

Handled by, department
Mathias Johansson
Energy Technology
+46 10 516 56 61, mathias.johansson.et@sp.se

Kaukora OY
PL 21
Tuotekatu 11
FI-21201 RAISIO
Finland

Testing a wood fired boiler Econature 40 (2 appendices)

The assignment

Testing in accordance with European Standard EN 303-5 section 5.8.2 and 5.9.1 after modification of the air supply to the grate of the boiler.
For other results according to EN 303-5 see test report nr P700360-02

Item for testing

The wood boiler – a Econature 40 manufactured by Kaukora OY, Raisio, Finland. The boiler arrived at SP on 9 June 2008 and was in used condition.

Technical description

The wood boiler works after the principle of inverse combustion. The boilers wood magazine has a ceramic grate with a circular hole. Combustion air is supplied by a fan that is placed at the flue gas duct of the boiler. The boilers has eight convection tubes, DN50. The tubes are fitted with turbulators.

Informative material supplied

Drawings of boiler

Drawing number	Date
P02325 Rev 1	2008-06-23

For other documentation se test report P700360-02

Test arrangement

The wood boiler was connected to a test rig consisting of a circulation pump, flow meter, valves and heat exchanger, which enabled the circulation flow and the supply and return temperatures to be maintained at the desired values.

The chimney diameter was 180 mm, with a height of about 6 m above floor level.

SP Technical Research Institute of Sweden

Postal address
SP
Box 857
SE-501 15 Borås
SWEDEN

Office location
Västeråsen
Brinellgatan 4
SE-504 62 Borås
SWEDEN

Phone / Fax / E-mail
+46 10 516 50 00
+46 33 13 55 02
info@sp.se

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Test procedure

This test report relates only to the actual item tested.

Testing was carried out at/by SP's Energy Technology Department during June 2008, in accordance with European Standard EN 303-5, 'Heating Boilers - Part 5 - Solid-fuel-fired Heating Boilers, Manually and Automatically Fired, with Nominal Output Powers up to 300 kW - Terminology, Requirements, Testing and Marking' section 5.8.2 and 5.9.1

The emission values were measured continuously during the test period.

The fuel used for the tests was birch wood. See test report P70360-02

The following parameters were measured and/or calculated (as appropriate) every 20 second (mean value from measurement every 10 second):

- Flow and return temperatures
- Circulation flow rate through the boiler
- Ambient temperature
- Flue gas temperature
- Boiler temperature
- Draught
- CO₂ concentration
- CO concentration
- O₂ concentration
- THC concentration (Total Hydro Carbon)
- NO_x concentration (only at nominal heat output)
- Heat output

Dust concentration was measured intermittently at nominal heat output.

The flow and return temperatures were measured directly at the boiler connections. The flue gas temperature was measured at a distance of about two chimney diameters from the connection of the flue gas duct.

Results

The table below shows a summary of the results. For complete results see appendix 1.

	Unit	Nominal heat output
Efficiency	%	91
Dust concentration	mg/m ³ _n dry gas at 10 % O ₂	24
Dust concentration	mg/m ³ _n dry gas at 13 % O ₂	18
CO	mg/m ³ _n dry gas at 10 % O ₂	700
CO	mg/m ³ _n dry gas at 13 % O ₂	509
OGC	mg/m ³ _n dry gas at 10 % O ₂	16
NO _x (as NO ₂)	mg/m ³ _n dry gas at 10 % O ₂	178

Comments

The Wood boiler – a Econature 40 manufactured by Kaukora OY, Raisio, Finland - complies with the Class 3 emission requirements for CO, OGC and dust in accordance with EN 303-5. The boiler also complies with the Class 3 requirements for efficiency

The wood boiler Econature 40 shall be connected to a storage tank of appropriate size.

SP Technical Research Institute of Sweden
Energy Technology - Combustion and Aerosol Technology


Geron Johansson
Technical Manager


Mathias Johansson
Technical Officer

Appendices

Appendix 1 Results

Appendix 2 Instrumentation and uncertainty of measureme

Appendix 1

Results

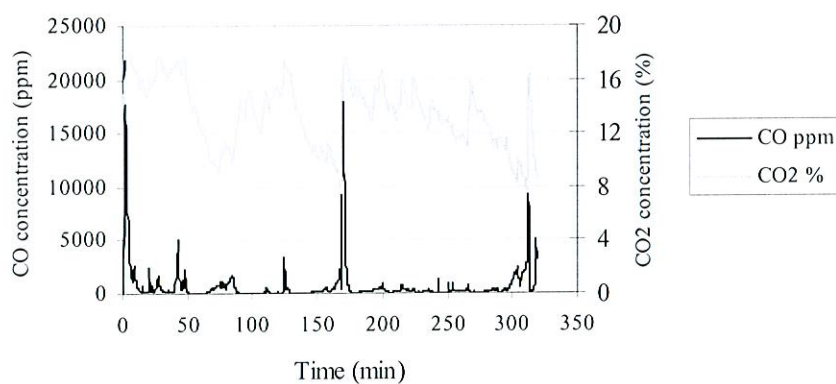
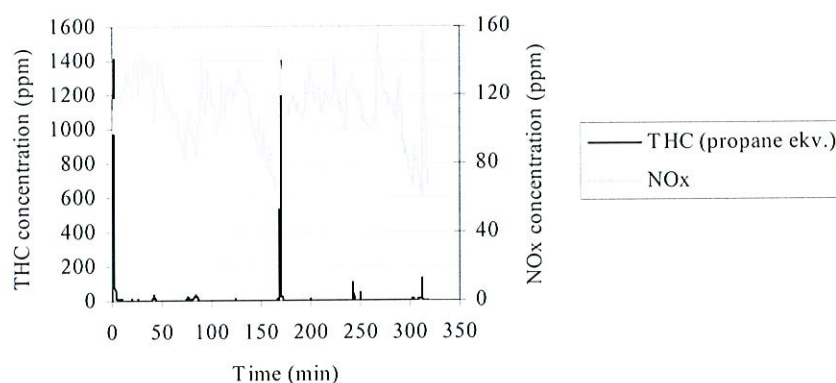
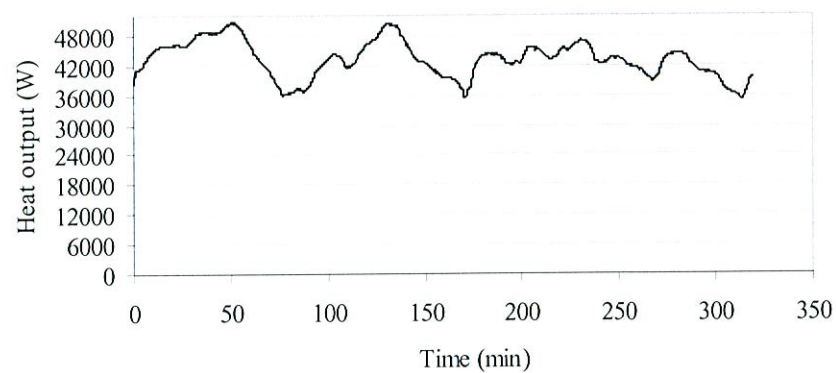
The following tests were performed in accordance with EN 303-5.

5.8.2 and 5.9.1 Nominal heat output

The test was performed 2008-06-17.

	Unit	Results
Test duration	h	5,3
Atmospheric pressure	mbar	990
Quantity of fuel supplied	kg	55,112
Lower calorific value (as fired basis)	MJ/kg	16,51
Water content fuel	%	12
Flow temperature, (mean value)	°C	74,3
Return temperature, (mean value)	°C	52,1
Circulation flow, (mean value)	m ³ /h	1,694
Boiler temperature, (mean value)	°C	-
Ambient temperature, (mean value)	°C	22,7
Heat output (mean value)	kW	43,1
Efficiency	%	91
Flue draught (chimney)	Pa	12
Flue gas temperature, (mean value)	°C	138
CO ₂ - concentration, (mean value)	%	13,4
O ₂ - concentration, (mean value)	%	6,8
CO - concentration, (mean value)	ppm	724
CO - concentration	mg/MJ	334
CO	mg/m ³ n dry gas at 10 % O ₂	700
CO	mg/m ³ n dry gas at 13 % O ₂	509
THC concentration, (mean value) (expressed as propane equivalent)	ppm	11
THC concentration	mg/MJ	7
OGC	mg/m ³ n dry gas at 10 % O ₂	16
OGC	mg/m ³ n dry gas at 13 % O ₂	11
Dust concentration	mg/MJ	10
Dust concentration	mg/m ³ n dry gas at 10 % O ₂	24
Dust concentration	mg/m ³ n dry gas at 13 % O ₂	18
NO _x concentration (mean value)	ppm	112
NO _x (as NO ₂)	mg/MJ	85
NO _x (as NO ₂)	mg/m ³ n dry gas at 10 % O ₂	178
NO _x (as NO ₂)	mg/m ³ n dry gas at 13 % O ₂	129

Appendix 1


CO and CO₂-emissions at nominall heat output

THC and NO_x-emissions at nominal heat output

Nominal heat output

Appendix 2

Instrumentation and uncertainty of measurement

The designations listed below refer to SP Energy Technology's quality system.

Instrumentation

Resistance thermometer, Pt-100	ETf-QD Db 2
Thermocouple, type K	ETf-QD Db 3
Water flow meter, Valmet 9V-MP115	Inv.nr. 201 655
Data logging system	Inv.nr. 202 561
Dust sampling equipment	Inv.nr. 200 399
Differential pressure gauge, Furness FCO 14	Inv.nr. 200 628
Weighing instrument, Sartorius LC 34	Inv.nr. 201 639
CO ₂ /CO-analysator type Binos 100 (0-3% CO)	Inv.nr. 201 667
THC-analysator JUM typ FID model 3-300A	Inv.nr. 201 664
O ₂ analysator, M.&C, Modell PMA 10	Inv.nr. 202 589
Nox analysator EcoPhysics typ CLD 700 EL ht	Inv.nr. 202 106

Uncertainty of measurement

Temperature difference, radiator circuit	±0,05 °C
Boiler temperature	±0,5 °C
Flue gas temperature	±3 °C
Ambient temperature	±1 °C
Negative pressure in chimney	±10 %
Liquid flow, radiator circuit	±1 %
Fuel quantity	±0,01 kg
Water content, fuel	±0,2 %
CO ₂ -concentration	±0,3 %-points
CO- concentration	±72 ppm
O ₂ - concentration	±0,5 %-points
THC- concentration	±3 ppm
NO _x - concentration	±31 ppm
OGC (mg/m ³ _n)	±15 % of measured value
CO (mg/m ³ _n)	±15 % of measured value
NO _x (mg/m ³ _n)	±15 % of measured value
Heat output	±1,5 %
Boiler efficiency	±3,0 %-points
Dust concentration	±4%

Table values

cp	±0,1 %
ρ	±0,1 %

Analysed values

Net calorific value	±0,12 MJ/kg
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