




<h1>VETO 60</h1>		
<h2>TEST RESULTS OF THE BOILER TESTING ACCORDING TO EN 303-5</h2>		
	VTT, Expert Services Ltd	
	Requested by:	Veljekset Ala-Talkkari Oy



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Tested appliance VETO 60

Testing has been undertaken according to the standard EN 303-5 – Part 5: Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 500 kW- Terminology requirements, testing and marking.

The standard EN 303-5 is listed on VTT's qualification certificate as an Accredited Laboratory.

Appliance description

VETO 60 is a wood chip boiler.

Photographs of the tested appliance are presented in appendix 1. Technical drawings of the tested appliance are given in appendix 2.

Test arrangement

The combustion equipment was measured using the 70 kW solid fuel boiler test rig, constructed to meet the requirements of EN 303-5 standard. Testing of VTT Expert Services Ltd is accredited by The Finnish Accreditation Service (FINAS). FINAS belongs to the European co-operation for Accreditation (EA).

Testing

The appliance construction was assessed against the requirements of Clause 4.1 of EN 303-5. The appliance performance was assessed against the requirements of Clause 4.2 in accordance with the test method requirements and additional performance and safety requirements for the appliance given in Clause 5 of EN 303-5.

The performance type testing consisted of a nominal heat output test and a partial heat output test. The CO₂-, O₂-, CO-, OGC- and NO_x-concentrations, as well as the flue gas temperature and dust concentrations were measured at both heat outputs. The CO₂-, O₂-, CO-, OGC- and NO_x-concentrations were measured from dry flue gases and OGC-concentration (concentration of total organic carbon) from moist flue gas at about 180 °C. Concentrations are presented in % or ppm (= part per million; for example 10000 ppm = 1%) and in mg/Nm³ of dry flue gas, as well as converted to 10% of oxygen. Emissions are presented in mg/MJ.

Total efficiency was calculated based on measured boiler output and fuel consumption and its properties. Surface temperatures of the boiler and its operating components were also measured.

Particulate measurement was carried out using gravimetric method directly from flue gases. The measurement device was manufactured by the German company Paul Gothe following the method VDI 2066 and the standard EN 13284-1. Measuring system contains zero-pressure nozzle which ensures automatic isokinetic sampling and two filters in line. The first filter is a thimble filter and the other filter a plain filter having diameter of 45 mm. Both filters are inside the heater that is kept in 150 °C temperature.

Test fuel properties

Testing was carried out using birch wood chips. A representative sample was taken from the fuel batch for analysis and it was analysed in the accredited laboratory of Labtium Oy (Enas Oy) in Jyväskylä. The fuel moisture was analysed also by Labtium Oy. The properties of the test fuel are given in table 1.

Table 1. Test fuel properties.

Nominal heat output test	unit	Wood chips
Moisture content	% (wet basis)	25.6
Calorific value of DS	MJ/kg	18.33
Calorific value as received	MJ/kg	13.01
Partial heat output test		
Moisture content	% (wet basis)	22.1
Calorific value of DS	MJ/kg	18.34
Calorific value as received	MJ/kg	13.75
Ash content (550 °C)	m-% of DM	0.4
Carbon content	m-% of DM	49.9
Hydrogen content	m-% of DM	5.9
Nitrogen content	m-% of DM	<0.02

Test results

Measured and calculated results of the nominal heat load test are presented in Table 2 and of the partial heat load test in Table 3. Results are averages of the total burning period.

Table 2. Measured and calculated results of the nominal heat load test. All concentrations are given in dry flue gas.

26 May 2014	Unit	Result
Test period	hour	6.00
Temperature of out flow water	°C	77.9
Temperature of return water	°C	54.9
Ambient temperature	°C	22.0
Amount of fuel burned	kg	115.7
Energy in fuel	kWh	418.1
Energy to water circuit	kWh	369.8
Boiler efficiency	%	89
Boiler output	kW	61.6
Electrical consumption	W/h	333
Under pressure in the stack	Pa	-94.4
Flue gas temperature	°C	111.5
CO ₂ concentration	%	12.9
O ₂ concentration	%	7.8
CO concentration	ppm	147
CO concentration	ppm (at 10 % O ₂)	122
CO concentration	mg/Nm ³ (at 10 % O ₂)	152
CO emission	mg/MJ	75
OGC concentration	ppm	2
OGC concentration	mg org C/m ³ (at 10 % O ₂)	3
OGC emission	mg org C/MJ	1
NO _x concentration	ppm	132
NO _x concentration	ppm (at 10 % O ₂)	109
NO _x concentration	mg/Nm ³ as NO ₂ (at 10 % O ₂)	224
NO _x emission	mg/MJ as NO ₂	111
Particulate concentration		
- measurement 1	mg/Nm ³	35
- measurement 2		34
- measurement 3		34
- measurement 4		35
Average particulate concentration	mg/Nm ³ (at 10 % O ₂)	29
Particle emission	mg/MJ	14

Table 3. Measured and calculated results of *the partial heat load test*. All concentrations are given in dry flue gas.

12 May 2014	Unit	Result
Test period	hour	6.00
Temperature of out flow water	°C	75.4
Temperature of return water	°C	59.7
Ambient temperature	°C	21.0
Amount of fuel burned	kg	25.7
Energy in fuel	kWh	96.8
Energy to water circuit	kWh	85.7
Boiler efficiency	%	89
Boiler output	kW	14.3
Electrical consumption	W/h	165
Under pressure in the stack	Pa	-29.9
Flue gas temperature	°C	67.1
CO ₂ concentration	%	7.8
O ₂ concentration	%	12.7
CO concentration	ppm	376
CO concentration	ppm (at 10 % O ₂)	501
CO concentration	mg/Nm ³ (at 10 % O ₂)	626
CO emission	mg/MJ	315
OGC concentration	ppm	2
OGC concentration	mg org C/m ³ (at 10 % O ₂)	4
OGC emission	mg org C/MJ	2
NO _x concentration	ppm	62
NO _x concentration	ppm (at 10 % O ₂)	83
NO _x concentration	mg/Nm ³ as NO ₂ (at 10 % O ₂)	169
NO _x emission	mg/MJ as NO ₂	85
Particulate concentration	mg/Nm ³	
- measurement 1		21
- measurement 2		18
- measurement 3		14
- measurement 4		15
Average particulate concentration	mg/Nm ³ (at 10 % O ₂)	23
Particle emission	mg/MJ	12

Surface temperatures

Surface temperatures of the boiler are presented in table 4.

Table 4. Surface temperatures.

Hottest points of the boiler *)	Temperature	Exceeding ambient room temperature by
	°C	K
Front	57.3	35.3
Back	32.1	10.1
Right side	32.6	10.6
Left side	32.5	10.5
Top	37.2	15.2
Bottom	-	-

*) boiler operating doors excluded

Surface temperatures were measured using the infrared camera ThermaCAM™ E2 and K-Type thermocouple. Temperature of the surrounding was 22.0 °C. Temperatures of the boiler surface did not exceed the maximum allowed temperature according to the standard which is $22.0 + 65 = 87.0$ °C.

Summary

The boiler **VETO 60**, met construction requirements detailed in clause 4.2 of EN 303-5.

The boiler **VETO 60**, met the safety requirements detailed in clause 5 of EN 303-5.

The boiler **VETO 60**, met the performance requirements detailed in clause 4.4 of EN 303-5. The mean carbon monoxide emission, calculated at 10% oxygen content, is below the maximum limit value of 500 mg/m³ for the best class 5 specified in clause 4.4.7 of EN 303-5. The mean organic gaseous compounds (OGC) content, calculated at 10% oxygen content, is below the maximum limit value of 20 mg/m³ for the best class 5 specified in clause 4.4.7 of EN 303-5. The mean particulate concentration, calculated at 10% oxygen content, is below the maximum limit value of 40 mg/m³ for the best class 5 specified in clause 4.4.7 of EN 303-5. The mean particulate concentration at partial heat output, calculated at 10% oxygen content, was 23 mg/m³@ 10% O₂.

The measured total efficiency at nominal heat output was 89 % and exceeded the requirement of not less than 89 % for the best class 5 specified in clause 4.4.2 of EN 303-5.

Measured flue gas temperature at nominal heat output was 112 °C and was less than 160 K above the test room temperature. The manufacturer shall make recommendations regarding the flue installation in order to ensure sufficient draught and to prevent sooting up of the chimney and condensation.

The appliance operating instructions supplied by the manufacturer satisfied the requirements for the appliance operating instructions as detailed in Clause 8 of EN 303-5.

Jyväskylä, 6 June 2014


Aimo Kolsi
Product Manager




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Laboratory Technician

Appendices	2 pieces	
Distribution	Customer VTT / Archive	Original Original



VETO 60

Figure 1. Photograph of the tested appliance.

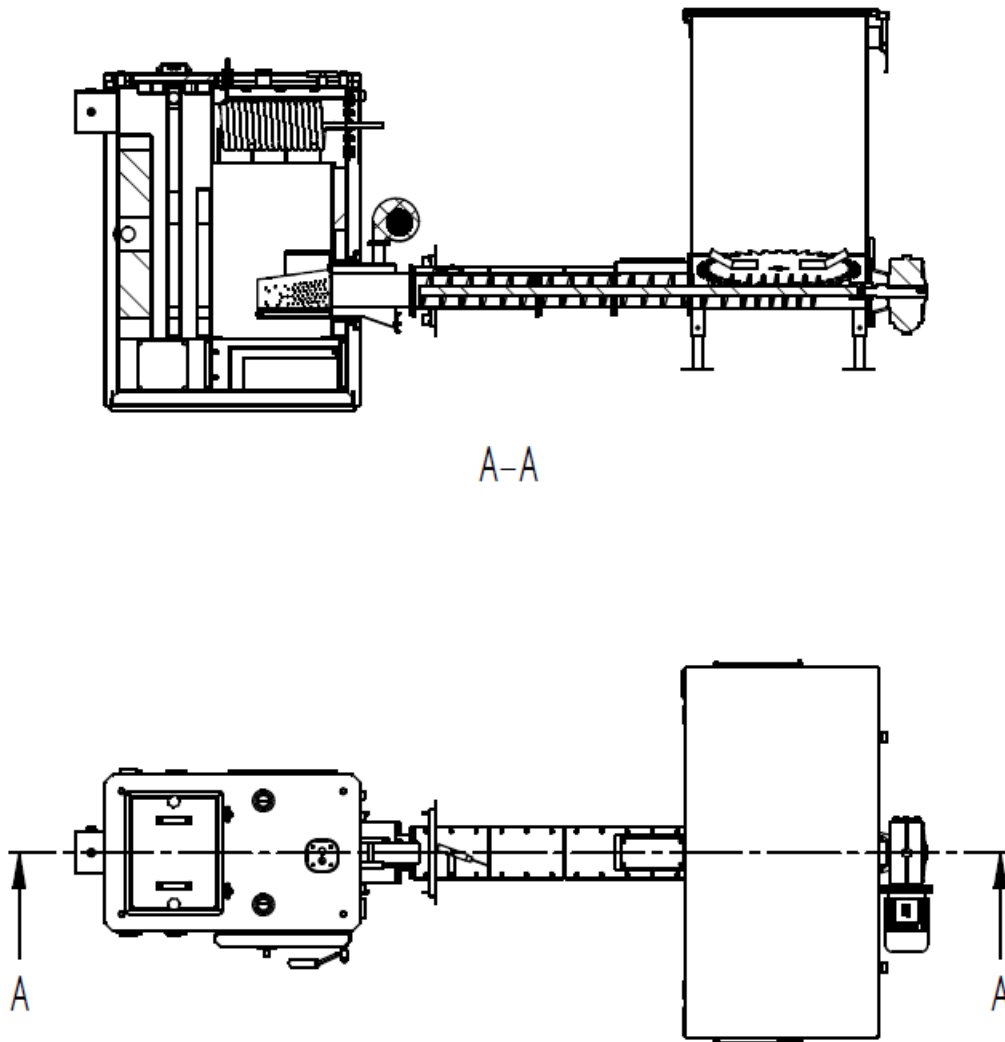


Figure 2. Technical drawings of the tested appliance.