



REPORT

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ETf P800709

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662 30 Åmål

Testing a pellet fired boiler 300 kW (4 appendices)

The assignment

Testing a pellet fired boiler Janfire System Jet in accordance with European Standard EN 303-5 section 5.7-5.14

Item for testing

The pellet boiler - a Janfire System Jet with nominal heat output 300 kW manufactured by Janfire AB, in Åmål, Sweden - arrived at SP on 29th January 2008. The boiler and burner were in new condition.

Technical description

The pellet boiler Janfire System Jet is fitted with a pellet burner, Janfire 300. The fuel to the pellet burner is conveyed from an external storage by a feed screw. The pellet falls from the feed screw into an internal fuel hopper in the burner. From the internal fuel hopper the pellet is fed to the retort. Combustion air is supplied by a fan. The boiler was equipped with a cyclone and a flue gas fan. The boiler can also be equipped with an automatic ash discharge. The pellet burner is designed with two different safety systems to prevent back burning. One of the safety system is a temperature limiter switch located in the drop chute and the other safety system is the drop chute.

The boiler has a water content of 1033 litre. The boiler has 30 convection tubes.

Informative material supplied

Operating and installation instructions:

Janfire Jet system	Janfire 2006
Serviceinstruktion	Vitoplex 100

Drawings:

	<u>Name</u>	<u>Drawing number</u>	<u>Date</u>
Burner:	Jet 300	6 30 06 000	2007-12-10
Boiler	Pellet boiler	3 57 06 001	2008-02-11

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Test arrangement

The pellet 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 return temperature to be maintained at the desired values.

The chimney diameter was 180 mm, with a height of about 5 m above floor level.

Test procedure

This test report relates only to the actual item tested.

Testing was carried out at/by SP's Energy Technology Department during february 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'.

The emissions were measured continuously during the test period. The emission sampling was carried out before the cyclone and the flue gas fan except for the dust sampling which was carried out after the cyclone and flue gas fan.

The fuel used for the test was 8 mm wood pellets (see appendix 3).

The following parameters were measured and/or calculated (as appropriate) every 20 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 after the cyclone and the flue gas fan.

Results

The table below shows a summary of the results. For complete results see appendix 2.

	Unit	Nominal heat output	Minimum heat output
Efficiency	%	90	90
Dust concentration	mg/m ³ n dry gas at 10 % O ₂	15	-
Dust concentration	mg/MJ	7	-
CO	mg/m ³ n dry gas at 10 % O ₂	82	200
CO	mg/MJ	39	96
OGC	mg/m ³ n dry gas at 10 % O ₂	0,4	0,4
OGC	mg/MJ	0,2	0,2
NO _x (as NO ₂)	mg/m ³ n dry gas at 10 % O ₂	102	-
NO _x (as NO ₂)	mg/MJ	49	-

Comments

The boiler tested - a Janfire System Jet 300 kW manufactured by Janfire AB, in Åmål Sweden - 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.

SP Sveriges Tekniska Forskningsinstitut Energy Technology - Combustion and Aerosol Technology



Andreas Johansson
Technical Manager



Henrik Persson
Technical Officer

Appendices

Appendix 1 Identification

Appendix 2 Results

Appendix 3 Test fuel specification

Appendix 4 Instrumentation and uncertainty of measurement

Appendix 1

Identification

The boiler Janfire Jet 300:





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Appendix 1

Data plate:

Viessmann
VITOPLEX 100
Ser nr: 7143285700193

Janfire
●●● pelletsvärme

Pannan är godkänd för 0-40de
Ändrad maxeffekt från 575kW
M max 300kW

I enlighet med
PED 97/23/EC (AFS 1999:4)
8§

Heizkessel / Chaudière / Boiler / Kazan
EN 14394 / TRD 702

Herstell-Daten / N° de fabrication / Serial no. / Seri no:

7143285700193 105



Nennwärmeleistung (LVR 92) bei Öl und Gas Puissance nominale (OPair 92) pour fioul/gaz Rated output for oil/gas Kazan anma isi gücü, sıvı ve gaz yakıt için	P_n	575 kW
Feuerungs-Nennwärmeleistung (LRV 92) Puissance calorifique nominale (OPair 92) Combustion rated input Yakma anma isi yükü	Q_r	625 kW
Wärmeleistungsbereich bei Öl und Gas ^{*1} Plage de puissance fioul/gaz Output range for oil/gas isi gücü aralığı, sıvı ve gaz yakıt için	P	575-635 kW
Feuerungs-Nennwärmeleistungsbereich (LRV 92) ^{*1} Plage de puissance calorifique nominale (OPair 92) Combustion rated input range Yakma isi yükü aralığı	Q	625-694 kW

V 1033 I
PS 6 bar = 0,6 MPa
TS 110 °C
AT ÖVGW-Reg.-Nr. G2:729
CH: Kessel/chaudière / Unit
230 V~ / 50 Hz / max. 6 A



CE-0085 07

Vitoplex 100
CE-0085 AQ 0823

^{*1} Nicht für / Pas pour / Not for / CH, DE, SE

Viessmann Werke GmbH & Co KG
Viessmann Ges. m. b. H.
Viessmann (Schweiz) AG

D-36107 Allendorf
A-4602 Wels
CH-8957 Spreitenbach

30
123456789

Appendix 2

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 2008-02-22.

The pellet burner had the following settings in the electronics:

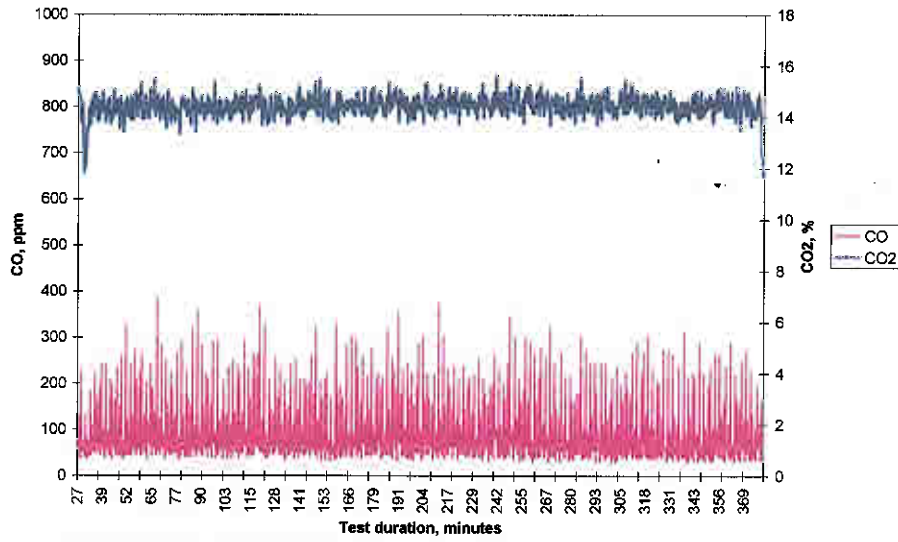
O₂- sensor: 6,0 %.

combustion fan: 84 %

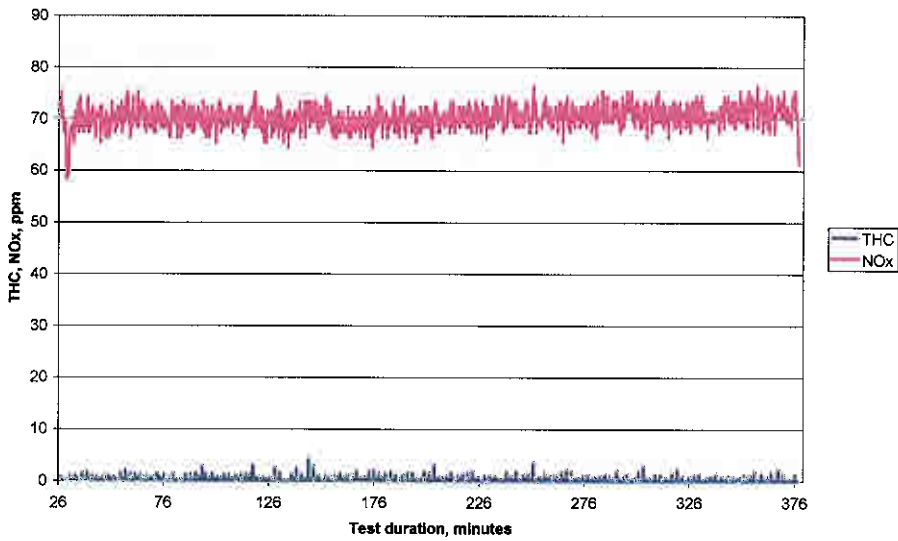
	Unit	Results
Test duration	h	5,9
Atmospheric pressure	mbar	977
Quantity of fuel supplied	kg	393,6
lower calorific value (as fired basis)	kWh/kg	4,77
Flow temperature, (mean value)	°C	77,9
Return temperature, (mean value)	°C	56,0
Circulation flow, (mean value)	m ³ /h	11,6
Boiler temperature, (mean value)	°C	78
Ambient temperature, (mean value)	°C	23
Heat output (mean value)	kW	289
Flue draught (chimney)	Pa	-25
Flue gas temperature, (mean value)	°C	68*
Flue gas flow, (mean value)	g/s	142
CO ₂ - concentration, (mean value)	%	14,4
O ₂ - concentration, (mean value)	%	5,6
CO - concentration, (mean value)	ppm	92
CO - concentration	mg/MJ	39
THC concentration, (mean value) (expressed as propane equivalent)	ppm	0,3
OGC concentration	mg/MJ	0,2
NO _x concentration (mean value)	ppm	70
NO _x (as NO ₂)	mg/MJ	49
Efficiency	%	90
Dust concentration	mg/m ³ n dry gas at 10 % O ₂	15
Dust concentration	mg/MJ	7
CO	mg/m ³ n dry gas at 10 % O ₂	82
OGC	mg/m ³ n dry gas at 10 % O ₂	0,4
NO _x (as NO ₂)	mg/m ³ n dry gas at 10 % O ₂	102

* The boiler was equipped with a cyclone and a flue gas fan.

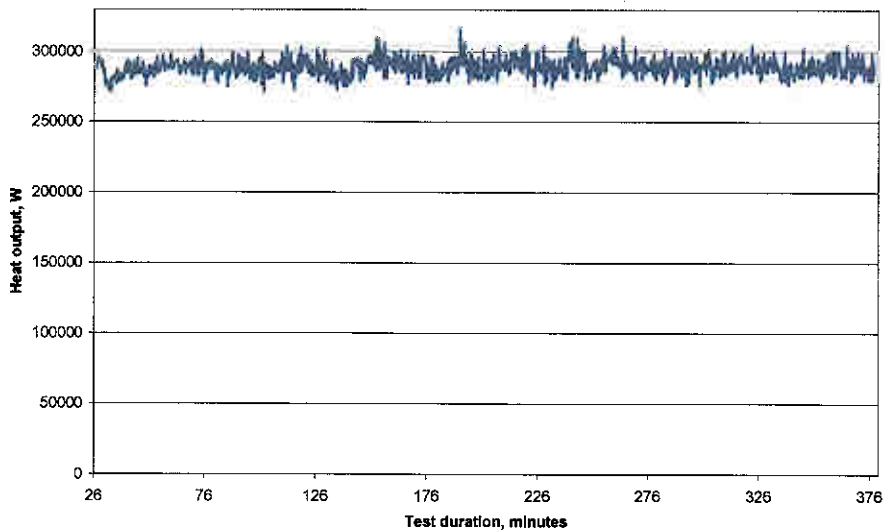
Appendix 2



CO and CO₂-emissions at nominal heat output



THC and NO_x-emissions at nominal heat output



Nominal heat output

Appendix 2

5.8.3 and 5.9.2 Minimum heat output

The test was performed 2008-02-25. The burner was operating continuously at 30 % of nominal heat output.

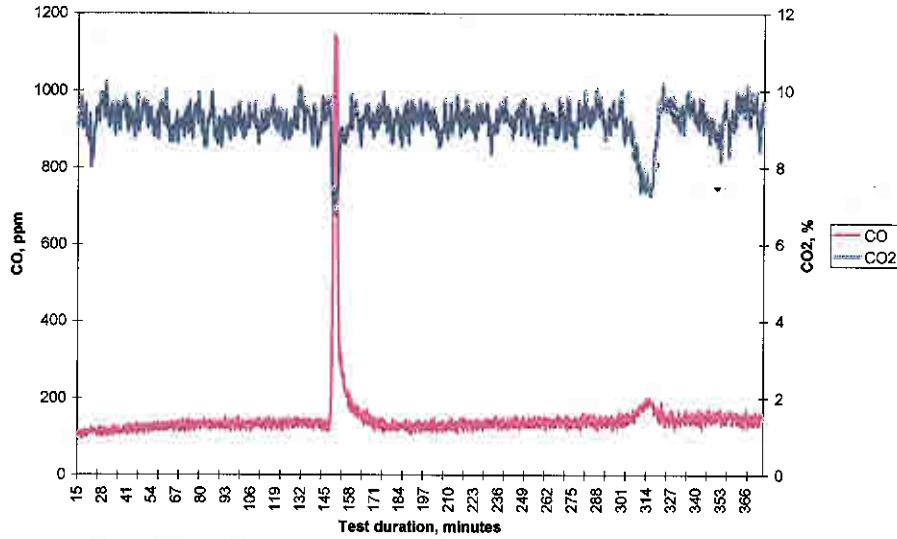
The pellet burner had the following settings in the electronics at minimum heat output:

O₂ sensor: 12,0 %

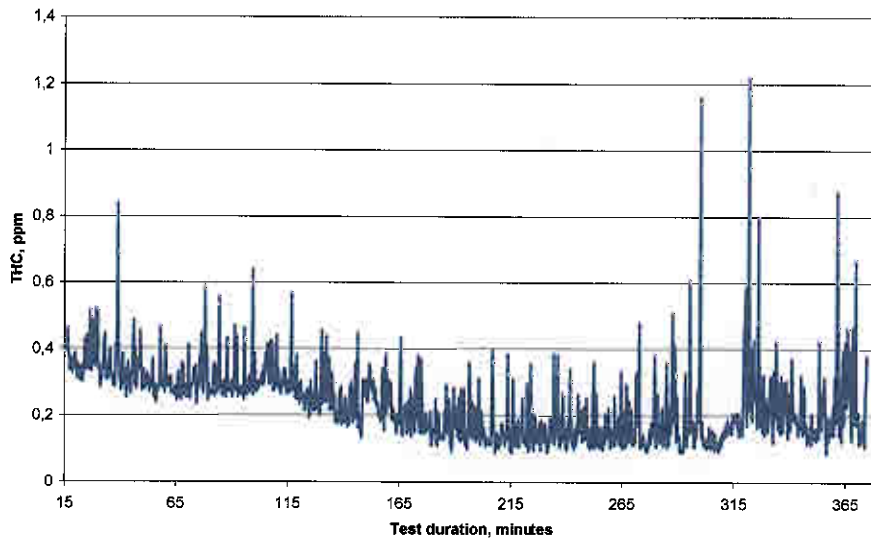
Combustion fan: 19,0 %

	Unit	Results
Test duration	h	6,0
Atmospheric pressure	mbar	1002
Quantity of fuel supplied	kg	118,1
lower calorific value (as fired basis)	kWh/kg	4,77
Flow temperature, (mean value)	°C	70,6
Return temperature, (mean value)	°C	55,7
Circulation flow, (mean value)	m ³ /h	4,94
Boiler temperature, (mean value)	°C	71
Ambient temperature, (mean value)	°C	21
Heat output	kW	84,1
Flue draught (chimney)	Pa	- 6
Flue gas temperature, (mean value)	°C	44
CO ₂ concentration, (mean value)	%	9,2
O ₂ concentration, (mean value)	%	11,1
CO concentration, (mean value)	ppm	144
CO concentration	mg/MJ	96
THC concentration, (mean value) (expressed as propane equivalent)	ppm	0,2
OGC concentration	mg/MJ	0,2
Efficiency	%	90
CO	mg/m ³ _n dry gas at 10% O ₂	200
OGC	mg/m ³ _n dry gas at 10% O ₂	0,4

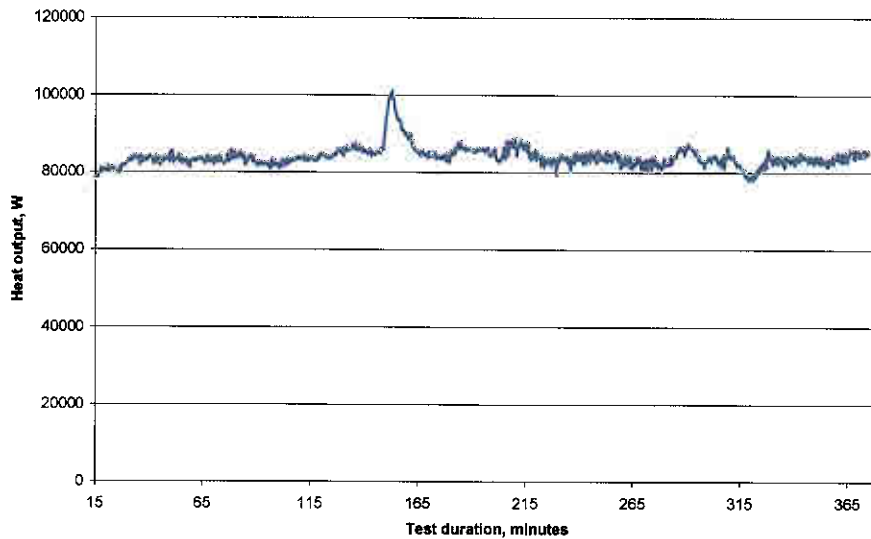
Appendix 2



CO and CO₂-emissions at minimum heat output



THC-emissions at minimum heat output



Minimum heat output

Appendix 2

5.11 Waterside resistance

Temperature difference at nominal heat output	Water flow (m ³ /h)	Waterside resistance (mbar)
20K	13,3	18
10K	26,5	78

5.12 Surface temperature

The below given surface temperatures are maximum values (each surface have at least five measuring points). The ambient temperature during the measurements was 20°C.

Side	29°C
Front	64°C
Boiler door	70°C
Rear	230°C
Burner	45°C

5.13 Function check of the temperature controller and safety temperature limiter

	Measured temperature	limit
Temperature controller	85°C	100°C
Safety temperature limiter	99°C	110°C

5.14 Function test on the device for dissipating excess heat

The pellet boiler was not equipped with a device for dissipating excess heat. The firing system is to be considered as rapidly disconnectable.

Appendix 3

Test fuel specifications
Test methods

Water content:	CEN/TS 14774-2
Ash content:	mod. SS 187171
Sulphur content:	CEN/TS 15289
Carbon, hydrogen and nitrogen content:	CEN/TS 15104
Oxygen content:	Calculated as a difference
Calorific value:	CEN/TS 14918

Results
Test fuel as fired basis

Water content, % of mass	8,3
Ash content, % of mass	0,3
Sulphur content, S, % of mass	<0,01
Carbon content, C, % of mass	45,7
Hydrogen content, H, % of mass	6,5
Nitrogen content, N, % of mass	0,05
Calorific value at constant volume , kWh/kg	5,16
Net calorific value at constant pressure, kWh/kg	4,77

Test fuel as dry basis

Ash content, % of mass	0,3
Sulphur, S, % of mass	<0,01
Carbon content, C, % of mass	49,8
Hydrogen content, H, % of mass	6,1
Nitrogen content, N, % of mass	0,05
Oxygen content, O, (diff) % of mass	44
Calorific value at constant volume , kWh/kg	5,63
Net calorific value at constant pressure, kWh/kg	5,26

Appendix 4

Instrumentation and uncertainty of measurement

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

- | | |
|---|--------------------------|
| • Resistance thermometer, Pt-100 | ETf-QD Db 2 |
| • Thermo element, type K | ETf-QD Db 3 |
| • Dust sampling equipment | ETf-QD Ca 9 |
| • Test rig | ETf-QD Ca 2 |
| • Dry gas meter, Schlumberger | SP inventory no. 201 618 |
| • Water flow meter, Valmet 9V-MP115 | SP inventory no. 200783 |
| • CO ₂ /CO analyser, Binos | SP inventory no. 201 668 |
| • O ₂ analyser, M.&C, Model PMA 10 | SP inventory no. 201 372 |
| • THC-analyser FID Model 3-300 A | SP inventory no. 200 626 |
| • NO _x -analyser Eco Physics CLD 700 EL ht | SP inventory no. 202 106 |
| • Data logging system | SP inventory no. 202 561 |
| • Differential pressure gauge, Furness | SP inventory no. 200 628 |
| • Weighing instrument, Sartorius LC 34 | SP inventory no. 201 639 |

Calibration gas

Gas	Identification	concentration
CO	842735	2505 ppm
CO ₂	842735	16,0 %
THC (C ₃ H ₈)	1992	91 ppm
NO _x	817466	914 ppm

Uncertainty of measurement

- | | |
|--|-------------------------|
| • Temperature difference, radiator circuit | ± 0,05 °C |
| • Liquid flow, radiator circuit | ± 1 % |
| • Fuel quantity | ± 0,01 kg |
| • Flue gas temperature | ± 3°C |
| • Ambient temperature | ± 1°C |
| • Boiler temperature | ±0,5°C |
| • Negative pressure in chimney | ±10 % |
| • CO ₂ concentration | ± 0,4 % CO ₂ |
| • CO concentration | ± 40 ppm CO |
| • O ₂ concentration | ± 0,4 % O ₂ |
| • THC concentration | ± 5 ppm THC |
| • Boiler efficiency | ± 2 percentage points |
| • Heat output | ± 1,5 % |
| • CO (mg/m ³ _n) | ± 5 % of emission limit |
| • OGC (mg/m ³ _n) | ± 5 % of emission limit |
| • Dust concentration | ± 4 % |

Analysed values

Net calorific value ±0,04 kWh/kg