Reg. No. 300

TEST REPORT (Translation of original Danish report)

Date: 2006.02.20*)	Report No.: 300-ELAB-1078	Page 1 of 12
Initials: KWI/MART	Project No.: 12500396-06	Number of appendices: 4

Requested by:	Contact person:	Jannich Hansen	
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Product:	Automatic biofuel boiler	
	Manufacturer: NBE	Type: Boink
	Nominal effect: 19 kW	Test fuel: Wood pellets

Deadlines:	Date of receipt:	2006.01.02
	Date of testing:	2006.01.08 - 2006.01.09

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

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

Remarks: See page 2.
*) This is a translation of the Danish test report dated 2006.02.20. In case of doubt, the Danish version of the test report prevails.

Vilkår:

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

Signature: Kim Winther
M.Sc.

Appendices:

a) Drawings of the boiler
b) Photos of the boiler: 20 pieces
c) Installation and operating instructions
d) Technical information and data plate.

The appendices are kept separately.

1 Remarks

Prior to the safety testing, the length of the immersion pocket for the temperature controller and the safety temperature limiter was increased to 140 mm to achieve the necessary contact with the boiler water.

The temperature of the bottom boiler door exceeded the limit value at testing with nominal heat output. The manufacturer has stated that the insulation of the door will be improved to meet the requirement.

2 Description of the boiler

NBE Boink is a fully automatically fired boiler for firing with finely divided solid fuel. The fuel is being transported via an auger from the external storage hopper to the burner where the combustion takes place with primary and secondary air supply. The regulating system of the boiler is a modulating control unit without lambda probe. There is no operating handle since the boiler's operating parameters have fixed settings from the factory. The boiler is a steel sheet boiler where the convection unit consists of 3 vertical tubes with baffle plates.

Settings during testing:
Boiler thermostat (fixed setting): ..... 68 °C

Feeding system:
Type: ..... External storage hopper with inclined transport auger
Fuel auger drive motor (el): .....LINIX 10W 1250 o/min.
Fuel feed duct: ..... ø75 mm

Burner:
Type: ..... Air-cooled tube burner
Built-in dimensions: ..... 120 x 120 mm
Length of burner tube: ..... 200 mm
Fan: 230V, 32W
Ignition plug: 230V, 300W
Primary air: ..... 35 pcs. ø4 mm
Secondary air: ..... 22 pcs. ø4 mm
Kindling air: ..... 10 pcs. ø4 mm

Boiler:
Type: ..... Steel sheet boiler, type OPOP H418
Height: ..... 870 mm
Width: ..... 390 mm
Length: ..... 600 mm
Water content: ..... Approx. 35 l
Fire door, top: ..... 310 x 178 mm
Cleaning door, top: ..... 310 x 228 mm
Cleaning door, ash pan: ..... 275 x 178 mm
Water side connection, inlet: .....5/4”
Water side connection, outlet: .....5/4”

Safety equipment:
Boiler thermostat, type: ..... Integrated in boiler control unit
Safety thermostat, type: ..... FIRT STB/83 T80 100°C+0-6
Back-burning security: .....Termoswitch (integrated in print) and drop chute of steel

3 Test equipment

Test rig and equipment are constructed according to EN 303-5 and EN 304.

Rack 1			
Instrument	**Type**	**Traceability**	**No.**
Data acquisition unit	HP 34970A	DANAK 200	270-A-1581
Pc	Dell Optiplex GX110	-	-
CO analyser	Rosemount Binos 100	-	270-A-1580
CO_2 analyser	ABB AO2020	-	270-A-1985
Pressure gauge	Autotran 0-1”	ELAB	270-A-1300
Heating hose	Winkler	-	270-A-1483
Probe	M&C PSP4000-H/C	-	270-A-1504
Flue gas temperature sensor	Type K	ELAB	270-A-1373
Ambient temperature sensor	Type K	ELAB	270-A-1371

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 analyser	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 software 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 PC 440	ELAB	270-A-947
Scale (humidity)	Mettler PJ6	ELAB	270-A-997
Scale (boiler)	Sauter E/40-E2100	ELAB	270-A-0551
Scale (fuel)	Sauter 60 kg	ELAB	270-A-484

4 Requirements for construction etc.

	Reference paragraph in EN 303-5	Meet the requirement
4.1 General requirements		
Safety during 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
User's 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 [1]
Thermal insulation	4.1.5.8	Yes
Leakages in flue gas system	4.1.5.10	Yes
Requirement for temperature control at open expansion	4.1.5.11.1	Yes
Requirement for temperature control at closed expansion	4.1.5.11.2	Yes [2]
Storage fuel hopper	4.1.5.12	Yes
Ash pit	4.1.5.13	Yes
Safety during automatic fuel supply	4.1.5.14.2	Yes
Accessories/fittings	4.1.5.15	Yes
Electrical safety	4.1.5.16	*

[1]) See remarks on page 2.

[2]) See remarks on page 2.

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

5 Test results

5.1 Water side resistance

Equivalent temperature difference at nominal output	Water flow	Drop of pressure
20 K	0.83 m^3/h	1 mbar
10 K	1.66 m^3/h	4 mbar

5.2 Leakage test

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

5.3 Surface temperatures

	Measured temperature	Tolerated limit
Fire doors etc., average of 5 measurements	133 °C [3]	(22 + 100) °C
Boiler's underside, average of 5 measurements	68 °C	(22 + 65) °C
Handles which are being touched during operation		
Metal and similar materials	-	-
Porcelain and similar materials	-	-
Plastic and similar materials	66 °C	(22 + 60) °C
Boiler's average surface temperature		
Average of 10 spot measurements	41 °C	-
Ambient temperature	22 °C	-

5.4 Functional 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 a manual reset device.

	Measured temperature	Tolerated limit
Temperature controller	97 °C	100 °C
Safety thermostat	103 °C	110 °C

5.5 Pressure testing of boiler shell

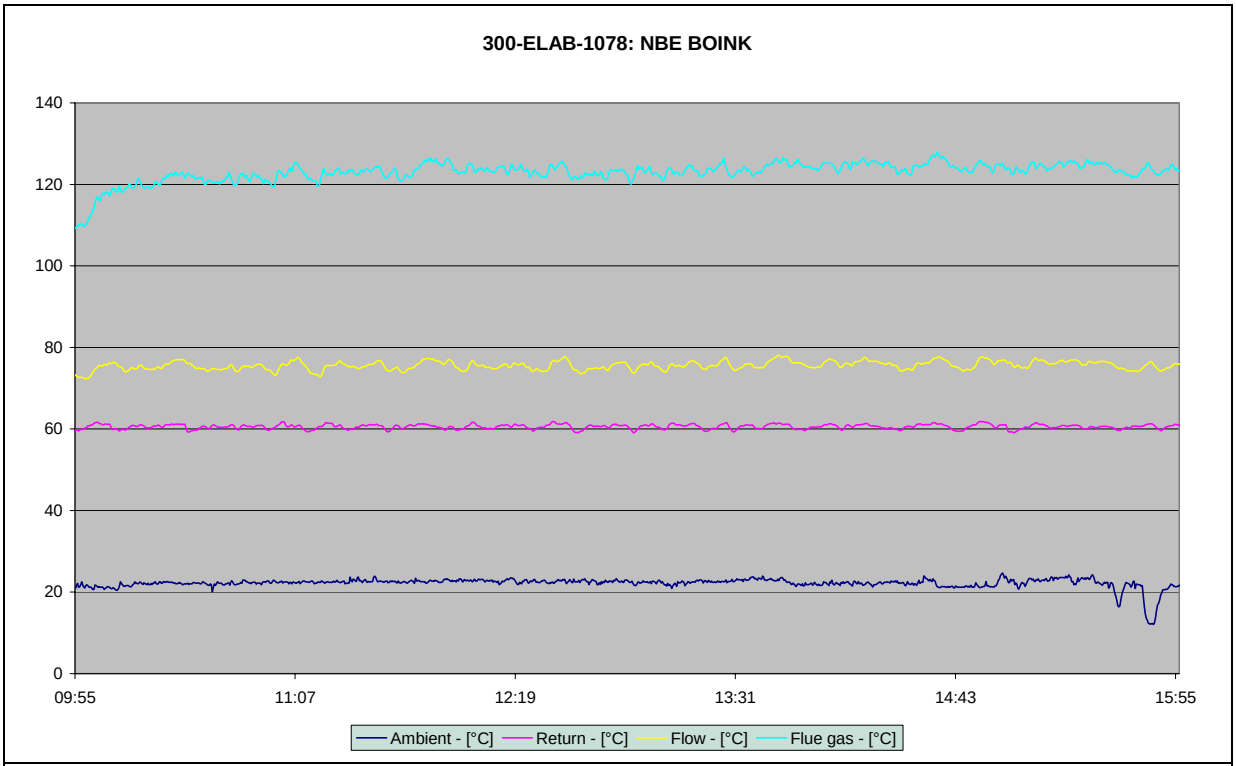
The necessary tests cf. DS/EN303-5, paragraph 5.4 is carried out by the manufacturer.

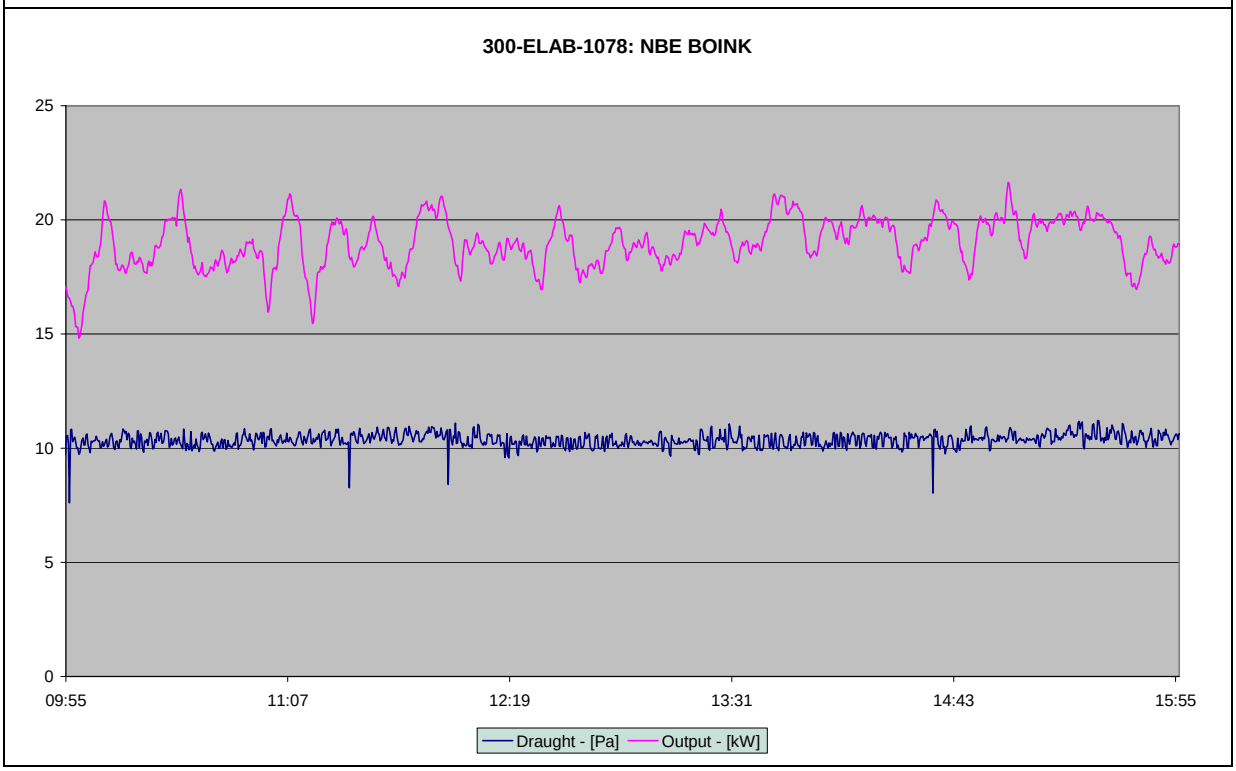
[3] See remark on page 2.

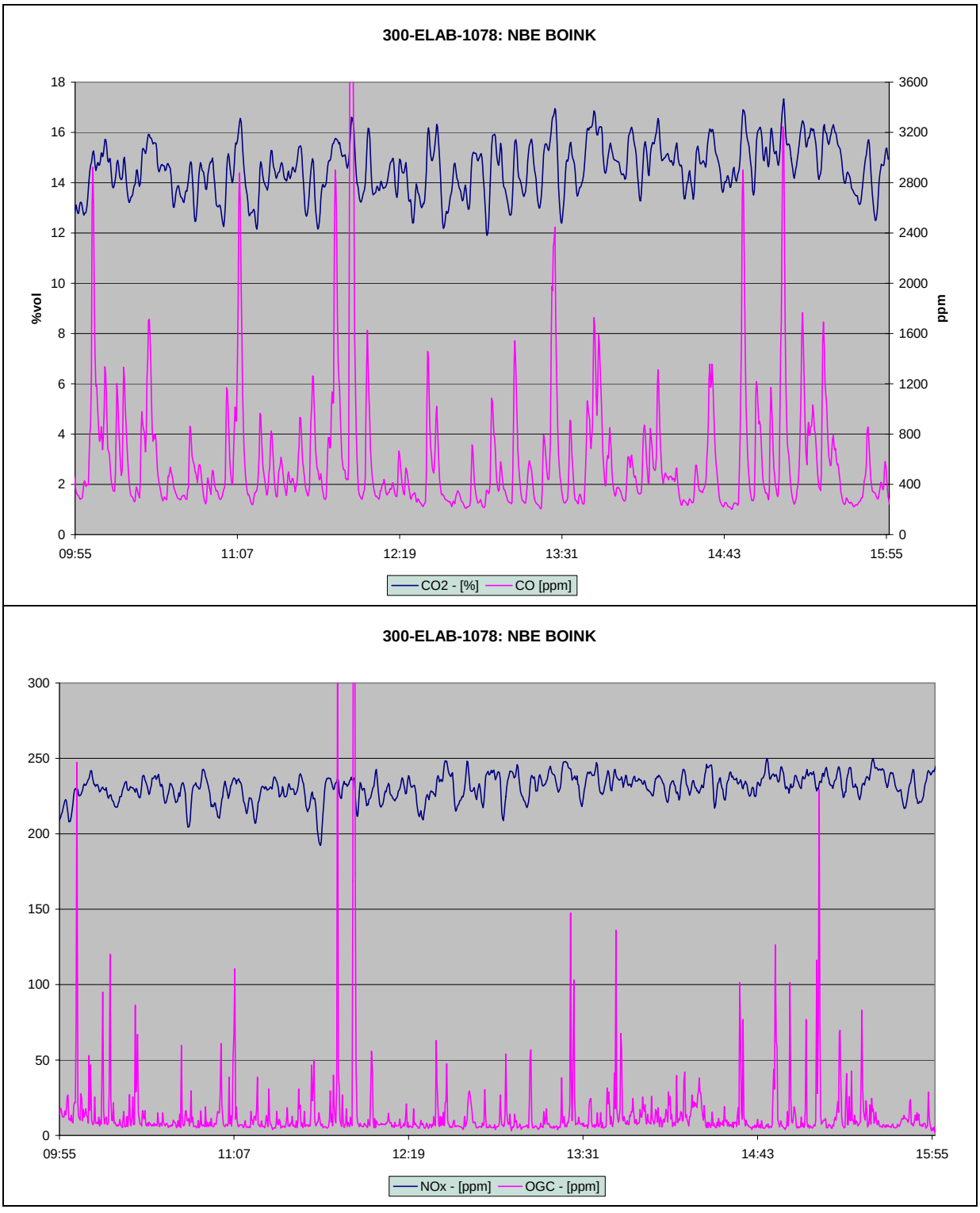
5.6 Test results at nominal output

Measurement	Result	Requirements
Return temperature	60.59 °C	
Inlet temperature	75.59 °C	
Water flow rate	1.11 m^3/h	
Heat output	18.97 kW	
Duration	6.02 h	
Fuel consumption	4.35 kg/h	
Water content	6.5 %	
Calorific value	17500 J/g	
Heat input	21.16 kW	
Efficiency	89.7 %	75 (Class 3) 78 (Austria)
Ambient temperature	22 °C	
Flue gas temperature	123 °C	
Chimney draught	10 Pa	26 (Max.)
Flue gas volume flow	42.2 m^3/h	
Flue gas mass flow	37.9 kg/h	
CO_2	14.6 $\%_{vol}$	
Dust measured	54 mg/m_n^3	
Dust at 10% O_2	39 mg/m_n^3	150 (Class 3)
Dust at 13% O_2	0.03 g/m_n^3	0.15 (Germany)
Dust emission	18 mg/MJ	60 (Austria)
CO measured	0.0597 $\%_{vol}$	
CO at 10% O_2	0.0431 $\%_{vol}$	
CO at 10% O_2	539 mg/m_n^3	3000 (Class 3)
CO at 13% O_2	0.3923 g/m_n^3	4 (Germany)
CO at 13% O_2	392 mg/m_n^3	4000 (Switzerland)
CO emission	253 mg/MJ	500 (Austria)
NO_x (NO_2) at 10% O_2	0.0167 $\%_{vol}$	
NO_x (NO_2) at 10% O_2	342 mg/m_n^3	
NO_x emission (NO_2)	160 mg/MJ	150 (Austria)
OGC (CH_4) at 10% O_2	0.0012 $\%_{vol}$	
OGC (C) at 10% O_2	7 mg/m_n^3	100 (Class 3)
OGC emission (C)	3 mg/MJ	40 (Austria)

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


300-ELAB-1078: NBE BOINK
140
120
100
80
60
40
20
0
09:55
11:07
12:19
13:31
14:43
15:55
Ambient - [°C]
Return - [°C]
Flow - [°C]
Flue gas - [°C]

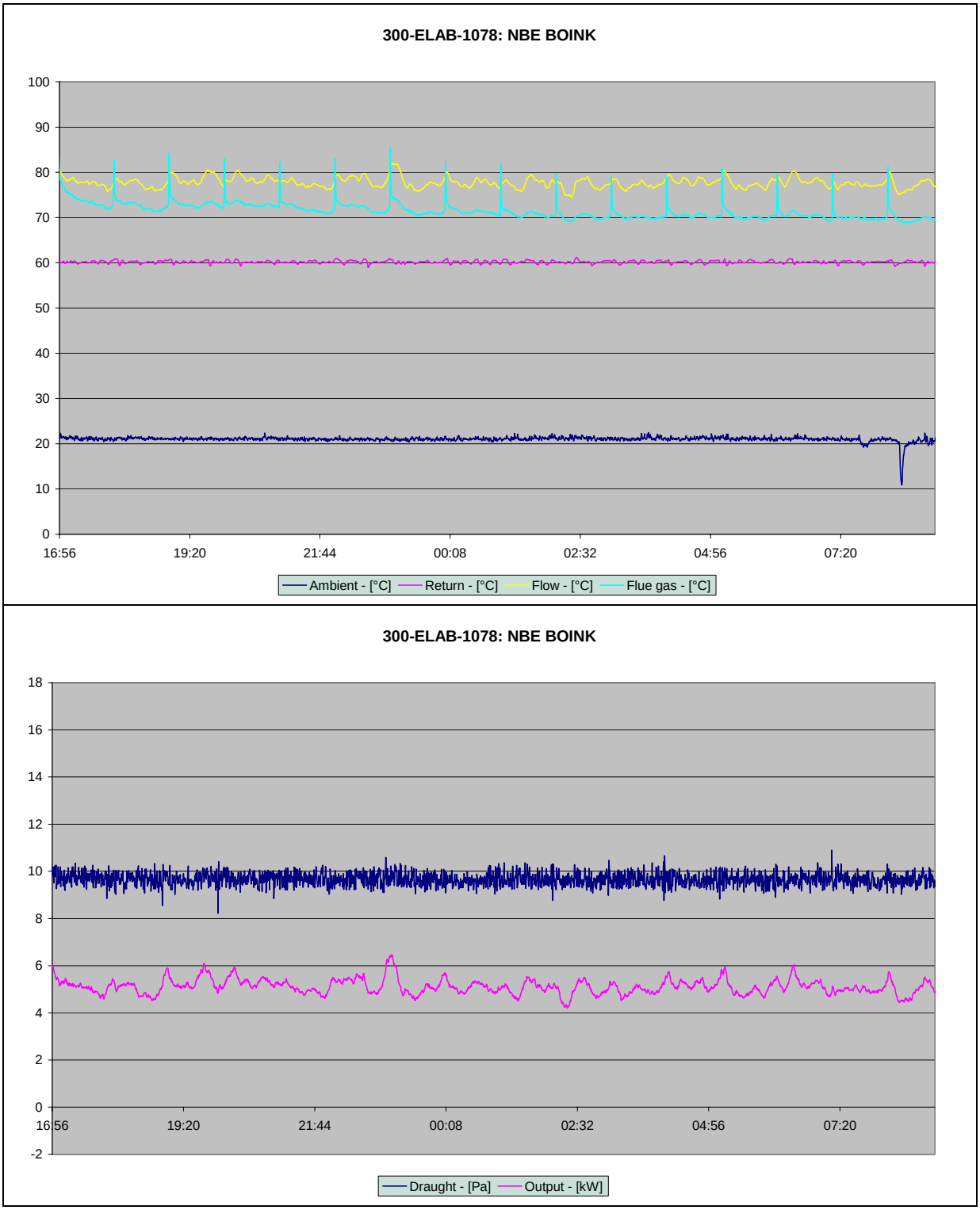

300-ELAB-1078: NBE BOINK
25
20
15
10
5
0
09:55
11:07
12:19
13:31
14:43
15:55
Draught - [Pa]
Output - [kW]

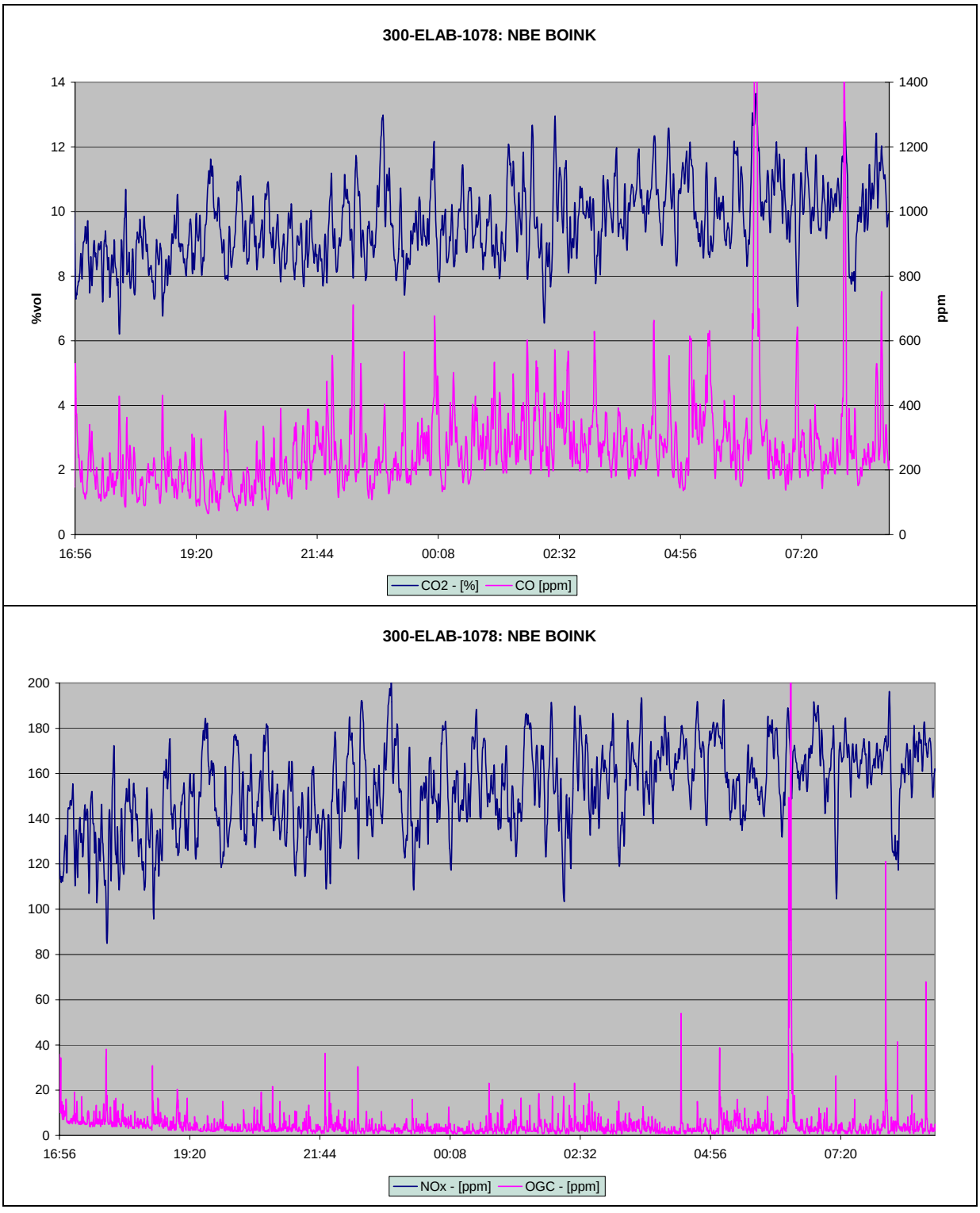

300-ELAB-1078: NBE BOINK
%vol
ppm
0
2
4
6
8
10
12
14
16
18
0
400
800
1200
1600
2000
2400
2800
3200
3600
09:55
11:07
12:19
13:31
14:43
15:55
CO2 - [%]
CO [ppm]
300-ELAB-1078: NBE BOINK
0
50
100
150
200
250
300
09:55
11:07
12:19
13:31
14:43
15:55
NOx - [ppm]
OGC - [ppm]

5.7 Test result at minimum output

Measurement	Result		Requirement	
Return temperature	60.19	°C		
Inlet temperature	77.73	°C		
Water flow rate	0.25	m^3/h		
Heat output	5.11	kW		
Duration	16.14	h		
Fuel consumption	1.19	kg/h		
Water content	6.5	%		
Calorific value	17500	J/g		
Heat input	5.78	kW		
Efficiency	88.4	%		(Class 3)
			78	(Austria)
Ambient temperature	21	°C		
Flue gas temperature	71	°C		
Chimney draught	10	Pa	26	(Max.)
Flue gas volume flow	14.6	m^3/h		
Flue gas mass flow	15.0	kg/h		
CO_2	9.7	$\%_{vol}$		
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	0.0268	$\%_{vol}$		
CO at 10% O_2	0.0292	$\%_{vol}$		
CO at 10% O_2	366	mg/m_n^3	3000	(Class 3)
CO at 13% O_2	0.2659	g/m_n^3	4	(Germany)
CO at 13% O_2	266	mg/m_n^3	4000	(Switzerland)
CO emission	172	mg/MJ	750	(Austria)
NO_x (NO_2) at 10% O_2	0.0167	$\%_{vol}$		
NO_x (NO_2) at 10% O_2	343	mg/m_n^3		
NO_x emission (NO_2)	161	mg/MJ	150	(Austria)
OGC (CH_4) at 10% O_2	0.0006	$\%_{vol}$		
OGC (C) at 10% O_2	3	mg/m_n^3	100	(Class 3)
OGC emission (C)	1	mg/MJ	40	(Austria)

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


300-ELAB-1078: NBE BOINK
100
90
80
70
60
50
40
30
20
10
0
16:56
19:20
21:44
00:08
02:32
04:56
07:20
Ambient - [°C]
Return - [°C]
Flow - [°C]
Flue gas - [°C]
300-ELAB-1078: NBE BOINK
18
16
14
12
10
8
6
4
2
0
-2
16:56
19:20
21:44
00:08
02:32
04:56
07:20
Draught - [Pa]
Output - [kW]


300-ELAB-1078: NBE BOINK
%vol
ppm
0
2
4
6
8
10
12
14
0
200
400
600
800
1000
1200
1400
16:56
19:20
21:44
00:08
02:32
04:56
07:20
CO2 - [%]
CO [ppm]
300-ELAB-1078: NBE BOINK
0
20
40
60
80
100
120
140
160
180
200
16:56
19:20
21:44
00:08
02:32
04:56
07:20
NOx - [ppm]
OGC - [ppm]