



TEST REPORT (Translation of original Danish report)

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Product: Automatic biofuel boiler

Manufacturer: VVS-Eksperten A/S Type: Orligno 400, 16 (pellet burner and boiler)

Nominal output: 15 kW Fuel: Wood pellets

Deadlines: Date of receipt: 2010.06.22

Date of testing: 2010.06.24 – 2010.07.16


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

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

Remarks: See remarks on page 2. This is a translation of the Danish test report dated 2010.09.17. 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 boiler: Drawing of hearth/burner head not numbered, 28700052 (17-11-2009), 75001_revB, 28720222, 28720222_Pos5, 28720222_Pos1, 75001 (all dated 2010.07.27)
- b) Photos of the biofuel boiler: 38 pcs.
- c) User's instructions, installation manual and technical information assembled in one, approved with remarks 2010.09.17
- d) Data plate.

The appendices are kept separately.

1 Remarks

Regarding the functions check (please refer to paragraph 5.4) it was agreed with the manufacturer to change the safety temperature limiter setting from 93 °C to 100 °C.

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.

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 six vertical boiler tubes. Each boiler tube is mounted with removable flue gas baffle plates.

The biofuel unit is mounted with a modulating controller which continu-

ously 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):	87/76 °C
Setting/Flue gas temperature max.:	350 °C
Setting/ Flue gas temperature min.:	45 °C
Setting/Fuel:	4.05
Setting/Start Fuel:	23
Setting/Pause Fuel:	7 s
Setting/Pause Air:	5 %
Setting/Clean Fan Time:	2 s
Setting/Clean Fan Int.:	15 m
Installer Setting/Flue gas start temp.:	2 °C
Installer Setting/Fuel min.:	5 %
Installer Setting/Auger max.:	18 %
Installer Setting/Air min.:	2 %
Installer Setting/Air max.:	67 %
Installer Setting/Air reduce:	15 %
Installer Setting/Start heat time:	15 m
Installer Setting/Start heat eff.:	100 %
Installer Setting/Start air:	7 %

Main dimensions, total biofuel unit:

Depth:	Approx. 660 mm
Height:	Approx. 1080 mm
Width:	Approx. 660 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:	ECOFOT 2GREAS 108x52R

Boiler:

Type:	Welded steel plate boiler
Height:	1080 mm
Width:	607 mm
Depth:	642 mm
Water content:	Approx. 50 l
Boiler door (cleaning opening):	Crescent, d=460 mm og h=180 mm
Flue gas tube:	ø133 mm
Flow connection:	1"
Return connection:	1"
Fire extinguishing equipment:	Drop chute and thermo switch



3 Test Equipment

Test rig and equipment are construction in accordance with 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 analyzer	Rosemount Binos 100	-	270-A-1580
CO ₂ analyzer	ABB AO2020	-	270-A-1985
NO analyzer	EPM NGA2000	-	270-A-2420
FID analyzer	M & C	-	270-A-1751
Pressure gauge	Autotran 0-1"	ELAB	270-A-1300
Heated hose/probe	M&C	-	270-A-1504
Heated hose/probe	M&C	-	270-A-1994
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 (flow)	DANAK 200	270-A-1492
Water temperature sensor	Pt100 (return)	DANAK 200	270-A-1491
Gas meter	IGA AC-5M	DANAK 207	270-A-1474

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 (boiler)	Mettler IND 560	ELAB	270-A-0551



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 Requirement 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
User's instructions	8.2	Yes
4.3 Requirement on welded steel plate 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 Krav til sikkerhed og 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 ²
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 with incorrect number is seen.

² 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	0.7 m ³ /h	5 mbar
10 K	1.3 m ³ /h	1 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	30 °C	+ 100 K
Boiler's underside, average of 5 measurements	25 °C	+ 65 K
Handles being touched during operation		
Metal and similar materials	-	+ 35 K
Porcelain and similar materials	-	+ 45 K
Plastic and similar materials	31 °C	+ 60 K
Boiler's average surface temperature		
Average of 10 spot measurements	32 °C	-
Ambient temperature	25 °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 or tested in accordance with DS/EN303-5 paragraph 5.13.

	Measured temperature	Allowed limit
Temperature controller	97 ³ °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.

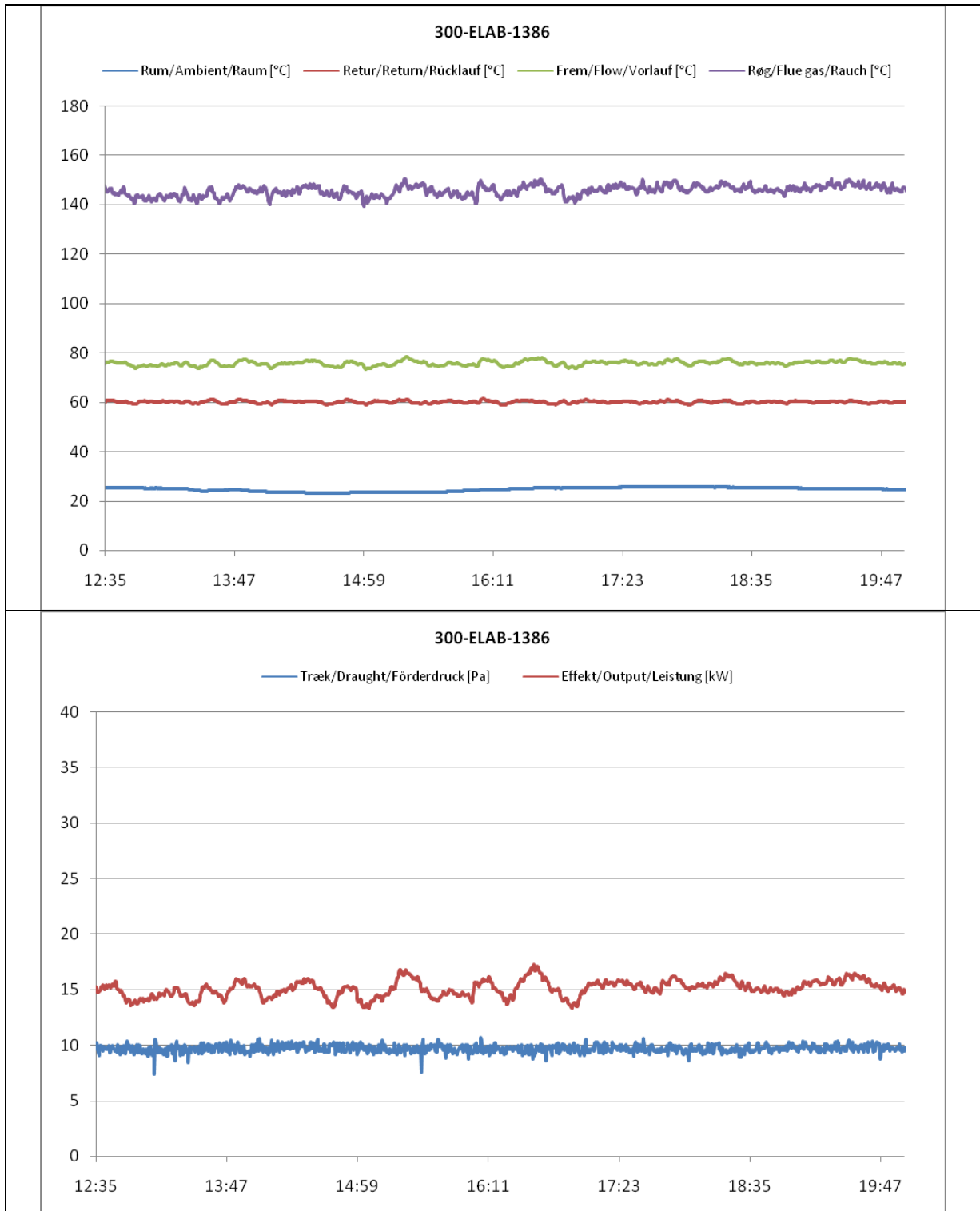
³ At the first attempt the safety temperature limiter stroke: It was agreed with the manufacturer to change the limiter's setting from 93 °C to 100 °C, after which the functions check of the temperature controller could be carried out.

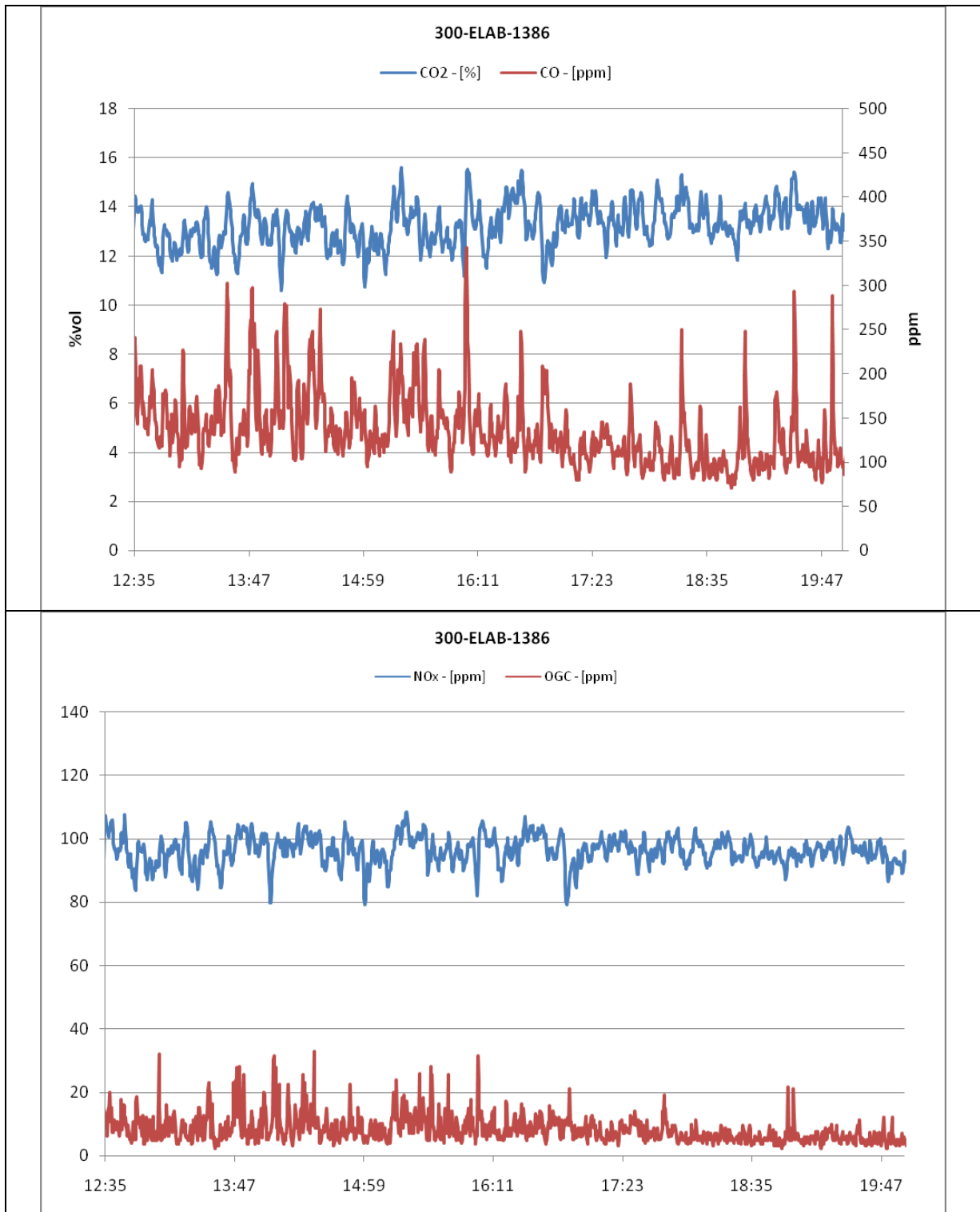


5.6 Test Results at Nominal Output

Measurement	Result	Requirement
Return temperature	60.00 °C	
Flow temperature	75.92 °C	
Water flow	0.83 m ³ /h	
Heat output	15.07 kW	
Test duration	7.42 h	
Fuel consumption	3.44 kg/h	
Water content	6.0 %	
Calorific value	17605 J/g	
Heat input	16.85 kW	
Efficiency	89.4 %	74 (Class 3) 74 (Denmark) 77 (Austria)
Ambient temperature	25 °C	
Flue gas temperature	146 °C	
Chimney draught	10 Pa	24 (Max.)
Flue gas volume flow	38.8 m ³ /h	
Flue gas mass flow	33.0 kg/h	
CO ₂	13.3 % _{vol}	
Dust measured	31 mg/m _n ³	
Dust at 10% O ₂	25 mg/m _n ³	150 (Class 3)
Dust at 13% O ₂	0.02 g/m _n ³	0,15 (Germany)
Dust emission	12 mg/MJ	60 (Austria)
CO measured	0.0135 % _{vol}	
CO at 10% O ₂	0.0109 % _{vol}	
CO at 10% O ₂	136 mg/m _n ³	3000 (Class 3)
CO at 13% O ₂	0.0987 g/m _n ³	4 (Tyskland)
CO at 13% O ₂	99 mg/m _n ³	4000 (Switzerland)
CO emission	64 mg/MJ	500 (Austria)
NO _x (NO ₂) at 10% O ₂	0.0077 % _{vol}	
NO _x (NO ₂) at 10% O ₂	159 mg/m _n ³	
NO _x emission (NO ₂)	74 mg/MJ	150 (Austria)
OGC (C ₃ H ₈) at 10% O ₂	0.0007 % _{vol}	
OGC (C) at 10% O ₂	12 mg/m _n ³	100 (Class 3)
OGC emission (C)	6 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	59.99 °C	
Flow temperature	76.39 °C	
Water flow	0.22 m ³ /h	
Heat output	4.06 kW	
Test duration	7.00 h	
Fuel consumption	0.93 kg/h	
Water content	6.0 %	
Calorific value	17713 J/g	
Heat input	4.58 kW	
Efficiency	88.7 %	- (Class 3) - (Denmark) 76 (Austria)
Ambient temperature	25 °C	
Flue gas temperature	77 °C	
Chimney draught	5 Pa	12 (Max.)
Flue gas volume flow	12.8 m ³ /h	
Flue gas mass flow	13.0 kg/h	
CO ₂	8.8 % _{vol}	
CO measured	0.0310 % _{vol}	
CO at 10% O ₂	0.0378 % _{vol}	
CO at 10% O ₂	472 mg/m _n ³	3000 (Class 3)
CO at 13% O ₂	0.3433 g/m _n ³	- (Germany)
CO at 13% O ₂	343 mg/m _n ³	4000 (Switzerland)
CO emission	219 mg/MJ	750 (Austria)
NO _x (NO ₂) at 10% O ₂	0.0073 % _{vol}	
NO _x (NO ₂) at 10% O ₂	149 mg/m _n ³	
NO _x emission (NO ₂)	69 mg/MJ	150 (Austria)
OGC (C ₃ H ₈) at 10% O ₂	0.0007 % _{vol}	
OGC (C) at 10% O ₂	12 mg/m _n ³	100 (Class 3)
OGC emission (C)	5 mg/MJ	40 (Austria)

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

