



TEST REPORT (Translation of original Danish report)

Info@teknologisk.dk
www.teknologisk.dk

Date: 2011.04.15

Report No.: 300-ELAB-1445

Page 1 of 12

Initials: LAKS/ABR/MART

Order No.: 411839

No. of appendices: 4

Requested by: Contact person: Jan Pihl
Company: VVS-Eksperten A/S www.vvs-eksperten.dk
Address: Svendborgvej 253 B
Postcode/town: DK-5260 Odense S
Phone: +45 75 89 03 03 E-mail: jan@vvs-eksperten.dk

Product: Automatic biofuel boiler
Manufacturer: VVS-Eksperten A/S Type: Orligno 400, 30 (pellet burner and boiler)
Nominal output: 30 kW Fuel: Wood pellets

Deadlines: Date of receipt: 2010.10.22
Date of testing: 2010.11.22 – 2010.12.2


Procedure: Testing of biofuel boiler according to DS/EN 303-5, April 1999.

Result: Requirements according to DS/EN 303-5 Class 3 were met.

Remarks: See remarks on page 2. This is a translation of the Danish test report dated 2011.02.04. In case of doubt, the Danish version of the test report prevails.

Terms: Accredited testing was carried out in compliance with the current guidelines laid down by DANAK (Danish Laboratory Accreditation Scheme), please see www.danak.dk and in compliance with DTI's General Terms and Conditions Regarding Commissioned Work Accepted by the Danish Technological Institute (DTI), February 2009. 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.

Origin: Danish Technological Institute, Energy Laboratory

Signature: 
Anette S. Brønnum
M.Sc.



Appendices:

- a) Drawings of the biofuel unit: 75011 rev. A, 75012 rev. A (both dated 2010.12.17), 75013 (2010.12.22), 75013 pos.1, 75013 pos. 5 (both dated 2010.07.27)
- b) Photos of the biofuel unit: 37 pcs.
- c) User's instructions, installation manual and technical information are assembled in one, approved with remarks 2011.01.05.
- d) Data plate.

The appendices are kept separately.

1 Remarks

According to BTV 32 the power supply for air fan and pellet burner shall be disconnected automatically when the pellet burner is loosened from the boiler. This is not relevant for the tested biofuel boiler. The manufacturer has informed that it will be relevant for the sold biofuel boilers.

The forwarded technical information and user's instructions have been elaborated for a smaller version of a similar boiler (Orligno 400, 16). The manufacturer has informed that the technical data etc. will be updated for Orligno 400, 30.

2 Description of the biofuel unit

The biofuel unit is an automatically fired boiler unit with external fuel supply consisting of a pellet burner with a boiler. The unit is not intended for firing with firewood. The pellet burner consists of a burner bowl, combustion air fan and electronic control box marked VVS-Eksperten Stokerstyring 9002. The fuel is conveyed by means of an inclined auger and drop chute down into a burner bowl, where the combustion takes place during supply of combustion air. The boiler is a welded steel plate boiler with a convection unit consisting of 16 vertical boiler tubes. Each boiler tube is mounted with removable flue gas baffle plates.

The biofuel unit is mounted with a modulating controller which continuously conform the fuel and air supply to the desired output. The unit has electric ignition and is without oxygen control. The unit is provided with thermo switch placed after the drop chute behind the hearth.





Settings on unit during testing (Danish text on display translated into English):

Temperature controller (nominal/partial load):	80/72 °C
Settings/Flue gas temperature max.:	340 °C
Settings / Flue gas temperature min.:	55 °C
Settings /Fuel:	5,35
Settings /Start Fuel:	25
Settings /Pause Fuel:	7 s
Settings /Pause Air:	5 %
Settings /Clean Fan Time:	5 s
Settings /Clean Fan Int.:	60 m
Installer Settings/Flue gas start temp:	3 °C
Installer Settings/Fuel min.:	15 %
Installer Settings/Auger max.:	25 %
Installer Settings/Air min.:	2 %
Installer Settings/Air max.:	74 %
Installer Settings/Air reduce:	7 %
Installer Settings/Start heat time:	15 m
Installer Settings/Start heat eff.:	100 %
Installer Settings/Start air:	8 %
Installer Settings/Reg. ramp time:	20 s

Main dimensions, total unit:

Depth:	Approx. 800 mm
Height:	Approx. 1200 mm
Width:	Approx. 600 mm

Feeding system:

Type:	Inclined auger and drop chute
Fuel auger drive motor (el):	IY GUAN MOTOR, YN80-25, 25W, 0,35A

Burner:

Type:	Quadratic, deep burner bowl
Width:	Approx. 160 mm
Depth:	Approx. 340 mm
Air fan:	ECOFIT 2GREAS 108x52R

Boiler:

Type:	Welded steel plate boiler
Height:	1196 mm
Width:	599 mm
Depth:	550 mm
Boiler door (cleaning opening):	Crescent, d=530 mm og h=180 mm
Flue gas tube:	ø152 mm
Flow connection:	1"
Return connection:	1"
Fire extinguishing equipment:	Drop chute and thermo switch



3 Test Equipment

Test rig and equipment are constructed in accordance with EN 303-5 and EN 304.

Rack A1			
Instrument	Type	Traceability	No.
Data acquisition unit	HP 34970A	DANAK 200	270-A-2435
Pc	Dell	-	-
CO analyzer	Sick Maihak Sidor	-	270-A-2429
CO/CO ₂ analyzer	Sick Maihak Sidor	-	270-A-2431
FID analyzer	Sick Maihak EuroFID		270-A-2433
NO analyzer	H&B Radas 2	-	270-A-1502
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

Test rig 2			
Instrument	Type	Traceability	No.
Water flow meter	0-3.2 m ³ /h	DANAK 200	270-A-1511
Water temperature sensor	Pt100 (flow)	DANAK 200	270-A-2285
Water temperature sensor	Pt100 (return)	DANAK 200	270-A-2286
Gas meter	IGA AC-5M	DANAK 207	270-A-1475

Other equipment			
Instrument	Type	Traceability	No.
Adiabatic calorimeter	-	IVC, Kemi	-
Spangas, C ₃ H 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 acquisition software	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 meter	ELAB	-	270-A-1759
Scale (dust)	Mettler PL 303	ELAB	270-A-2427
Scale (humidity)	Mettler PC 440	ELAB	270-A-947
Scale (fuel)	Sauter 60 kg	ELAB	270-A-484
Scale (magasin)	Mettler IND 560	ELAB	270-A-1990



4 Requirements on construction, etc.

	Reference para- graph in EN303-5	Requirement met
4.1 General requirements		
Safety during normal use	4.1.1	Yes
4.2 Requirements on documentation		
Drawings	4.1.2.1	Yes
Quality manual	4.1.2.2	Yes
Data plate	7.1-7.2	Yes ¹
Technical information	8.1	Yes ²
User's instructions	8.2	Yes
4.3 Requirements on welded steel plate boiler		
Execution of welding work	4.1.3.1	*
Welding seams and fillers	4.1.3.2	*
Parts of steel subject to pressure	4.1.3.3	*
Minimum wall thickness and tolerances	4.1.3.4	*
4.4 Requirements on safety and design		
Venting, etc.	4.1.5.1	Yes
Cleaning of heating surfaces	4.1.5.2	Yes
Inspection of the flame	4.1.5.3	Yes
Water tightness	4.1.5.4	Yes
Replacement and spare parts	4.1.5.5	Yes
Water side connections	4.1.5.6	Yes
Thermostat pockets	4.1.5.7	Yes
Thermal insulation	4.1.5.8	Yes
Leakages in flue gas system	4.1.5.10	Yes
Temperature control for open vented systems	4.1.5.11.1	Yes
Temperature control for closed vented systems	4.1.5.11.2	Yes ³
Storage hopper	4.1.5.12	Yes
Ash chamber	4.1.5.13	Yes
Safety during automatic fuel supply	4.1.5.14.2	Yes
Accessories/fittings	4.1.5.15	Yes
Electric safety	4.1.5.16	*

¹ Draft for data plate without values are shown

² The forwarded technical information and user's instructions have been elaborated for a smaller version of a similar boiler (Orligno 400, 16).

³ Only valid during automatic firing.

* Not included by this report. Please refer to the manufacturer's EU declaration of conformity.



5 Test Results

5.1 Water side resistance

Equivalent temperature difference at nominal output	Water flow	Drop of pressure
20 K	2.6 m ³ /h	13 mbar
10 K	1.3 m ³ /h	4 mbar

5.2 Leakage Test

Since the boiler operates with a negative pressure in the combustion chamber, there are no requirements on leakage flow.

5.3 Surface Temperatures

	Measured temperature	Allowed limit
Boiler doors, etc., average of 5 measurements	29 °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	36 °C	+ 60 K
Boiler's average surface temperature		
Average of 10 spot measurements	31 °C	-
Ambient temperature	24 °C	-

5.4 Functions Check

The biofuel boiler is rapidly disconnectable, DS/EN303-5 paragraph 4.1.5.11.2 a), and therefore the safety equipment includes a temperature controller and a safety thermostat with manual reset device. The boiler's thermostats are tested in accordance with DS/EN303-5 paragraph 5.13.

	Measured temperature	Allowed limit
Temperature controller	95 °C	100 °C
Safety thermostat	100 °C	110 °C

5.5 Pressure Test of Boiler Shell

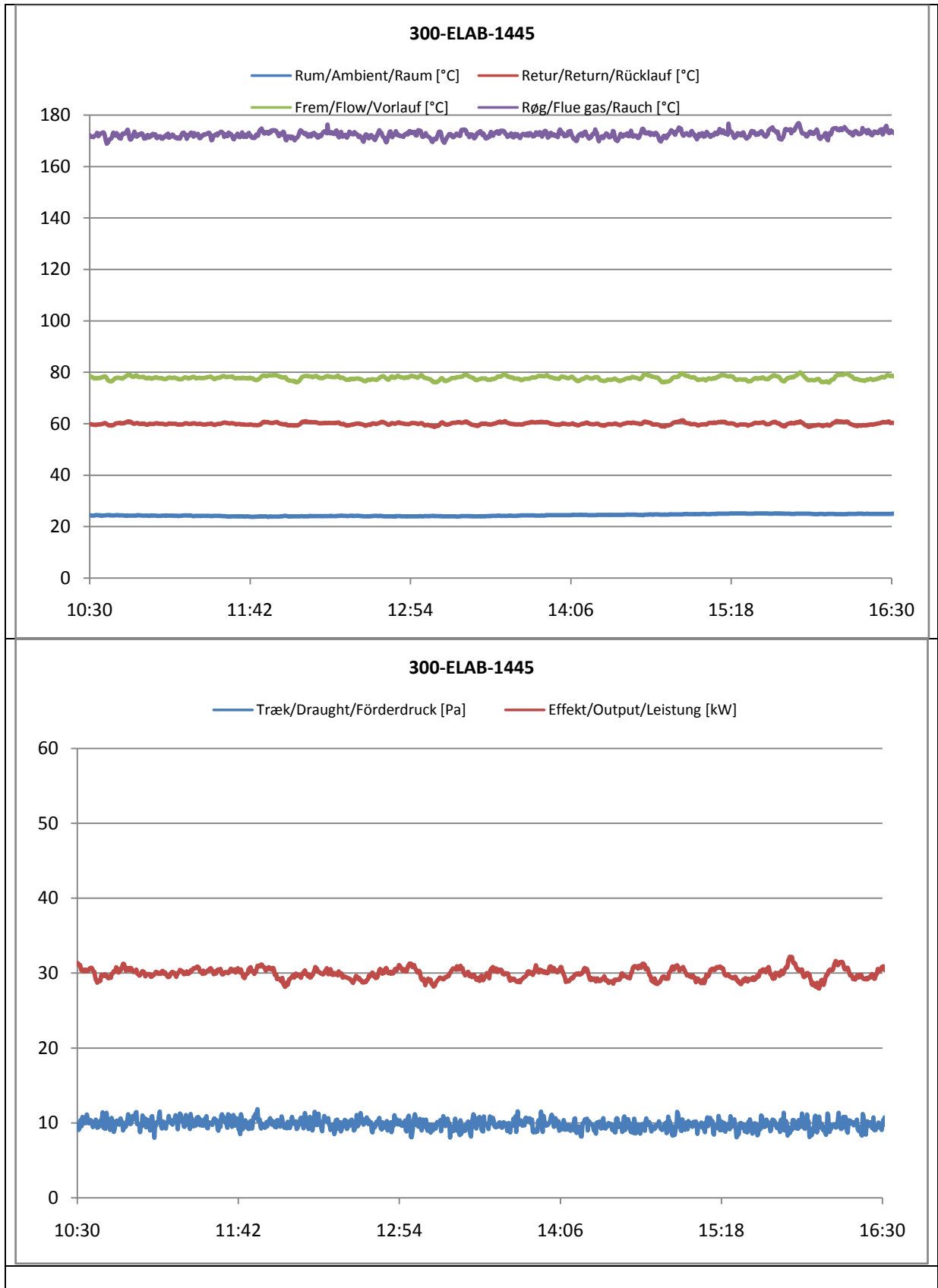
The necessary tests cf. DS/EN303-5 paragraph 5.4, are carried out by the manufacturer.

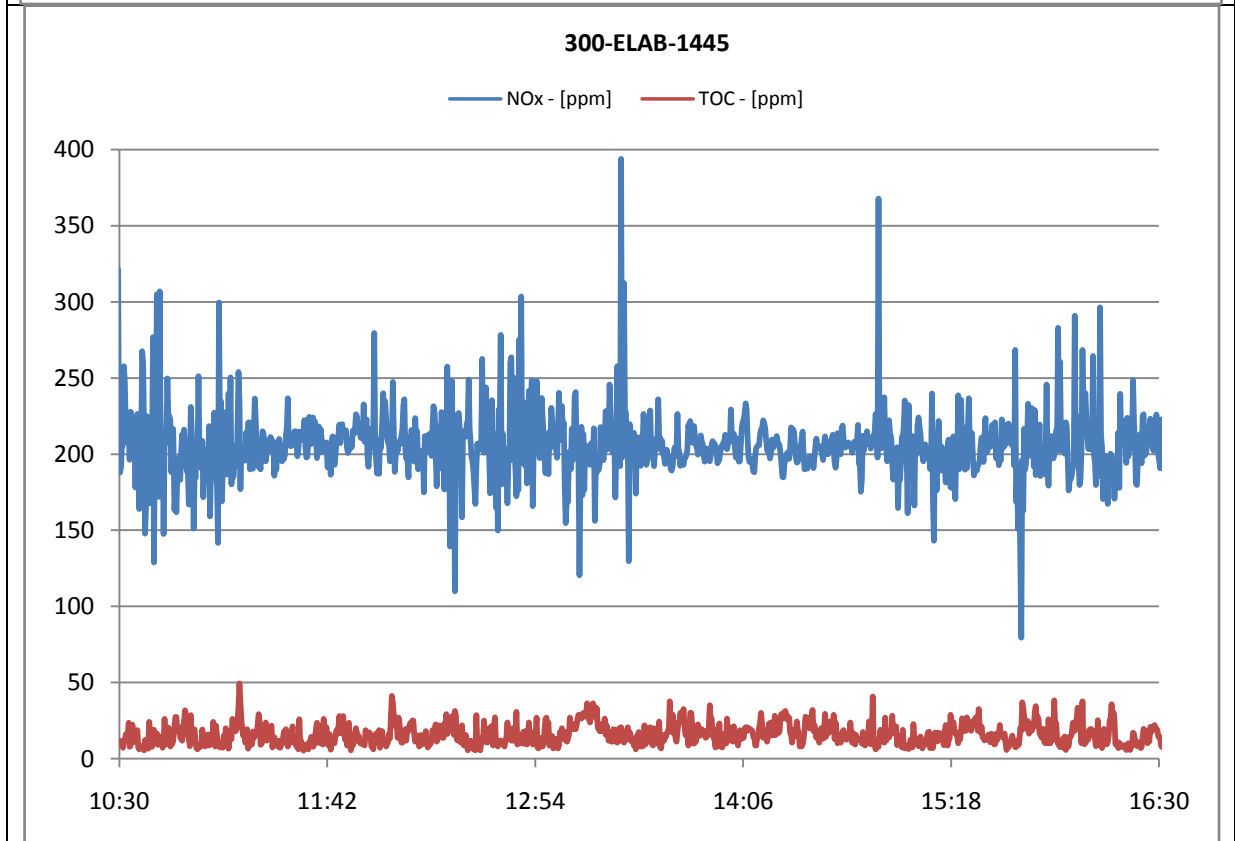
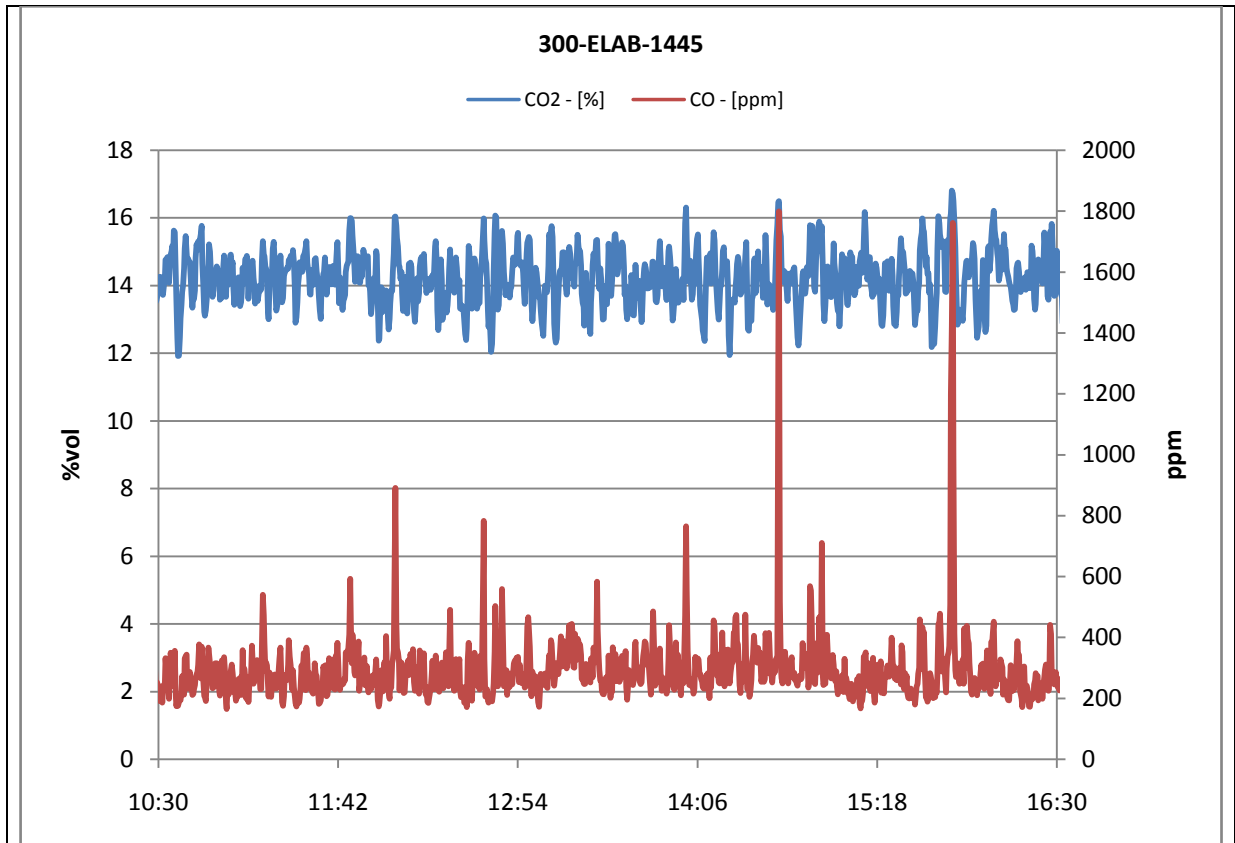


5.6 Test Results at Nominal Output

Measurement	Result	Requirement
Return temperature	59.98 °C	
Flow temperature	77.76 °C	
Water flow	1.47 m ³ /h	
Heat output	29.90 kW	
Test duration	6.00 h	
Fuel consumption	6.72 kg/h	
Water content	6.3 %	
Calorific value	17442 J/g	
Heat input	32.56 kW	
Efficiency	91.8 %	76 (Class 3) 76 (Denmark) 80 (Austria)
Ambient temperature	24 °C	
Flue gas temperature	173 °C	
Chimney draught	10 Pa	30 (Max.)
Flue gas volume flow	75.2 m ³ /h	
Flue gas mass flow	60.1 kg/h	
CO ₂	14.2 % _{vol}	
Dust measured	70 mg/m _n ³	
Dust at 10% O ₂	53 mg/m _n ³	150 (Class 3)
Dust at 13% O ₂	0.04 g/m _n ³	0,15 (Germany)
Dust emission	25 mg/MJ	60 (Austria)
CO measured	0.0292 % _{vol}	
CO at 10% O ₂	0.0218 % _{vol}	
CO at 10% O ₂	273 mg/m _n ³	3000 (Class 3)
CO at 13% O ₂	0.1985 g/m _n ³	4 (Germany)
CO at 13% O ₂	198 mg/m _n ³	4000 (Switzerland)
CO emission	128 mg/MJ	500 (Austria)
NO _x (NO ₂) at 10% O ₂	0.0154 % _{vol}	
NO _x (NO ₂) at 10% O ₂	316 mg/m _n ³	
NO _x emission (NO ₂)	148 mg/MJ	150 (Austria)
OGC (C ₃ H ₈) at 10% O ₂	0.0013 % _{vol}	
OGC (C) at 10% O ₂	21 mg/m _n ³	100 (Class 3)
OGC emission (C)	10 mg/MJ	40 (Austria)

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







5.7 Test Results at Lowest Output

Measurement	Result	Requirement
Return temperature	60.00 °C	
Flow temperature	76.65 °C	
Water flow	0.41 m ³ /h	
Heat output	7.88 kW	
Test duration	6.00 h	
Fuel consumption	1.75 kg/h	
Water content	6.2 %	
Calorific value	17450 J/g	
Heat input	8.47 kW	
Efficiency	93.0 %	- (Class 3) - (Denmark) 80 (Austria)
Ambient temperature	24 °C	
Flue gas temperature	84 °C	
Chimney draught	5 Pa	30 (Max.)
Flue gas volume flow	19.7 m ³ /h	
Flue gas mass flow	19.6 kg/h	
CO ₂	11.0 % _{vol}	
Dust measured	- mg/m _n ³	
Dust at 10% O ₂	- mg/m _n ³	(Class 3)
Dust at 13% O ₂	- g/m _n ³	(Germany)
Dust emission	- mg/MJ	(Austria)
CO measured	0.0305 % _{vol}	
CO at 10% O ₂	0.0294 % _{vol}	
CO at 10% O ₂	367 mg/m _n ³	3000 (Class 3)
CO at 13% O ₂	0.2672 g/m _n ³	4 (Germany)
CO at 13% O ₂	267 mg/m _n ³	4000 (Switzerland)
CO emission	172 mg/MJ	750 (Austria)
NO _x (NO ₂) at 10% O ₂	0.0130 % _{vol}	
NO _x (NO ₂) at 10% O ₂	266 mg/m _n ³	
NO _x emission (NO ₂)	125 mg/MJ	150 (Austria)
OGC (C ₃ H ₈) at 10% O ₂	0.0005 % _{vol}	
OGC (C) at 10% O ₂	8 mg/m _n ³	100 (Class 3)
OGC emission (C)	4 mg/MJ	40 (Austria)

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

