calorific value	17475 J/g	
Heat input	3.38 kW	
Efficiency	90.5 %	88.0 (Class 5) 88.0 (Denmark) 80 (Austria)
Ambient temperature	21 °C	
Flue gas temperature	61 °C	
Chimney draught	4 Pa	
Flue gas volume flow	11.0 m <sup>3</sup> /h	
Flue gas mass flow	11.7 kg/h	
CO <sub>2</sub>	7.1 % <sub>vol</sub>	
Dust measured	17 mg/m <sub>n</sub> <sup>3</sup>	
Dust at 10% O <sub>2</sub>	28 mg/m <sub>n</sub> <sup>3</sup>	40 (Class 5)
Dust at 13% O <sub>2</sub>	0.02 g/m <sub>n</sub> <sup>3</sup>	0.1/0.02* (Germany)
Dust emission	12 mg/MJ	60/30* (Austria)
CO measured	0.0211 % <sub>vol</sub>	
CO at 10% O <sub>2</sub>	0.0310 % <sub>vol</sub>	
CO at 10% O <sub>2</sub>	388 mg/m <sub>n</sub> <sup>3</sup>	500 (Class 5)
CO at 13% O <sub>2</sub>	0.2820 g/m <sub>n</sub> <sup>3</sup>	0.5/0.4* (Germany)
CO at 13% O <sub>2</sub>	282 mg/m <sub>n</sub> <sup>3</sup>	300 (Switzerland)
CO emission	183 mg/MJ	375 (Austria)
NO <sub>x</sub> (NO <sub>2</sub> ) at 10% O <sub>2</sub>	0.0067 % <sub>vol</sub>	
NO <sub>x</sub> (NO <sub>2</sub> ) at 10% O <sub>2</sub>	137 mg/m <sub>n</sub> <sup>3</sup>	
NO <sub>x</sub> emission (NO <sub>2</sub> )	65 mg/MJ	150/100* (Austria)
OGC (C <sub>3</sub> H <sub>8</sub> ) at 10% O <sub>2</sub>	0.0004 % <sub>vol</sub>	
OGC (C) at 10% O <sub>2</sub>	6 mg/m <sub>n</sub> <sup>3</sup>	20 (Class 5)
OGC emission (C)	3 mg/MJ	40 (Austria)

All emission values are stated on the basis of dry flue gas.

\*) Limit values are valid from 1.1.2015

