

TEST REPORT (Translation of original Danish report)

Date: 2005.12.15

Report No.: 300-ELAB-1040

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Initials: KWI/MART

Project number: 1250396-06

Number of appendices: 4

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Product: Automatic biofuel boiler
Manufacturer: Nordjysk bioenergi Type: Biocomfort / Woody Stoker Sæt
Nominal output: 14.9 kW Test fuel: Wood pellets 6 mm

Deadlines: Date of receipt: 2005.08.23
Date of testing: 2005.09.07 - 2005.09.08

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

Result: Requirements in accordance with DS/EN 303-5 Class 3 were met.

Remarks: None. This is a translation of the Danish test report dated 2005.12.12. In case of doubt, the Danish version of the test report prevails.

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), August 1999. 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: Technological Institute, Energy laboratory

Date:

Signature: Kim Winther
M.Sc.

Appendices belonging to this report:

- a) Drawings of the boiler: Version 16-06-2005
- b) Photos of the boiler: 36 pieces
- c) Installation and operation instructions: Version 16-06-2005
- d) Technical information and data plate: Version 16-06-2005.

The appendices are being kept separately.

1 Remarks

None.

2 Description of the boiler

Biocomfort / Woody Stoker Sæt is an automatically fired boiler for stoking with wood pellets. The fuel is being transported via an inclined pellet burner auger from the external fuel hopper to the burner where the combustion takes place during induction of primary and secondary air.

The control system of the boiler is based on a 10 step adaptive oxygen device. Continuous control of e.g. fuel consumption and output is carried out. The boiler has automatic ignition.

The boiler is a welded steel sheet boiler with a convection part consisting of 3 rectangular tubes with removable flue gas baffle plates.

The boiler is provided with drop chute and thermo switch to prevent back-burning in the fuel storage container.



Settings during testing:

Operating method:Automatic
Boiler thermostat (nominal): 80°C
Boiler thermostat (partial load): 80°C
Setpoint for O₂ (nominal): 8%
Setpoint for O₂ (partial load): 13.5%

Main dimensions, outer boiler:

Length: 700 mm
Height: 1050 mm
Width: 700 mm

Feeding system:

Type:Rotating auger, external magasin
Fuel motor drive auger (el):LINIX 10W 1250 rpm.
Fuel feed duct: ø75 mm

Burner:

Type: Air-cooled duct burner
Internal measurement: 120 x 120 mm
Burner tube, length: 200 mm
Fan: 230 V, 32 W
Ignition plug: 230 V, 300 W
Primary air: 35 pieces ø4 mm
Secondary air: 22 pieces ø4 mm

Boiler:

Type: Welded steel sheet boiler
Height: 865 mm
Width: 400 mm
Length: 620 mm
Water content: 26 l
Boiler door (opening): 183 x 307 mm
Cleaning door (opening): 223 x 310 mm
Flue spigot: ø130 mm
Water side connection, flow: 1¼"
Water side connection, return: 1¼"
Charge: ½"

Safety equipment:

Boiler thermostat, type: Electronic
Safety thermostat, type: DIN STB-83199 IMIT LSI 90/110°C
Safety heat exchanger, type: None
Fire extinguishing equipment: None

3 Test equipment

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

Rack 3			
Instrument	Type	Traceability	No.
Data acquisition unit	HP 34970A	DANAK 200	270-A-1509
Pc	Amitech Pentium	-	-
CO/CO ₂ /O ₂ meter	H & B Uras 14	-	270-A-1501
Pressure gauge	Autotran 700	ELAB	270-A-1578
Heating hose	Winkler	-	270-A-1495
Probe	M & C	-	270-A-1479
Flue gas temperature sensor	Type K	ELAB	270-A-1528
Ambient temperature sensor	Type K	ELAB	270-A-1527

Test rig 3			
Instrument	Type	Traceability	No.
Water flow meter	0-2.6 m ³ /h	DANAK 200	270-A-1991
Water temperature sensor	Pt100 (inlet)	DANAK 200	270-A-1492
Water temperature sensor	Pt100 (return)	DANAK 200	270-A-1491
Gas meter	IGA AC-5M	IGA	270-A-1474

Other equipment			
Instrument	Type	Traceability	No.
NO meter	H&B Radas 2	-	270-A-1502
Converter	H&B CGO-K	-	270-A-1503
FID analyser	M&A Thermo-Fid	-	270-A-1751
Heating hose	Winkler	-	270-A-1753
Probe	M & C	-	270-A-1752
Adiabatic calorimeter	-	IVC, Kemi	-
Span gas, CH ₄	Alpha-gaz	Hede Nielsen	270-A-1729-1
Span gas, CO/CO ₂	Alpha-gaz	Hede Nielsen	270-A-1727-3
Span gas, NO/SO ₂	Alpha-gaz	Hede Nielsen	270-A-1725-1
Zero gas, N ₂	Alpha-gaz	Hede Nielsen	270-A-1731-1
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	ELAB	-	270-A-1759
Balance (dust)	Mettler PC 440	ELAB	270-A-947
Balance (humidity)	Mettler PJ6	ELAB	270-A-997
Balance (boiler)	Sauter E/40-E2100	ELAB	270-A-0551
Balance (fuel)	Sauter 60 kg	ELAB	270-A-484

4 Requirements for construction etc.

	Reference paragraph in EN303-5	Requirements met
4.1 General requirements		
Safety at normal use	4.1.1	Yes
4.2 Requirement for documentation		
Drawings	4.1.2.1	Yes
Quality manual	4.1.2.2	Yes
Data plate	7.1-7.2	Yes
Technical information	8.1	Yes
Users instructions	8.2	Yes
4.3 Requirements for welded steel sheet boilers		
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 Safety and design requirements		
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
Storage hopper	4.1.5.12	Yes
Ash chamber	4.1.5.13	Yes
Safety at automatic stoking	4.1.5.14.2	Yes
Accessories/Fittings	4.1.5.15	Yes
Electrical safety	4.1.5.16	*

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

5 Test results

5.1 Water drag

Equivalent temperature difference at nominal output	Water flow	Drop of pressure
20 K	0.64 m ³ /h	0.7 mbar
10 K	1.28 m ³ /h	2.6 mbar

5.2 Leakage test

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

5.3 Surface temperatures

	Measured temperature	Tolerated limit
Boiler doors etc., average of 5 measurements	33 °C	+ 100 K
Boiler's underside, average of 5 measurements	<65 °C	+ 65 K
Handles that are 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	35 °C	-
Ambient temperature	26 °C	-

5.4 Function check

The firing system 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 were tested in accordance with DS/EN303-5 paragraph 5.13.

	Measured temperature	Tolerated limit
Temperature controller	88 °C	100 °C
Safety thermostat	96 °C	110 °C

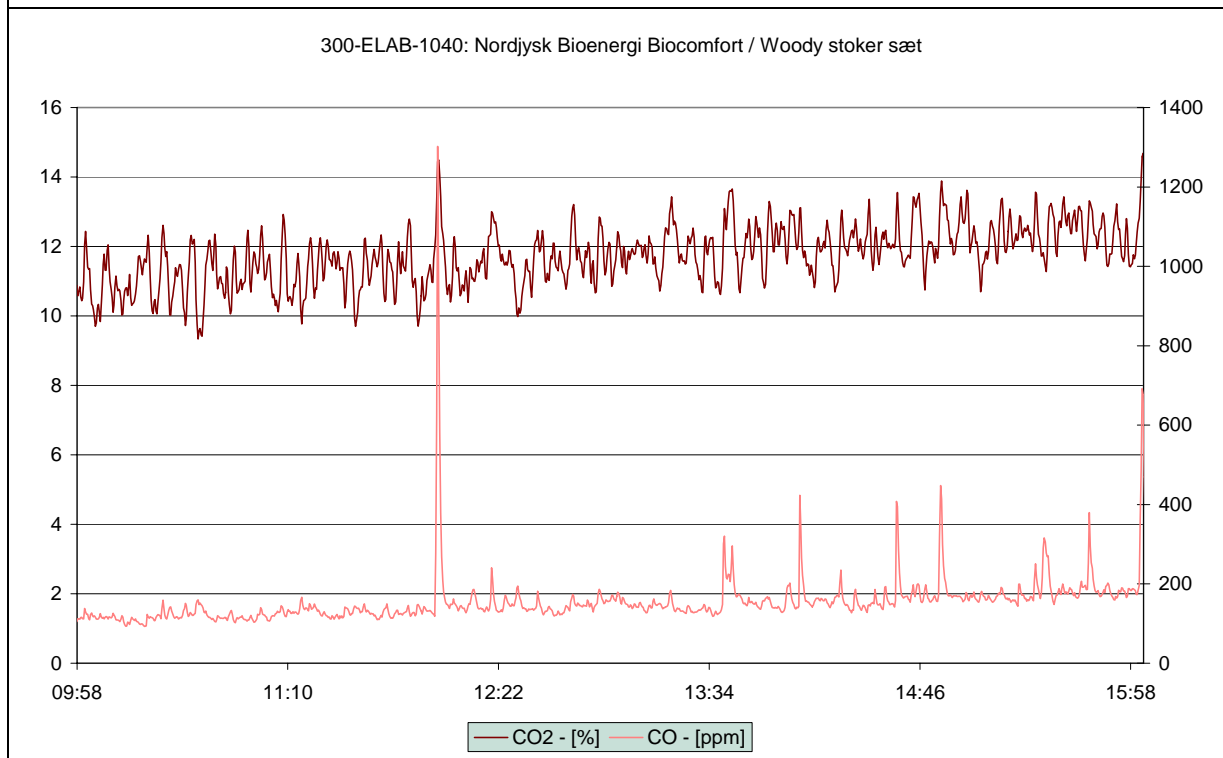
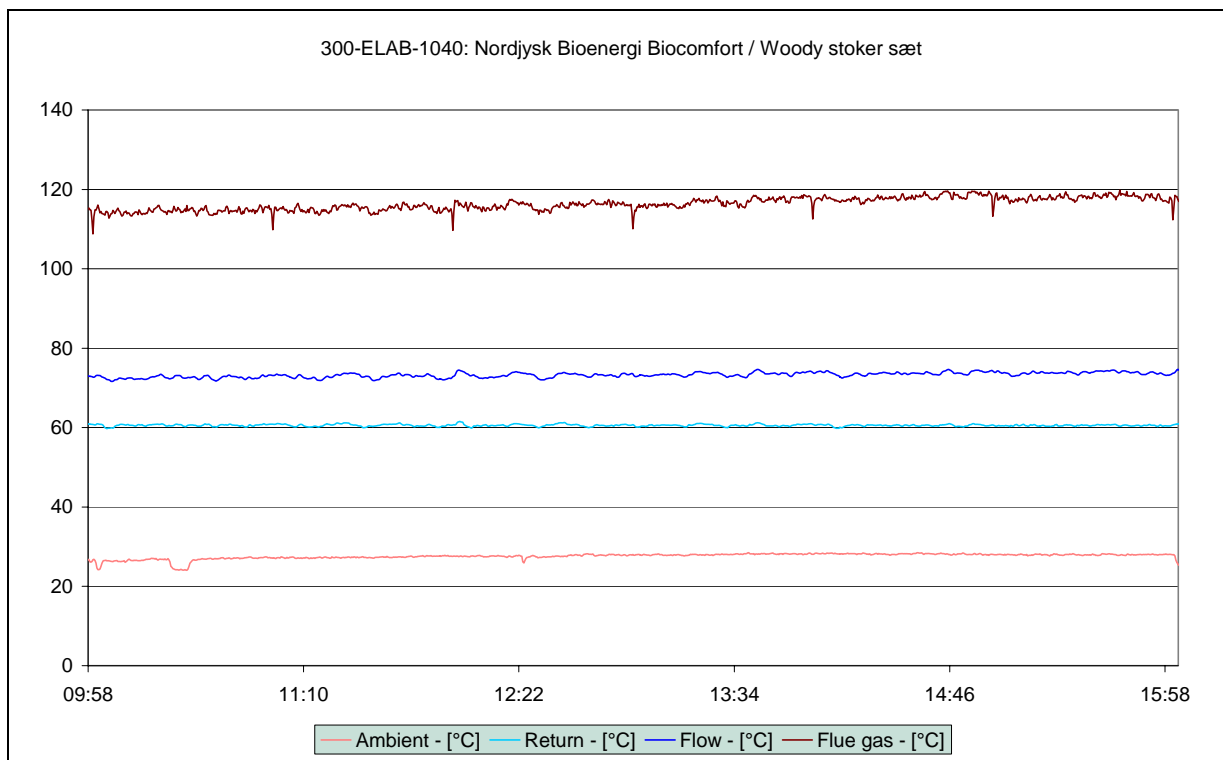
5.5 Pressure test of boiler shell

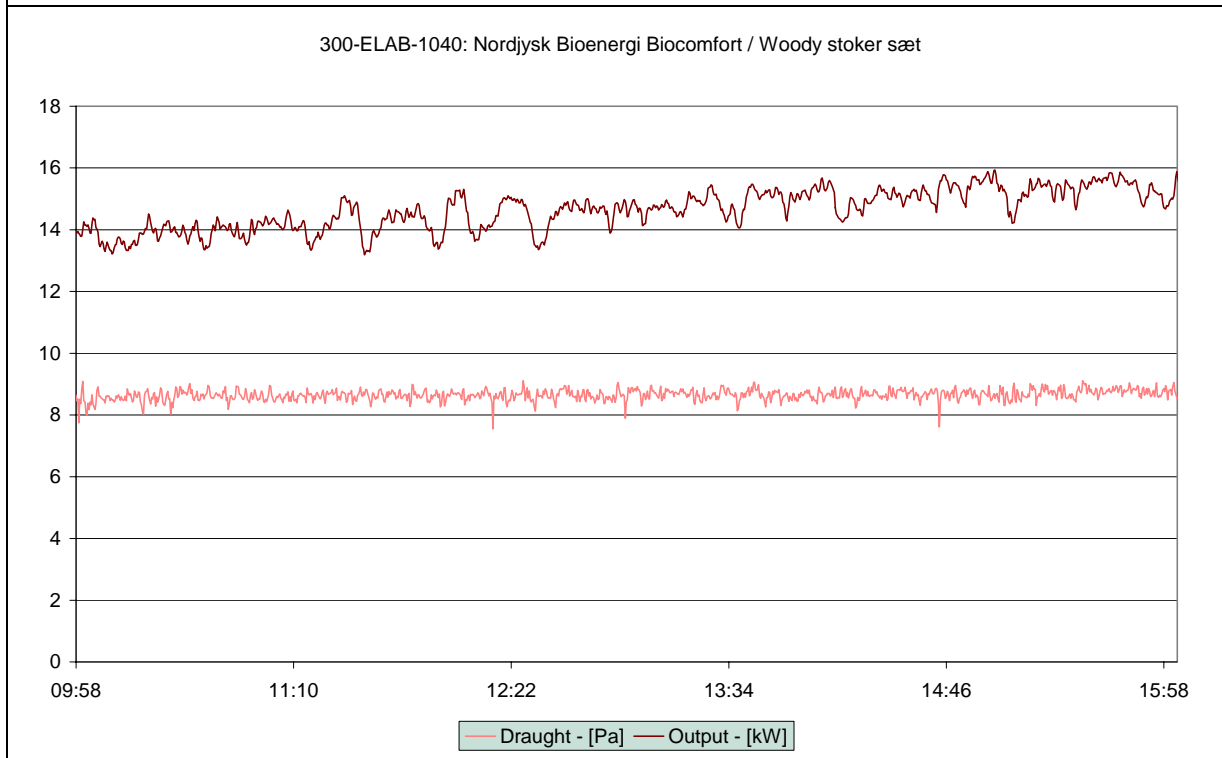
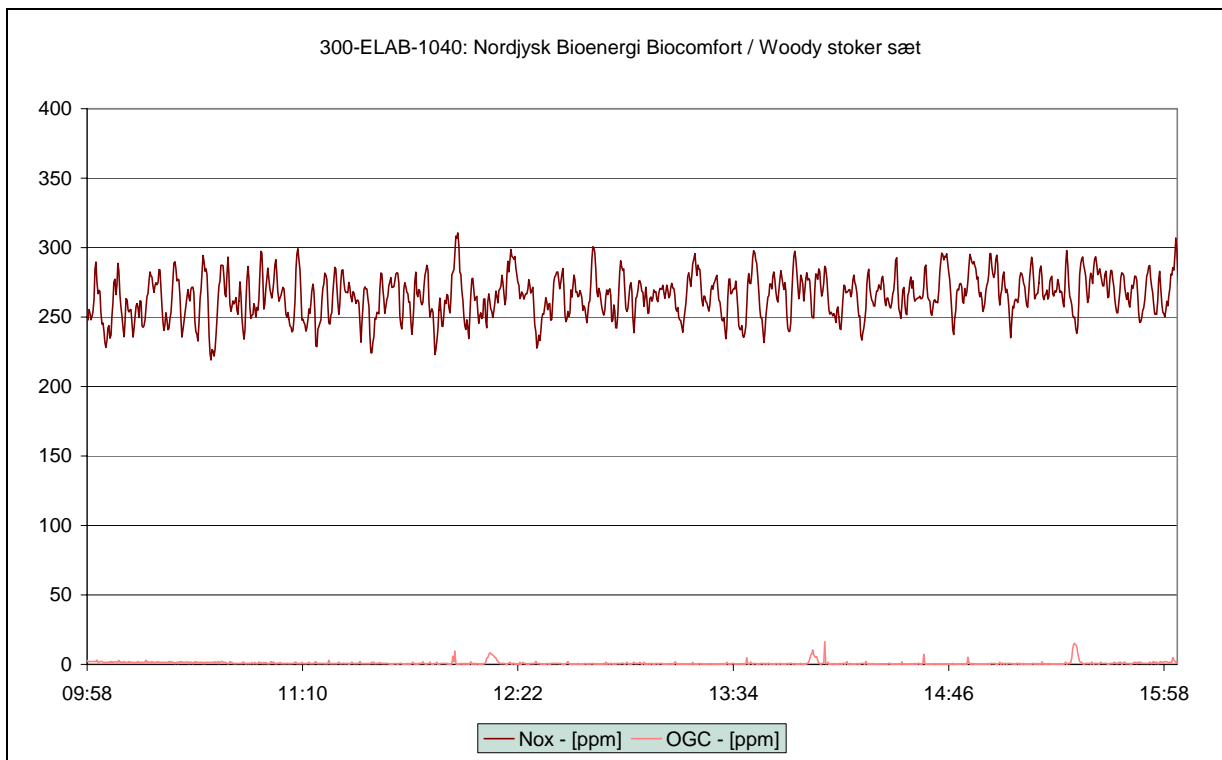
The necessary tests cf. DS/EN303-5 paragraph 5.4 will be carried out by the manufacturer.

5.6 Test results at nominal output

Measurement	Result	Requirement
Return temperature	60.57 °C	
Flow temperature	73.27 °C	
Water flow	1.01 m ³ /h	
Heat output	14.64 kW	
Duration	6.07 h	
Fuel consumption	3.28 kg/h	
Water content	5.4 %	
Calorific value	17230 J/g	
Heat input	15.68 kW	
Efficiency	93.3 %	74 (Class 3) 77 (Austria)
Ambient temperature	28 °C	
Flue gas temperature	116 °C	
Chimney draught	9 Pa	23 (Max.)
Flue gas volume flow	38.7 m ³ /h	
Flue gas mass flow	35.3 kg/h	
CO ₂	11.7 % _{vol}	
Dust measured	22 mg/m _n ³	
Dust at 10% O ₂	20 mg/m _n ³	150 (Class 3)
Dust at 13% O ₂	0.01 g/m _n ³	0.15 (Germany)
Dust emission	9 mg/MJ	60 (Austria)
CO measured	0.0154 % _{vol}	
CO at 10% O ₂	0.0138 % _{vol}	
CO at 10% O ₂	173 mg/m _n ³	3000 (Class 3)
CO at 13% O ₂	0.1255 g/m _n ³	- (Germany)
CO at 13% O ₂	125 mg/m _n ³	4000 (Switzerland)
CO emission	84 mg/MJ	500 (Austria)
NO _x (NO ₂) at 10% O ₂	0.0237 % _{vol}	
NO _x (NO ₂) at 10% O ₂	486 mg/m _n ³	
NO _x emission (NO ₂)	238 mg/MJ	150 (Austria)
OGC (CH ₄) at 10% O ₂	0.0001 % _{vol}	
OGC (C) at 10% O ₂	0 mg/m _n ³	100 (Class 3)
OGC emission (C)	0 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	68.28 °C	
Flow temperature	82.34 °C	
Water flow	0.25 m ³ /h	
Heat output	3.93 kW	
Duration	13.30 h	
Fuel consumption	0.90 kg/h	
Water content	6.5 %	
Calorific value	17012 J/g	
Heat input	4.26 kW	
Efficiency	92.1 %	(Class 3) 78 (Austria)
Ambient temperature	24 °C	
Flue gas temperature	67 °C	
Chimney draught	8 Pa	
Flue gas volume flow	14.7 m ³ /h	
Flue gas mass flow	15.3 kg/h	26 (Max.)
CO ₂	7.1 % _{vol}	
CO measured	0.0293 % _{vol}	
CO at 10% O ₂	0.0435 % _{vol}	
CO at 10% O ₂	543 mg/m _n ³	3000 (Class 3)
CO at 13% O ₂	0.3952 g/m _n ³	4 (Germany)
CO at 13% O ₂	395 mg/m _n ³	4000 (Switzerland)
CO emission	265 mg/MJ	750 (Austria)
NO _x (NO ₂) at 10% O ₂	0.0189 % _{vol}	
NO _x (NO ₂) at 10% O ₂	388 mg/m _n ³	
NO _x emission (NO ₂)	189 mg/MJ	150 (Austria)
OGC (CH ₄) at 10% O ₂	0.0128 % _{vol}	
OGC (C) at 10% O ₂	69 mg/m _n ³	100 (Class 3)
OGC emission (C)	34 mg/MJ	40 (Austria)

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

