TEST Reg.no. 300

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TEST REPORT

Requested by: Contact person: Nusret Suzme

Company: Salih KOZLU - KOZLUSAN www.kozlusan.com

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City: Akhisar / Manisa - TURKEY Tel.: +90 (236) 427 23 13
+90 (236) 427 24 27

Subject: Automatic biofuel boiler

Manufacturer: Salih KOZLU - KOZLUSAN Type: PROPEL 100

Nominal output: 99 kW Fuel: Wood pellets (C1), Ø6 mm

Deadlines: Date of receipt: 2013.09.11
Date of testing: 2013.09.12- 2013.09.23

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

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

Remarks: See page 2.

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.

Place: Danish Technological Institute, Energy Laboratory

Signature: Anette S. Brønnum
Master of Engineering

Appendices to report:

a) Drawings of the biofuel boiler: 07 00 06 (2013.09.05), 07 00 11 (2013.10.31), 07 00 18 (2013.10.31), 07 00 14 (2013.10.31), 07 00 21 (2013.10.31), 07 00 15 (2013.09.05), 07 00 22 (2013.10.31), 07 00 26 (2013.09.05), 07 00 24 (2013.09.05), 07 00 27 (2013.10.31), 07 00 25 (2013.09.05), 07 00 29 (2013.09.05), 07 00 39 (2013.09.05), 07 00 45 (2013.09.05), 07 00 43 (2013.09.05), 07 00 46 (2013.09.05), 07 00 48 (2013.09.05), 07 00 44 (2013.10.31), 07 00 49 (2013.09.05), 07 00 70 (2013.11.05), 07 00 32 (2013.11.05), 07 00 71 (2013.11.05)
b) Photos of the biofuel boiler and steering: 21 pcs. of boiler and 10 pcs. of steering
c) User's instructions, installation manual and technical information: Owner's Manual V1.0
d) Data plate: seri no: 20131043
e) Risk assessment: dated 2013.11.13

The appendixes are kept separately.

1 Remarks

During testing of safety thermostat the boiler boiled over. Safety thermostat's setting according to type plate is 100 °C. The position of the safety thermostat was reduced and the safety test was successfully repeated. It must be secured that the safety thermostat is correctly adjusted and/or set so that boiler temperature does not exceed 110 °C.

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 for minimum 4 hours at 105 °C

2 Description of the biofuel boiler

The biofuel boiler is a compact fully automatic heating boiler for stoking with wood pellets. The fuel is transported via an inclined internal auger from the fuel supply to the firebox where combustion takes place during supply of primary and secondary air.

The unit is mounted with electrical ignition. The electrical ignition has been used during testing.

The boiler is unsuitable for firewood.

The boiler is a welded steel sheet boiler with a convection part consisting of 36 boiler tubes all with removable flue gas baffle plates. The boiler is equipped with a drop chute and thermal fuse.

Safety equipment:

Operating thermostat, type: ..... Electronic
Safety thermostat: .....IMIT STB FIX100°C TYPE LS1 6025 DIN STB2011
Protection against back-burning: ..... Drop chute >250 mm
Protection against back-burning: . Thermal protection on boiler tubes, set. point 55°C

Stand-by power consumtion (measured) .....9.6 W

Settings on biofuel boiler during testing

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

Main dimensions, entire unit:

Length: .....ca. 1700 mm
Heigth: .....ca. 1700 mm
Width: .....ca. 1850 mm
Weigth: .....935 kg

Feeding system:

Type: .....inclined auger with drop chute
Fuel engine: KAC-6150-TWF-02, 230V, 5,8W
Fuel feed duct: ..... Ø76 mm

Burner:

Type: ..... air-cooled cylindrical hearth
Diameter: .....ca.195 mm
Heigth: .....ca. 235 mm
Fan: ..... ebmpapt, R2E210-AB34, 230V, 120W

Boiler:

Type: ..... Welded steel sheet boiler
Height: .....ca. 1700 mm
Width: .....ca. 750 mm
Length: .....ca. 1700 mm
Water content: .....315 l
Flue gas tube: ..... ø200 mm
Flow connection: .....2”
Return connection: .....2”

3 Test equipment

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

Rack A1			
Instrument	**Type**	**Traceability**	**No.**
Data logger	HP 34970A	DANAK 200	270-A-2435
PC	Dell	-	-
CO analyser	Sick Maihak Sidor	-	270-A-2429
CO/CO_2 analyzer	Sick Maihak Sidor	-	270-A-2431
FID analyzer	Sick Maihak EuroFID		270-A-2433
NOx analyzer	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

Testing stand 4			
Instrument	**Type**	**Traceability**	**No.**
Water flow meter	0-11 m^3/h	DANAK 200	270-A-1760
Water temperature sensor	Pt100 (forward)	DANAK 200	270-A-1306
Water temperature sensor	Pt100 (return)	DANAK 200	270-A-1307
Gas meter	IGA AC-5M	DANAK 207	270-A-1474

Other equipment			
Instrument	**Type**	**Traceability**	**No.**
Adiabatic calorimeter	-	IVC, Kemi	-
Spangas, C_3H_8	AGA	Swedac	270-A-2294
Spangas, CO/CO_2	AGA	Swedac	270-A-1727
Spangas, NO/SO_2	AGA	Swedac	270-A-1725
Zero gas, N_2	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. no. 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-0551

4 Requirements for construction etc.

	Reference paragraph in EN303-5	Requirement met
4.1 General requirements		
Safety during normal use	4.1	Yes
4.2 Requirements for documentation		
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
4.3 Requirements on welded steel sheet boiler		
Svejsernes kvalifikationer	4.2.2.1	*
Svejsesømme og materialer	4.2.2.2	*
Trykbærende konstruktioner	4.2.2.3	*
Mindste godstykkelse og tolerancer	4.2.2.4	*
4.4 Requirements on safety and design		
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
Fuel box	4.2.4.10	Not relevant
Firebox	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
4.5 Safety requirements in connection with stoking		
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
4.6 Safety requirements at automatic stoking		
Temperature control for open vented systems	4.3.8.2	Yes
Temperature control for closed vented systems	4.3.8.3	Yes[1]
Accessories	4.3.9.1	Yes
Electric safety	4.3.9.2	*
Electromagnetic compatibility, EMC	4.3.9.3	*

[1] Only applies for automatic stoking.

* Not included in this report. Please refer 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	4.1 m^3/h	4 mbar
10 K	8.1 m^3/h	12 mbar

5.2 Disconnection of air fan

	Measured CO	Allowed limit CO
Disconnection of air fan	< 5%$_{vol}$	5 %$_{vol}$

5.3 Surface Temperatures

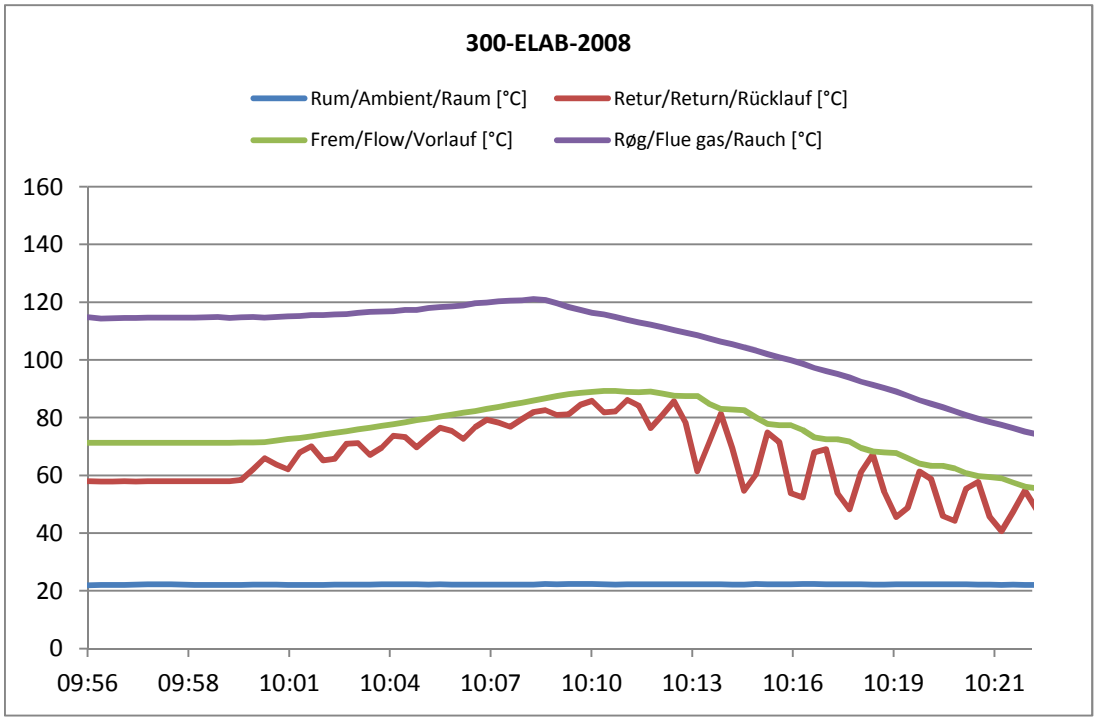
	Measured temperature	Allowed limit
Boiler doors etc., average of 5 measurements	22 °C	+ 100 K
Boiler's underside, average of 5 measurements	36 °C	+ 65 K
Handles being touched during operation		
Metal and similar materials	22 °C	+ 35 K
Porcelain and similar materials	-	+ 45 K
Plastic and similar materials	-	+ 60 K
Boiler's average surface temperature		
Average of 10 spot measurements	23 °C	-
Ambient temperature	22 °C	-

5.4 Function check

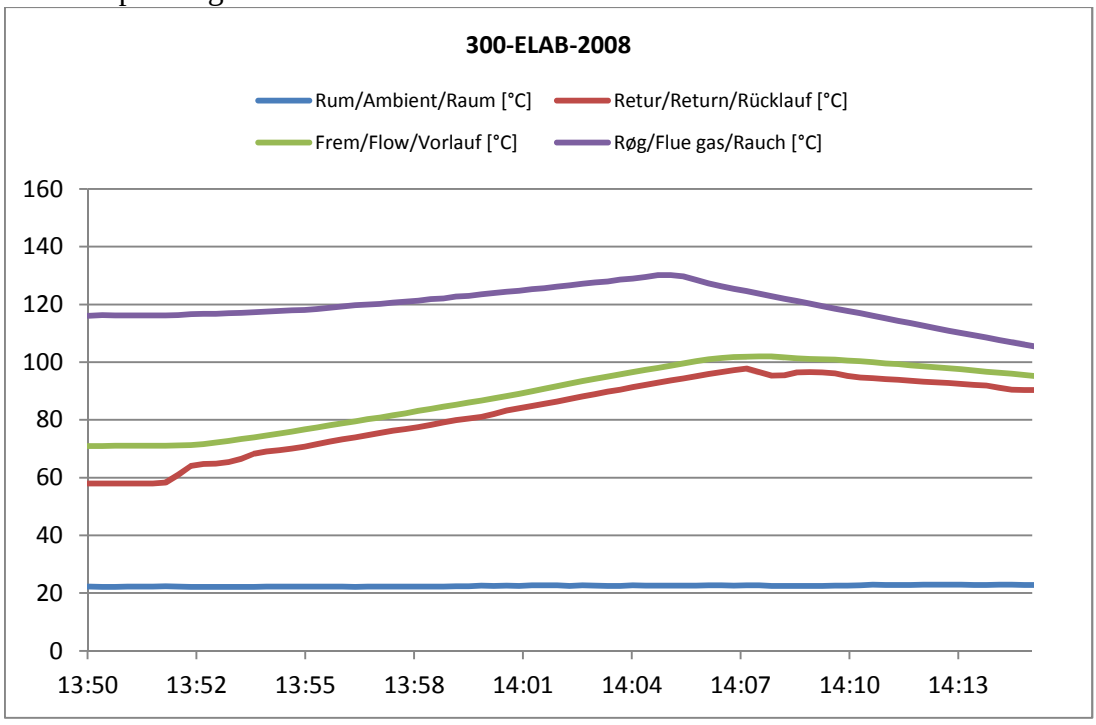
The stoking system is completely disconnectable, DS/EN303-5 paragraph 4.3.8.3 a), therefore the safety equipment includes an operating thermostat and a safety thermostat with manual reset device.

The boiler's thermostats have been tested according to DS/EN303-5 paragraph 5.13. Loss of power supply has been tested according to paragraph 5.14.

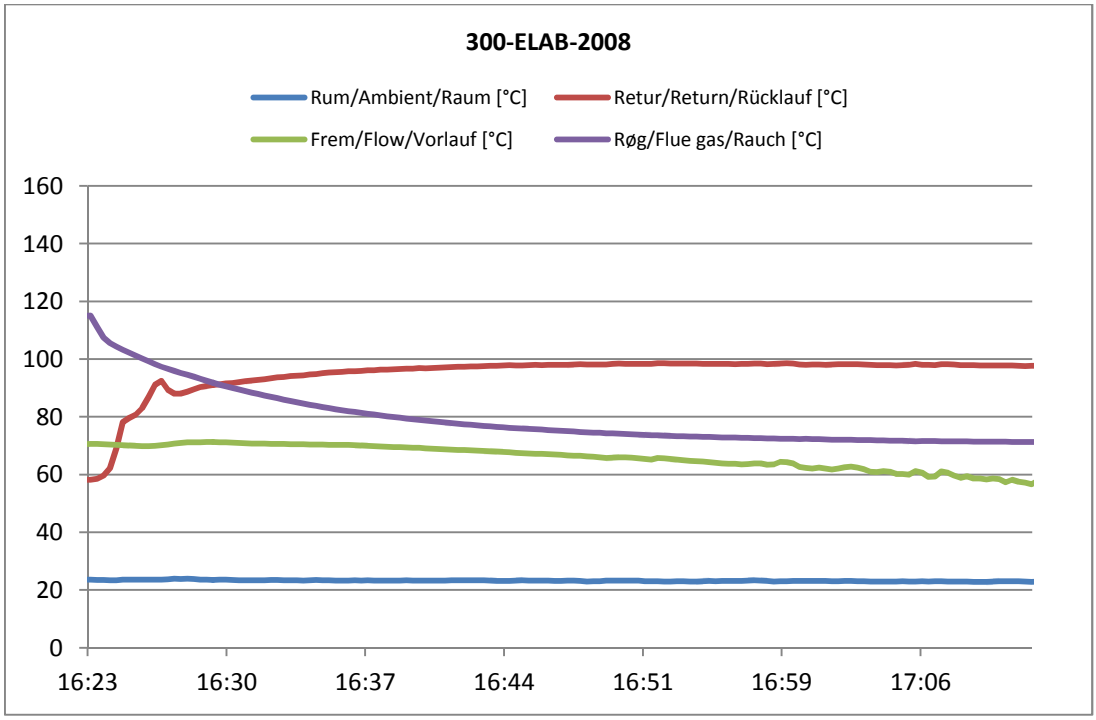
	Measured temperature	Allowed limit
Operating thermostat	89.4 °C	100 °C
Safety thermostat	97.7 °C	110 °C



Test of operating thermostat



Test of safety thermostat



Test of power failure

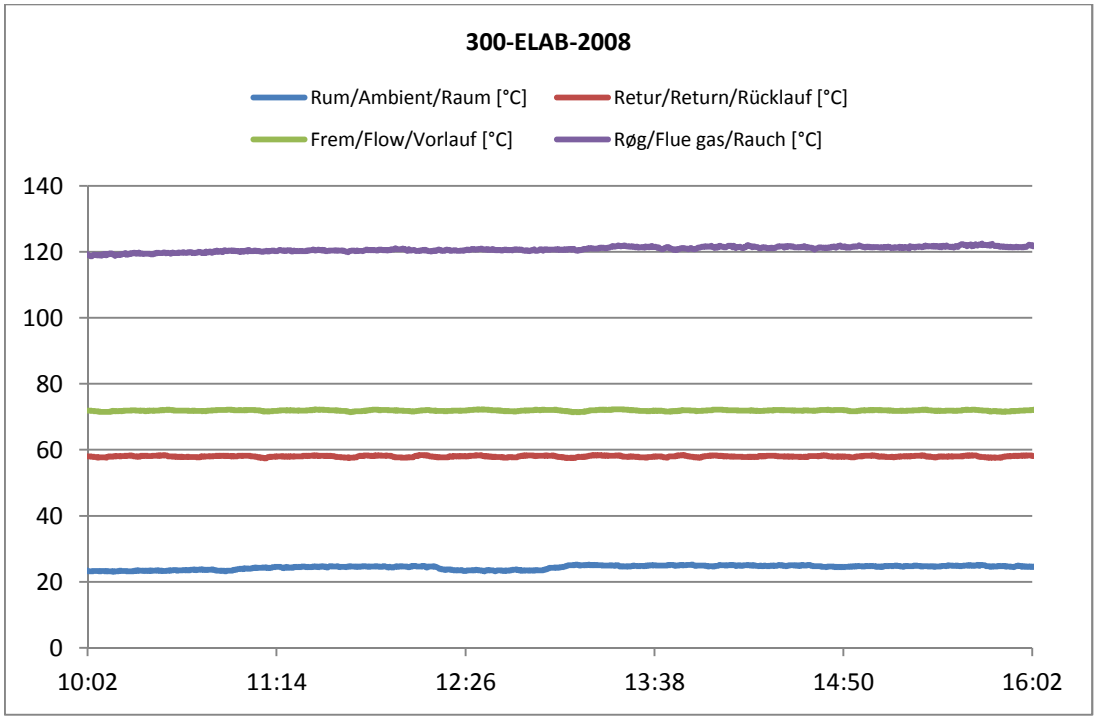
5.5 Pressure test of boiler shell

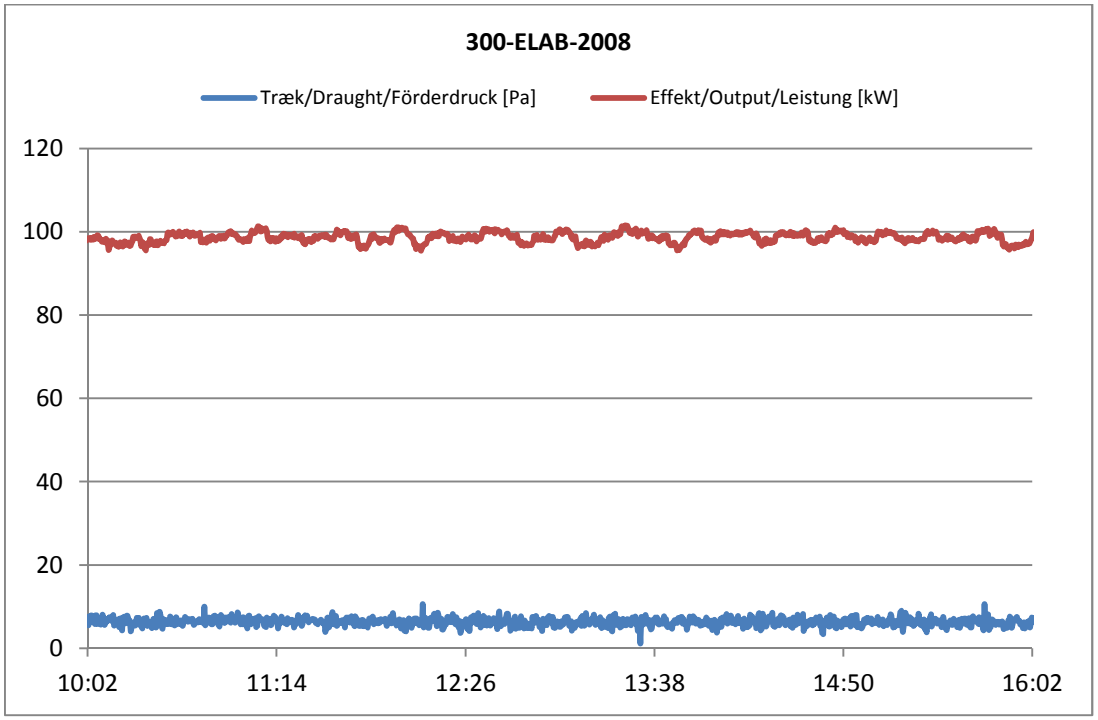
The necessary tests cf. DS/EN303-5 paragraph 5.4, are carried out by the manufacturer.

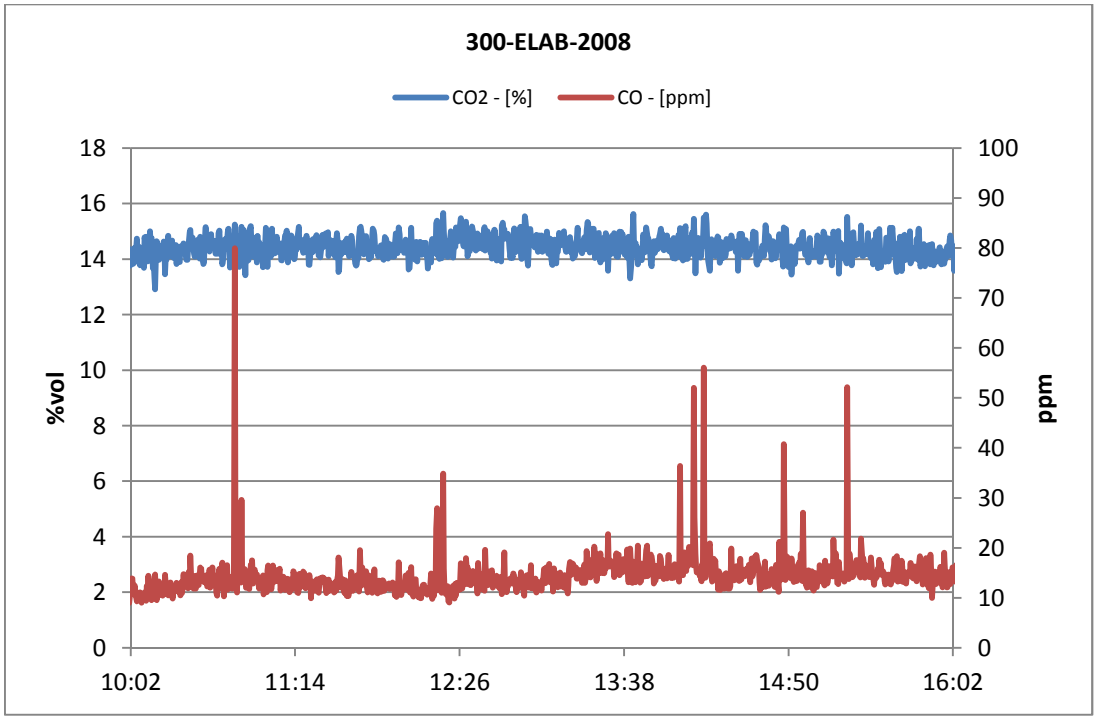
5.6 Test results at nominal output

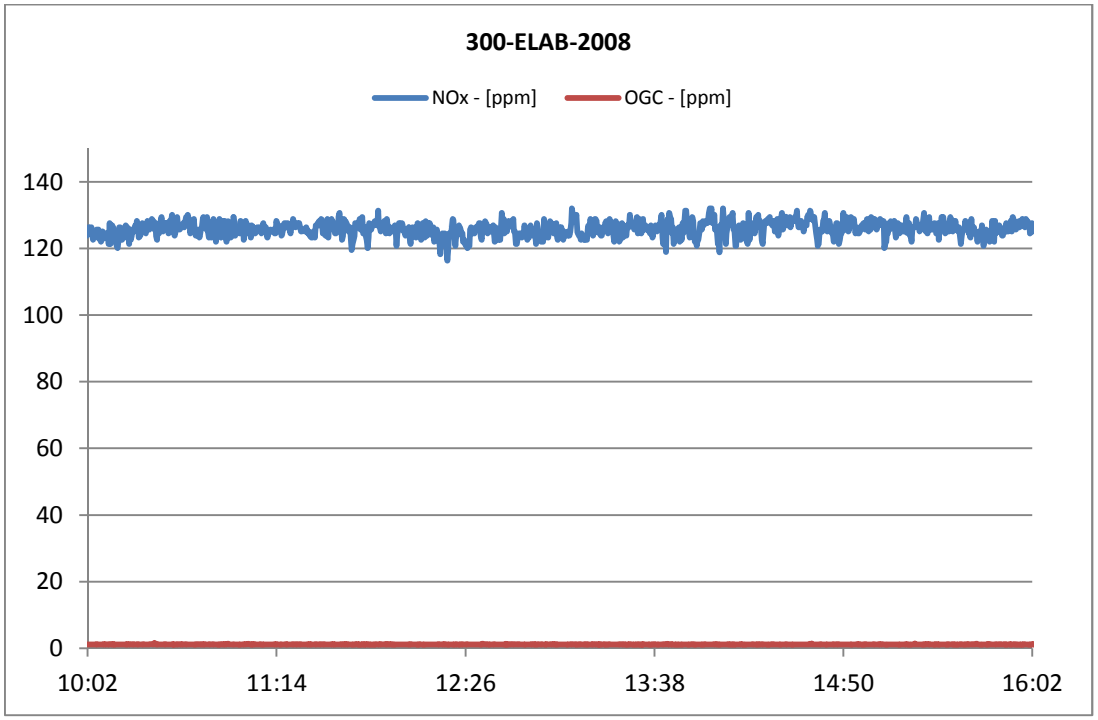
Measurement	Result	Demands
Return temperature	58.00 °C	
Flow temperature	71.90 °C	
Water flow	6.20 m^3/h	
Heat output	98.65 kW	
Test duration	6.00 h	
Power consumption	139.03 W	
Fuel consumption	20.77 kg/h	
Water content	4.1 %	
Calorific value	17939 J/g	
Heat input	103.47 kW	
Efficiency	95.3 %	89.0 (Class 5) 89.0 (Denmark) 87.7 (Austria)
Ambient temperature	24 °C	
Flue gas temperature	121 °C	
Chimney draught	6 Pa	40 (Max.)
Flue gas volume flow	208.4 m^3/h	
Flue gas mass flow	188.8 kg/h	
CO_2	14.4 $\%_{vol}$	
Dust measured	22 mg/m_n^3	
Dust at 10% O_2	16 mg/m_n^3	40 (Class 5)
Dust at 13% O_2	0.01 g/m_n^3	0.1/0.02* (Germany)
Dust emission	8 mg/MJ	40/20* (Austria)
CO measured	0.0014 $\%_{vol}$	
CO at 10% O_2	0.0010 $\%_{vol}$	
CO at 10% O_2	13 mg/m_n^3	500 (Class 5)
CO at 13% O_2	0.0095 g/m_n^3	0.5/0.4* (Germany)
CO at 13% O_2	9 mg/m_n^3	300 (Switzerland)
CO emission	6 mg/MJ	250 (Austria)
NO_x (NO_2) at 10% O_2	0.0092 $\%_{vol}$	
NO_x (NO_2) at 10% O_2	188 mg/m_n^3	
NO_x emission (NO_2)	89 mg/MJ	150/100* (Austria)
OGC (C_3H_8) at 10% O_2	<0.0004 $\%_{vol}$	
OGC (C) at 10% O_2	<6 mg/m_n^3	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 01.01.2015


300-ELAB-2008
Rum/Ambient/Raum [°C]
Retur/Return/Rücklauf [°C]
Frem/Flow/Vorlauf [°C]
Røg/Flue gas/Rauch [°C]
140
120
100
80
60
40
20
0
10:02
11:14
12:26
13:38
14:50
16:02


300-ELAB-2008
Træk/Draught/Förderdruck [Pa]
Effekt/Output/Leistung [kW]
120
100
80
60
40
20
0
10:02
11:14
12:26
13:38
14:50
16:02

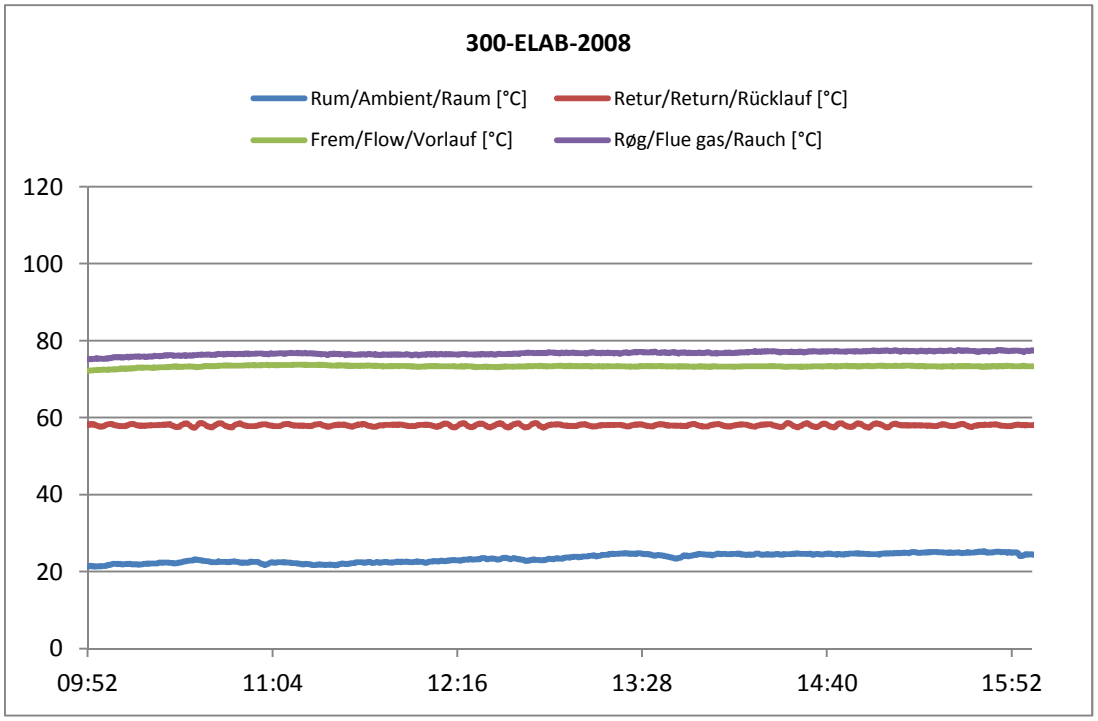

300-ELAB-2008
CO2 - [%]
CO - [ppm]
%vol
ppm
18
16
14
12
10
8
6
4
2
0
100
90
80
70
60
50
40
30
20
10
0
10:02
11:14
12:26
13:38
14:50
16:02

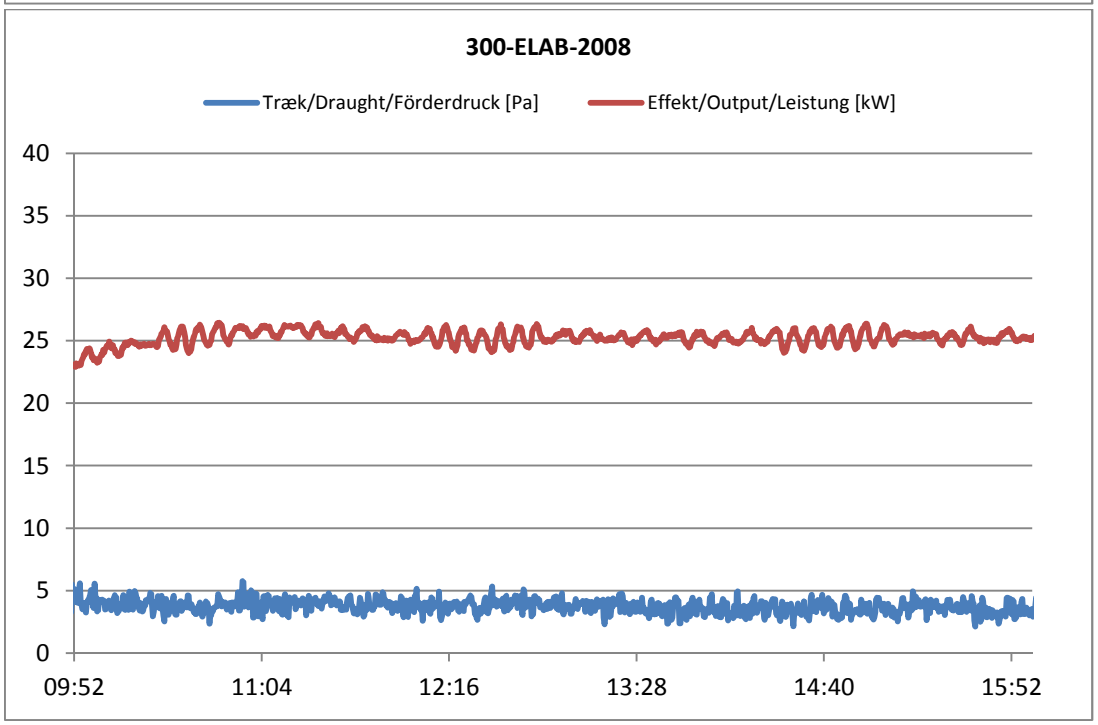

300-ELAB-2008
NOx - [ppm]
OGC - [ppm]
140
120
100
80
60
40
20
0
10:02
11:14
12:26
13:38
14:50
16:02

5.7 Test results at lowest output

Measurement	Result	Demands
Return temperature	58.00 °C	
Flow temperature	73.32 °C	
Water flow	1.44 m^3/h	
Heat output	25.26 kW	
Test duration	6.13 h	
Power consumption	59.85 W	
Fuel consumption	5.59 kg/h	
Water content	4.1 %	
Calorific value	17939 J/g	
Heat input	27.84 kW	
Efficiency	90.7 %	88.4 (Class 5) 88.4 (Denmark) 87.7 (Austria)
Ambient temperature	24 °C	
Flue gas temperature	77 °C	
Chimney draught	4 Pa	26 (Max.)
Flue gas volume flow	81.2 m^3/h	
Flue gas mass flow	82.3 kg/h	
CO_2	8.5 $\%_{vol}$	
Dust measured	17 mg/m_n^3	
Dust at 10% O_2	21 mg/m_n^3	40 (Class 5)
Dust at 13% O_2	0.02 g/m_n^3	0.1/0.02* (Germany)
Dust emission	10 mg/MJ	40/20* (Austria)
CO measured	0.0080 $\%_{vol}$	
CO at 10% O_2	0.0100 $\%_{vol}$	
CO at 10% O_2	125 mg/m_n^3	500 (Class 5)
CO at 13% O_2	0.0907 g/m_n^3	0.5/0.4* (Germany)
CO at 13% O_2	91 mg/m_n^3	300 (Switzerland)
CO emission	59 mg/MJ	250 (Austria)
NO_x (NO_2) at 10% O_2	0.0072 $\%_{vol}$	
NO_x (NO_2) at 10% O_2	147 mg/m_n^3	
NO_x emission (NO_2)	70 mg/MJ	150/100* (Austria)
OGC (C_3H_8) at 10% O_2	<0.0004 $\%_{vol}$	
OGC (C) at 10% O_2	<6 mg/m_n^3	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


300-ELAB-2008
Rum/Ambient/Raum [°C]
Retur/Return/Rücklauf [°C]
Frem/Flow/Vorlauf [°C]
Røg/Flue gas/Rauch [°C]
120
100
80
60
40
20
0
09:52
11:04
12:16
13:28
14:40
15:52


300-ELAB-2008
Træk/Draught/Förderdruck [Pa]
Effekt/Output/Leistung [kW]
40
35
30
25
20
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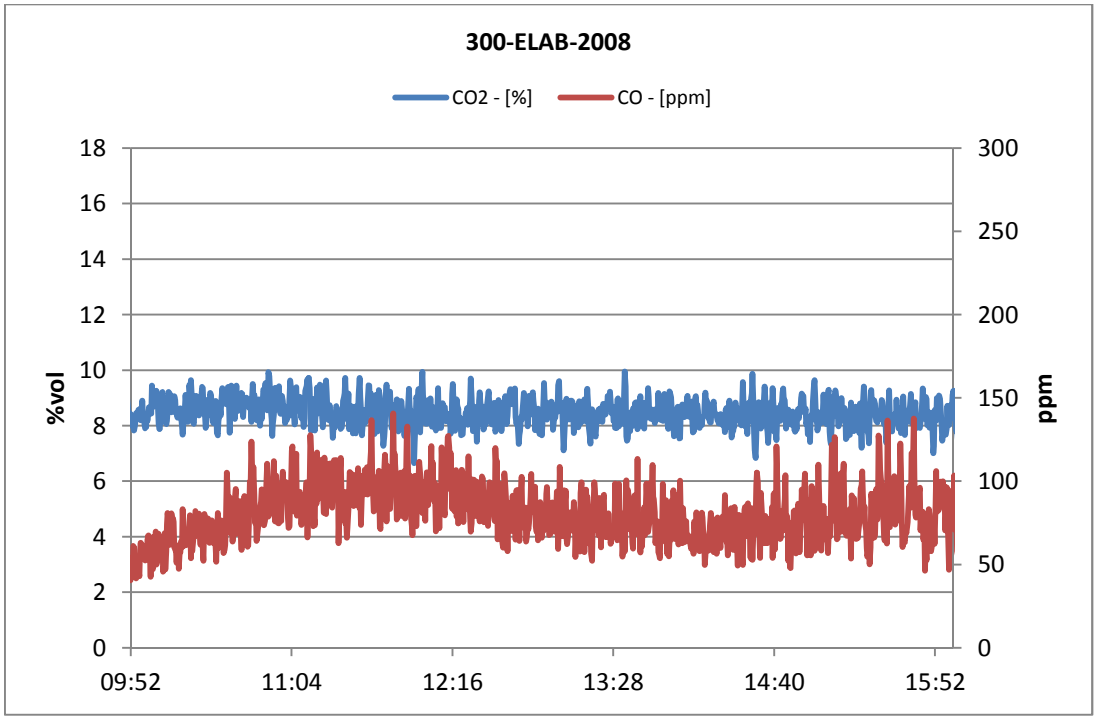
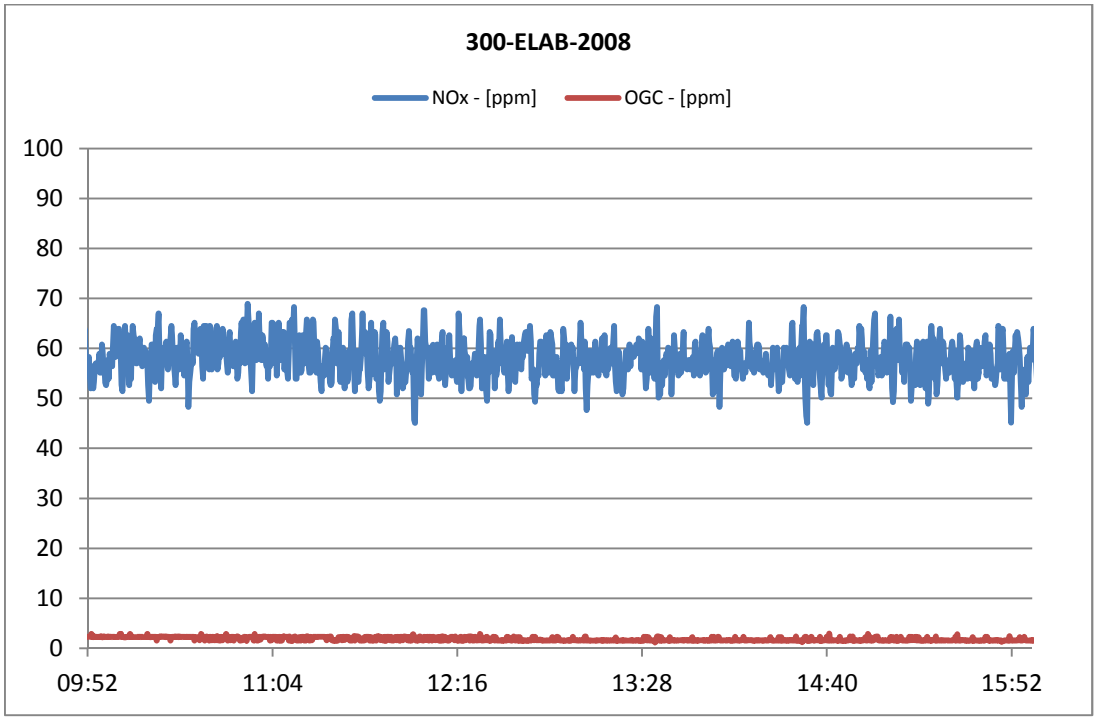
10
5
0
09:52
11:04
12:16
13:28
14:40
15:52


300-ELAB-2008
CO2 - [%]
CO - [ppm]
%vol
ppm
18
16
14
12
10
8
6
4
2
0
300
250
200
150
100
50
0
09:52
11:04
12:16
13:28
14:40
15:52


300-ELAB-2008
NOx - [ppm]
OGC - [ppm]
100
90
80
70
60
50
40
30
20
10
0
09:52
11:04
12:16
13:28
14:40
15:52