



TEST REPORT

32-10562/T

Product: Hot-water boiler for solid fuel (wood – A) with manual fuel supply

Type designation ABC DELTA 20, ABC DELTA 30

Customer: ABC Proizvod
Miloša Obrenovića 2
31000 Užice
SERBIA

Manufacturer: ABC Proizvod
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The tests were performed based on these documents:

- Order B-72214 of 2021-02-08 (Order reg. no. B-72214 delivered on 2021-02-10)
- Contract B-72214/32
- Amendment D1 to Contract B-72214/32

I. Description of product tested

Hot-water boilers ABC DELTA are designed to burn solid fuel – wood on principle of wood gas generation using a fan. The body of the boiler is manufactured as welded sheet-steel structure. It comprises a loading chamber which in its upper part is equipped with ceramic nozzle with longitudinal slot through which passes the wood gas produced. Below it is the combustion chamber where the wood gas burns, lined with ceramic refractory pieces. The control panel is situated at the top of the boiler.

Further detailed descriptions of individual assembly groups are provided in the enclosed technical documentation to Task 32-10562.

II. Sample tested

- Number of samples: 2
- Date of submission or sampling: 202-05-06
- Reg. number: -
- Serial number: prototype1, prototype2

Boiler output versions that are the subject of the proceedings:

(table 1)

Boiler output version	Nominal heat output [kW]	Test fuel
ABC DELTA 20	20.0	Wood - A
ABC DELTA 30	30.0	

Visual inspection, testing and evaluation were carried out by Vladimir Foit test Engineer, at the test station of Kvalitet Niš a.d., Boulevard Svetog Cara Konstantina 82-86, 18000 Niš, Serbia in 05/2020.



The tests were carried out with the use of validly calibrated measuring and test equipment.

III. Measuring and test equipment

No.	Description	Inventory number	Calibration valid until	Accuracy
1.	Gas analyzer ULTRAMAT 23 SIEMENS	N1K2179	calibration prior to each measurement	Cert TUV 0000053810-10
2.	Gas analyzer ULTRAMAT 23 SIEMENS	N1K2180	calibration prior to each measurement	Cert TUV 0000053810-10
3.	Continuous Gas Analysis Gas analyzer for determination of total hydrocarbon content, FIDAMAT 6	N1JN440	calibration prior to each measurement	MCERTS CSA Group MC170331/01
4.	Platform scale, Elicom / SIEMENS/ SIWAREX / EEP600-2-4-C-x	008937/2016	10/2021	U 20V0100
5.	Platform scale, Elicom , EEP30-2-1-NL-x	9787	10/2021	U 20V0110
6.	Analitical balance, ADB 200-4	WE16000164	10/2021	U 20V0120
7.	Stopwatch – ZSD-808	143073	11/2021	Z-L-90/19-2
8.	Digital thermometer AHLBORN , FTA05L0500	A18010020	10/2022	1647/2020
9.	Digital probe Moisture and barometer pressure AHLBORN	FHAD 46-C2L05 5690-2	10/2022	1612/2020
8.	Draught gauge FSM / DPS	703092011802	09/2021	2018A67
9.	Electromagnetic flow sensor, Sitrans FM MAG3100/MAG 6000	486940H168	11 /2021	0001633502
10.	Electromagnetic flow sensor, Sitrans FM MAG3100/MAG 6000	YSNM 5258207958	01 /2023	0050076999
11.	Thermo sensors Pt 100	SFR50-3-4-S-6-50-14-R	10 / 2022	1613/2020
12.	Thermometer FLUKE , k type	87930009	06 / 2023	U 847
13.	Electricity meter 7KT1530	7G7A3634 89147	07 / 2022	27-08-18-09-45
14.	Rotametar GEMU - PAUL GOTHE	875R1007W2114	06 / 2023	p-21/099

Uncertainty of measurement

Parameter measured	Uncertainty of measurement
CO	±10 %
THC/OGC	±10 %
NO _x	±5 %
O ₂	±5 %
CO ₂	±5 %
Dust	±10 mg/m ³ from measured values

“The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, k=2, corresponding to the coverage certainty of 95% for standard classification. The uncertainties do not reflect the impact of sample taking and lack of homogeneity. The standard uncertainty was determined in accordance with Document EA 4/02.”



IV. Results of tests and evaluation

No.	Requirement	Technical standard, regulation applied	Source materials	Test evaluation
1.	Pressurized component tightness and strength test (T 001*)	ČSN EN 303-5:2013 Art. 5.4, 5.4.1, 5.4.2	Page 5	+
2.	Surface temperature test (T 001*)	ČSN EN 303-5:2013 Art. 5.12, 5.16.4, 4.3.6	Pages 6 - 8	+
3.	Test of heat output, input and efficiency (T 001*) Test of combustion product temperature (T 001*)	ČSN EN 303-5:2013 Art. 4.4.2, 4.4.3, 5.7, 5.8, 5.10 ČSN EN 303-5:2013 Art. 4.4.3	Pages 9 - 13	+
4.	Electrical consumption (T 071*)	ČSN EN 303-5:2013 Art. 5.8.5 ČSN EN 15456 Art. 5	Page 14	+
5.	Combustion efficiency test – emissions (T 001*)	ČSN EN 303-5:2013 Art. 5.7.3, 5.7.4, 5.9, 5.10.4	Pages 15 - 16	+
6.	Test of heat output, input and efficiency (T 001*) Combustion efficiency test – emissions (T 001*)	ČSN EN 303-5:2013 Annex C, Deviation from Austria C.2.2, C.2.3	Pages 17 - 18	+
		ČSN EN 303-5:2013 Annex C, C.3 Deviation from Croatia	-	0
		ČSN EN 303-5:2013 Annex C, Deviation from Denmark C.4.1, C.4.2	Pages 19 - 20	+
		ČSN EN 303-5:2013 Annex C, Deviation from Germany C.5.1, C.5.2	Pages 21 - 22	+
		ČSN EN 303-5:2013 Annex C C.6 Deviation from Switzerland	Pages 23 - 24	+
		ČSN EN 303-5:2013 Annex C C.8 Deviation from Italy	-	0
7.	Test of control, regulation and safety elements (T 001*) Combustion efficiency test - emissions (T 001*)	ČSN EN 303-5:2013 Art. 5.13, 5.14, 5.16.2, 5.16.3 ČSN EN 303-5:2013 Art. 5.9, 5.10.4	Pages 25 - 27	+
8.	Test of device for dissipating excess heat (T 001*)	ČSN EN 303-5:2013 Art. 4.1, 5.15	Page 28	+

Evaluation:

- + Requirement fulfilled
- Requirement not fulfilled
- x Not assessed
- 0 Not applicable



Accredited test
number:

T 001* Test title: **Pressurized component tightness and strength test**

Test method: ČSN EN 303-5:2013 Art. 5.4, 5.4.1, 5.4.2

Sample tested: ABC DELTA 20, 30

Measuring equipment used: Chapter III - Measuring and test equipment

Test results:

Requirement	Requirement specification	Test evaluation	Note
Pressure test for boilers of sheet or sheet metal of non-ferrous metal	ČSN EN 303-5:2013 Art. 5.4		
Tests to be carried out before production The type test pressure is $2 \times PS$ using hydraulic pressure where PS is the maximum permissible operating pressure. The test period shall be at least 10 min and if it is to apply to a range of boilers, the test shall be carried out on at least 3 boiler sizes (smallest, medium, and largest size). No leakage or noticeable permanent deformation shall occur during the test. A record shall be made of the test, including the following details: <ul style="list-style-type: none"> - exact description of the boiler tested by stating the drawing number; - test pressure in bar and duration of the test; - test result; - place and date of the test, including the names of persons carrying out the test. The test report shall be signed by, as a minimum, the works tester responsible and one witness.	ČSN EN 303-5:2013 Art. 5.4.1	<div>+</div> <div>+</div> <div>+</div> <div>+</div> <div>+</div>	Enclosed technical documentation.
Test during production Each boiler shall be tested during the production and the test pressure shall be at least $1.43 \times PS$.	ČSN EN 303-5:2013 Art. 5.4.2	+	

Measurement results: ABC DELTA 20, ABC DELTA 30

Boiler Type	ABC DELTA 20, ABC DELTA 30
Testing pressure [bar]	5.0
Maximal operation pressure [bar]	2.5
Ambient temperature (°C)	25.2
Humidity (%)	35.5
Air pressure (kPa)	98.25
Time [min]	30
Test medium	water
Date	2021-05-05

Test evaluation:

No leakages or visible permanent deformations appeared during the test.



Accredited test
number:

T 001* Test title: **Surface temperature test**

Test method:

ČSN EN 303-5:2013 Art. 5.12, 5.16.4, 4.3.6

Sample tested:

ABC DELTA 20, ABC DELTA 30

Measuring equipment used:

Chapter III - Measuring and test equipment

Test results:

Requirement	Requirement specification	Test evaluation	Note
Surface temperature The mean surface temperature shall be measured at nominal heat output. In order to do this, a minimum of 5 points on each boiler surface shall be measured. Under the same conditions, the critical temperatures (e.g. boiler doors, operating levers) shall be measured.	ČSN EN 303-5:2013 Art. 5.12	+	
The surface temperature on the outside of the boiler (including the bottom and doors but not including the flue gas outlet and maintenance openings of natural draft boilers) shall not exceed the room temperature by more than 60 K when tested in accordance with 5.12. The requirement for the bottom is not applicable for instances when the manufacturer declares that the boiler is to be installed on a non-combustible base. When tested in accordance with 5.12, the surface temperature of operating levers and all parts which shall be touched by hand during operation of the boiler shall not exceed the room temperature by more than the following values: <ul style="list-style-type: none"> - 35 K for metals and similar materials; - 45 K for porcelain and similar materials; - 60 K for plastics and similar materials. 	ČSN EN 303-5:2013 Art. 4.3.6	+	
Resistance to thermal conductance Temperature measurement shall be performed on the surface of the stoking device at the place next to the fuel line but within a maximum distance which shall be less than 1 m against the feeding direction from the inner wall of the combustion chamber. For boilers with integrated hopper, the temperature measurement shall be performed on the surface of the stoking device at the place next to the integrated hopper but within a maximum distance which shall be less than 1 m against the feeding direction from the inner wall of the combustion chamber. In addition, the highest surface temperature of the hopper shall be measured.	ČSN EN 303-5:2013 Art. 5.16.4	+	



Measurement results: ABC DELTA 20

Average temperatures of boiler walls, doors and covers (°C):	
Boiler type	ABC DELTA 20
Fuel type	Wood - A
Heat output	Nominal
Testing date	2021-05-05
ambient temperature (°C)	25.2
humidity (%)	35.5
air pressure (kPa)	98.25
Front wall	43.3
Rear wall	30.6
Right wall	31.8
Left wall	33.0
Upper wall	36.3
Lower wall	30.2
Temperatures of control elements (°C):	
Upper handle (plastic)	34.0
Middle handle (plastic)	37.0
Lower handle (plastic)	40.0
El. control panel (plastic)	30.0
Cleaning handles (plastic)	30.0 / 48.0

Measurement uncertainty: 2 °C for temperatures within the range of (0 ÷ 200) °C

"The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, $k=2$, corresponding to the coverage certainty of 95% as regards standard classification. The uncertainties do not reflect the impact of sample taking and lack of homogeneity. The standard uncertainty was determined in accordance with Document EA 4-02."

Test evaluation: The specified temperature rise values have not been exceeded.



Measurement results: ABC DELTA 30

Average temperatures of boiler walls, doors and covers (°C):	
Boiler type	ABC DELTA 30
Fuel type	Wood - A
Heat output	Nominal
Testing date	2021-05-06
ambient temperature (°C)	25.3
humidity (%)	34.0
air pressure (kPa)	98.88
Front wall	45.8
Rear wall	30.8
Right wall	32.3
Left wall	33.0
Upper wall	39.8
Lower wall	30.8
Temperatures of control elements (°C):	
Upper handle (plastic)	34.0
Middle handle (plastic)	37.0
Lower handle (plastic)	40.0
El. control panel (plastic)	30.0
Cleaning handles (plastic)	30.0 / 48.0

Measurement uncertainty: 2 °C for temperatures within the range of (0 ÷ 200) °C

"The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, $k=2$, corresponding to the coverage certainty of 95% as regards standard classification. The uncertainties do not reflect the impact of sample taking and lack of homogeneity. The standard uncertainty was determined in accordance with Document EA 4-02."

Test evaluation: The specified temperature rise values have not been exceeded.



Accredited test number: **T 001*** Test title: **Test of heat output, input and efficiency
Test of combustion product temperature**

Test method: ČSN EN 303-5:2013
Art. 4.4.2, 4.4.3, 5.7 to 5.10

Sample tested: ABC DELTA 20, ABC DELTA 30

Measuring equipment used: Chapter III - Measuring and test equipment

Test results:

Average measured and calculated values (solid fuels):

Test:	I.	II.	Average
Boiler type:	ABC DELTA 20		
Testing date:	2021-05-05		
Output tested:	Nominal		
Fuel type:	Wood - A		
Combustion period, (automatic) stoking	2 x 5.0 hours		
Nominal heat output (specified by manufacturer) [kW]	20.0	20.0	20.0
Flue gas temperature [°C]	117.7	119.0	118.3
Fuel mass added [kg/h]	4.967	4.930	4.95
Inlet water temperature [°C]	51.0	51.0	51.0
Outlet water temperature [°C]	72.3	72.0	72.2
Cooling water temperature [°C]	-	-	-
Water flow rate [m3/h]	0.8000	0.8088	0.8044
Draught [Pa]	12.0	12.0	12.0
Ambient temperature [°C]	25.3	25.2	25.2
Relative air humidity [%]	31.9	35.5	33.7
Barometric pressure [kPa]	98.46	98.25	98.36

Analysis of combustion products:

Test (period of burning) :	I.	II.	Average
Oxygen O ₂ [%]	5.05	5.00	5.03
Carbon dioxide CO ₂ [%]	15.25	15.27	15.26
Carbon monoxide CO [ppm]	89	156	122
Higher hydrocarbons THC/OGC [ppm]	15	19	17
Nitrogen oxides NOx [ppm]	73	71	72
Sulfur oxides SO ₂ [ppm]	< 1	< 1	< 1



Auxiliary combustion values (solid fuels):

Test (period of burning) :	I.	II.	Average
Stoichiometric oxygen volume [m ³ /kg]	0.835	0.835	0.835
Stoichiometric air volume [m ³ /kg]	3.977	3.977	3.977
Stoichiometric volume of dry combustion products [m ³ /kg]	3.933	3.933	3.933
Maximum content of CO ₂ [%]	20.08	20.08	20.08
Stoichiometric air multiple [-]	1.31	1.31	1.31
Volume of dry combustion products. actual [m ³ /kg]	5.178	5.168	5.173
Content of H ₂ O in combustion air [m ³ /kg]	0.055	0.061	0.058
Content of H ₂ O in combustion products [m ³ /kg]	0.827	0.832	0.829
Flue gas mass flow [kg/s]	0.011	0.011	0.011

Calculated values - thermal overview

Test (period of burning) :	I.	II.	Average
Loss of sensible heat of combustion products [%]	5.0	5.0	5.0
Loss of gas underburning [%]	0.1	0.1	0.1
Loss of mechanical underburning [%]	0.4	0.4	0.4
Loss of heat transfer into environment [%]	2.1	2.1	2.1
Total loss [%]	7.5	7.6	7.5
Efficiency – indirect method [%]	92.5	92.4	92.5
Fuel mass added - actual [kg/h]	4.996	4.959	4.977
Heat input [kW]	21.5	21.3	21.4
Heat output [kW]	19.6	19.5	19.5
Uncertainty of determining heat output [kW]	0.1	0.1	0.1
Efficiency – direct method [%]	91.2	91.4	91.3
Output / nominal output [%]	97.9	97.5	97.7

At nominal output, when burning **Wood – A**, the boiler efficiency meets the requirements applicable to **Class 5** as per ČSN EN 303-5:2013, Fig. 1.

Test evaluation:

The measured heat output is within the $\pm 8\%$ tolerance;
Boiler Class 5;
At nominal output, combustion product temperature is less than 160 K above the ambient temperature;
When burning Wood - A, the period of burning is 2 x 5.0 hours.



Test results:

Average measured and calculated values (solid fuels):

Test:	I.	II.	Average
Boiler type:	ABC DELTA 30		
Testing date:	2021-05-06		
Output tested:	Nominal		
Fuel type:	Wood - A		
Combustion period, (automatic) stoking	2 x 3.0 hours		
Nominal heat output (specified by manufacturer) [kW]	30.0	30.0	30.0
Flue gas temperature [°C]	154.9	156.6	155.8
Fuel mass added [kg/h]	7.472	7.390	7.43
Inlet water temperature [°C]	51.0	51.0	51.0
Outlet water temperature [°C]	72.1	71.8	71.9
Cooling water temperature [°C]	-	-	-
Water flow rate [m ³ /h]	1.2120	1.2140	1.2130
Draught [Pa]	12.0	12.0	12.0
Ambient temperature [°C]	24.2	25.3	24.7
Relative air humidity [%]	31.9	34.0	33.0
Barometric pressure [kPa]	99.15	98.88	99.01

Analysis of combustion products:

Test (period of burning) :	I.	II.	Average
Oxygen O ₂ [%]	5.00	4.67	4.83
Carbon dioxide CO ₂ [%]	15.49	15.81	15.65
Carbon monoxide CO [ppm]	119	143	131
Higher hydrocarbons THC/OGC [ppm]	3	3	3
Nitrogen oxides NO _x [ppm]	80	76	78
Sulfur oxides SO ₂ [ppm]	< 1	< 1	< 1

Auxiliary combustion values (solid fuels):

Test (period of burning) :	I.	II.	Average
Stoichiometric oxygen volume [m ³ /kg]	0.835	0.835	0.835
Stoichiometric air volume [m ³ /kg]	3.977	3.977	3.977
Stoichiometric volume of dry combustion products [m ³ /kg]	3.933	3.933	3.933
Maximum content of CO ₂ [%]	20.08	20.08	20.08
Stoichiometric air multiple [-]	1.31	1.28	1.30
Volume of dry combustion products. actual [m ³ /kg]	5.094	4.991	5.042
Content of H ₂ O in combustion air [m ³ /kg]	0.051	0.057	0.054
Content of H ₂ O in combustion products [m ³ /kg]	0.823	0.829	0.826
Flue gas mass flow [kg/s]	0.016	0.016	0.016



Calculated values - thermal overview

Test (period of burning) :		I.	II.	Average
Loss of sensible heat of combustion products [%]		7.0	6.9	6.9
Loss of gas underburning [%]		0.1	0.1	0.1
Loss of mechanical underburning [%]		0.4	0.4	0.4
Loss of heat transfer into environment [%]		1.6	1.7	1.7
Total loss [%]		9.0	9.0	9.0
Efficiency – indirect method [%]		91.0	91.0	91.0
Fuel mass added - actual [kg/h]		7.515	7.433	7.474
Heat input [kW]		32.3	32.0	32.1
Heat output [kW]		29.3	29.0	29.1
Uncertainty of determining heat output [kW]		0.2	0.2	0.2
Efficiency – direct method [%]		90.6	90.7	90.7
Output / nominal output [%]		97.6	96.7	97.2

At nominal output, when burning **Wood – A**, the boiler efficiency meets the requirements applicable to **Class 5** as per ČSN EN 303-5:2013, Fig. 1.

Test evaluation:

The measured heat output is within the $\pm 8\%$ tolerance;
Boiler Class 5;
At nominal output, combustion product temperature is less than 160 K above the ambient temperature;
When burning Wood - A, the period of burning is 2 x 3.0 hours.



Fuel analysis

Fuel type	Wood - A			
Analytical indicator	Symbol	Unit	Value	Uncertainty
Higher heating value	Q_s	[MJ/kg]	17.00	0.22
Lower heating value	Q_j	[MJ/kg]	15.48	0.22
All water in original condition	W_t^r	[% by weight]	15.40	0.01
Ash	A	[% by weight]	0.40	0.01
Carbon	C	[% by weight]	42.87	0.24
Hydrogen	H	[% by weight]	5.23	0.20
Nitrogen	N	[% by weight]	0.14	0.14
Sulphur	S	[% by weight]	0.009	0.001
Chlorine	Cl	[% by weight]	0.007	0.001
Oxygen – calculation for 100%	O	[% by weight]	35.97	
Conversion factor f_{emis} for emissions in [mg/m ³] to [mg/MJ]	f_{emis}	[-]	0.25926	

Note: Sample in original condition

Measurement uncertainty: Specified in Measurement results

"The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, $k=2$, corresponding to the coverage certainty of 95% for standard classification.



Accredited test
number:

T 071* Test title: **Electrical consumption**

Test method:

ČSN EN 303-5:2013 Art. 5.8.5
ČSN EN 15456 Art. 5

Sample tested:

ABC DELTA 20, ABC DELTA 30

Measuring equipment used:

Chapter III - Measuring and test equipment

Test results:

Requirement	Requirement specification	Test evaluation	Note
Electrical consumption During the tests, the electrical consumption shall be determined according to EN 15456. The values for maximum consumption, for stand by, nominal heat output and minimum heat output shall be stated in the test report. For boilers with automatic feeding systems (fuel line), the electrical consumption of the boiler and the fuel line shall be determined and stated separately. The average electrical power consumption during stand by shall be measured for a minimum duration of 10 min and shall be stated in watts. In cases where control operations influence the intrinsic energy consumption, a longer duration might be necessary.	ČSN EN 303-5:2013 Art. 5.8.5	+	

Test results: ABC DELTA 20

Maximum electrical input	80 W
Electrical input at nominal heat output	31 W
Maximum electrical input for air supply	2 W
Maximum electrical input for ventilator	70 W
Electrical input for STAND BY mode	3 W

Note: Testing date and ambient conditions – see Test No. T 001* (Test of heat output, input and efficiency)

Test results: ABC DELTA 30

Maximum electrical input	80 W
Electrical input at nominal heat output	46 W
Maximum electrical input for air supply	2 W
Maximum electrical input for ventilator	70 W
Electrical input for STAND BY mode	3 W

Note: Testing date and ambient conditions – see Test No. T 001* (Test of heat output, input and efficiency)



Accredited test
number:

T 001* Test title: **Combustion efficiency test - emissions**

Test method:

ČSN EN 303-5:2013
Art. 5.7.3, 5.7.4, 5.9, 5.10.4

Sample tested:

ABC DELTA 20, ABC DELTA 30

Measuring equipment used:

Chapter III - Measuring and test equipment

Requirement	Requirement specification	Test evaluation	Note
Emission limits Combustion shall be of low-emission. This requirement shall be satisfied if the emission values shown in Table 6 are not exceeded when operating at nominal heat output or, in the case of boilers with heat output range, when operating at nominal heat output and minimum heat output, in accordance with 5.7, 5.9 and 5.10.	ČSN EN 303-5:2013 Art. 4.4.7	+	

Table 6

Stoking	Fuel	Nominal heat output	Emission limits								
			CO			OGC/THC			Dust		
			mg/m ³ at 10% O ₂								
		kW	Class	Class	Class	Class	Class	Class	Class	Class	Class
			3	4	5	3	4	5	3	4	5
Manual	Biogenic	≤ 50	5000	1200	700	150	50	30	150	75	60
		> 50 ≤ 150	2500			100					
		> 150 ≤ 500	1200			100					
	Fossil	≤ 50	5000			150			125		
		> 50 ≤ 150	2500			100					
		> 150 ≤ 500	1200			100					
Automatic	Biogenic	≤ 50	3000	1000	500	100	30	20	150	60	40
		> 50 ≤ 150	2500			80					
		> 150 ≤ 500	1200			80					
	Fossil	≤ 50	3000			100			125		
		> 50 ≤ 150	2500			80					
		> 150 ≤ 500	1200			80					

NOTE 1: The dust values in this Table are based on the experience of the gravimetric filter method. The method used needs to be referred to in the test report. The particulate matter emission measured according to this European Standard does not include condensable organic compounds which may form additional particulate matter when the flue gas is mixed with ambient air. The values are therefore not directly comparable with values measured by dilution tunnel methods. Neither can they be directly translated into ambient air particulate concentrations.

NOTE 2: Additional test methods and emission limits which apply in some countries are given in the A-Deviations in Annex C.

^a Referred to dry exit flue gas, 0 °C, 1013 mbar.

^b Boilers of class 3 for type E-fuels according to 1.2.1 or e-fuels according to 1.2.3 in this Table and marked with the classification E-fuels and e-fuels do not need to fulfil the requirements for the dust emissions. The actual value shall be stated in the technical documentation and shall not exceed 200 mg/m³ at 10 % O₂.



Measurement results: ABC DELTA 20 - Wood - A

Boiler output	Average values									
	Measured values						Converted values O ₂ =10%			
	O ₂ [%]	CO ₂ [%]	CO [ppm]	OGC/THC [ppm]	NO _x [ppm]	Dust [mg/m ³]	CO [mg/m ³]	OGC/THC [mg/m ³]	NO _x [mg/m ³]	Dust [mg/m ³]
I. period	5.05	15.25	89	15	73	13	76	17	103	9
II. period	5.00	15.27	156	19	71	12	134	21	101	8
Average	5.03	15.26	122	17	72	12	105	19	102	9

Note: Testing date and ambient conditions – see Test No. T 001* (Test of heat output, input and efficiency)

Test evaluation:

ABC DELTA 20 – Wood - A meets at nominal output the emission requirements for **Class 5**, as per ČSN EN 303-5:2013 Table 6.

Measurement results: ABC DELTA 20 - Wood - A

Boiler output	Average values									
	Measured values						Converted values O ₂ =13%			
	O ₂ [%]	CO ₂ [%]	CO [ppm]	OGC/THC [ppm]	NO _x [ppm]	Dust [mg/m ³]	CO [mg/m ³]	OGC/THC [mg/m ³]	NO _x [mg/m ³]	Dust [mg/m ³]
I. period	5.05	15.25	89	15	73	13	56	13	75	7
II. period	5.00	15.27	156	19	71	12	97	15	73	6
Average	5.03	15.26	122	17	72	12	76	14	74	6

Note: Testing date and ambient conditions – see Test No. T 001* (Test of heat output, input and efficiency)

Measurement results: ABC DELTA 30 - Wood - A

Boiler output	Average values									
	Measured values						Converted values O ₂ =10%			
	O ₂ [%]	CO ₂ [%]	CO [ppm]	OGC/THC [ppm]	NO _x [ppm]	Dust [mg/m ³]	CO [mg/m ³]	OGC/THC [mg/m ³]	NO _x [mg/m ³]	Dust [mg/m ³]
I. period	5.00	15.49	119	3	80	21	102	3	113	15
II. period	4.67	15.81	143	3	76	23	121	3	105	15
Average	4.83	15.65	131	3	78	22	112	3	109	15

Note: Testing date and ambient conditions – see Test No. T 001* (Test of heat output, input and efficiency)

Test evaluation:

ABC DELTA 30 – Wood - A meets at nominal output the emission requirements for **Class 5**, as per ČSN EN 303-5:2013 Table 6.

Measurement results: ABC DELTA 30 - Wood - A

Boiler output	Average values									
	Measured values						Converted values O ₂ =13%			
	O ₂ [%]	CO ₂ [%]	CO [ppm]	OGC/THC [ppm]	NO _x [ppm]	Dust [mg/m ³]	CO [mg/m ³]	OGC/THC [mg/m ³]	NO _x [mg/m ³]	Dust [mg/m ³]
I. period	5.00	15.49	120	3	80	21	74	2	82	11
II. period	4.67	15.81	143	3	76	23	88	3	76	11
Average	4.83	15.65	131	3	78	22	81	2	79	11

Note: Testing date and ambient conditions – see Test No. T 001* (Test of heat output, input and efficiency)



Accredited test
number:

T 001*

Test title: **Test of heat output input and efficiency
Combustion efficiency test - emissions**

Requirement:

ČSN EN 303-5:2013
Annex C,
Deviation from Austria, C.2.2, C.2.3

Sample tested:

ABC DELTA 20, ABC DELTA 30

Test results: Evaluation of the test results stated in this Test Report only.

Requirement		Requirement specification	Test evaluation
Boiler efficiency for nominal heat output and minimum heat output		ČSN EN 303-5:2013 Annex C, Deviation from Austria, C.2.2	
Boiler	Minimum efficiency		+
Heating boilers for solid fuels	75 %		
a) manually loaded			
up to 10 kW	79 %		
>10 to 200 kW	(71.3 + 7.7 log P _n) %		+
>200 kW	89 %		
a) automatically loaded			
up to 10 kW	80 %		
>10 to 200 kW	(72.3 + 7.7 log P _n) %		
>200 kW	90 %		
NOTE <i>P_n is the nominal heat output (Q_n in this standard)</i>			

Requirement					Requirement specification		Test evaluation			
Emission limits					ČSN EN 303-5:2013 Annex C, Deviation from Austria, C.2.3		+			
Small burners used for solid fuels manually loaded										
Parameter	Emission limits mg-MJ									
	Wood		Other standardised biogenous fuels						Fossil fuels	
	Room heaters	Central heaters	< 50 kW nominal heat output	> 50 kW nominal heat output					< 50 kW nominal heat output	> 50 kW nominal heat output
CO	1100	500	1100	500					1100	500
NO _x	150	100	300	300	100	100				
OGC/THC	50	30	50	30	80	30				
Dust	35	30	35	35	35	35				



Measurement results: ABC DELTA 20 – Wood - A

Boiler output	Minimum efficiency	Measured efficiency
I. period	81.3	91.2
II. period		91.4
Average		91.3

Test evaluation:

The measured efficiency of ABC DELTA 20 - Wood - A is **higher** than required.

Measurement results: ABC DELTA 20 – Wood - A

Boiler output	Average values								
	Measured values					Converted values O ₂ =0%			
	O ₂ [%]	CO [ppm]	NO _x [ppm]	OGC/THC [ppm]	Dust [mg/m ³]	CO [mg/MJ]	NO _x [mg/MJ]	OGC/THC [mg/MJ]	Dust [mg/MJ]
I. period	5.05	89	73	15	13	37	50	8	4
II. period	5.00	156	71	19	12	65	49	10	4
Average	5.03	122	72	17	12	51	50	9	4

Test evaluation:

The measured emission values for ABC DELTA 20 - Wood - A **do not exceed** the specified values.

Measurement results: ABC DELTA 30 – Wood - A

Boiler output	Minimum efficiency	Measured efficiency
I. period	82.7	90.6
II. period		90.7
Average		90.7

Test evaluation:

The measured efficiency of ABC DELTA 30 - Wood - A is **higher** than required.

Measurement results: ABC DELTA 30 – Wood - A

Boiler output	Average values								
	Measured values					Converted values O ₂ =0%			
	O ₂ [%]	CO [ppm]	NO _x [ppm]	OGC/THC [ppm]	Dust [mg/m ³]	CO [mg/MJ]	NO _x [mg/MJ]	OGC/THC [mg/MJ]	Dust [mg/MJ]
I. period	5.00	119	80	3	21	50	55	2	7
II. period	4.67	143	76	3	23	59	51	2	7
Average	4.83	131	78	3	22	54	53	2	7

Test evaluation:

The measured emission values for ABC DELTA 30 - Wood - A **do not exceed** the specified values.



Accredited test
number:

T 001*

Test title: **Test of heat output, input and efficiency
Combustion efficiency test - emissions**

Requirement:

ČSN EN 303-5:2013
Annex C,
Deviation from Denmark, C.4.1, C.4.2

Sample tested:

ABC DELTA 20, ABC DELTA 30

Test results: Evaluation of the test results stated in this Test Report only.

Requirement	Requirement specification	Test evaluation
Boiler Efficiency	ČSN EN 303-5:2013 Annex C, Deviation from Denmark , C.4.1	
According to the Danish Construction Code BR08, Clause 8.5.1.4, Sub-clause 7, boilers for coal, coke, bio fuel or biomass shall have an efficiency equivalent to Class 3 in EN 303-5.		
Minimum efficiency (67 + 6 log Qn) %		
For boilers above 300 kW, the requirement corresponding to 300 kW shall be used.		

Requirement					Requirement specification	Test evaluation	
Emission limits							
According to the Danish EPA Statutory Order no. 1432 of 11-12-2007, only Class 3 (or higher) is acceptable for Denmark.					ČSN EN 303-5:2013 Annex C, Deviation from Denmark , C.4.2		
Stoking	Fuel	Nominal heat output	Emission limit values ^a				
			CO	OGC/THC		Dust	
		kW	mg-m ³ at 10% O ₂				
			Class				
						3	
Manual	Biogenic	≤ 50	5000	150		150	
		> 50 to 150	2500	100			
		> 150 to 300	1200				
	Fossil	≤ 50	5000	150		125	
		> 50 to 150	2500	100			
		> 150 to 300	1200				
Automatic	Biogenic	≤ 50	3000	80		150	
		> 50 to 150	2500				
		> 150 to 300	1200				
	Fossil	≤ 50	3000	100		125	
		> 50 to 150	2500				
		> 150 to 300	1200				
^a Referring to dry exit flue gas, 0 °C, 1 013 mbar.							

^a Referring to dry exit flue gas, 0 °C, 1 013 mbar.



Measurement results: ABC DELTA 20 - Wood - A

Boiler output	Minimum efficiency	Measured efficiency
I. period	74.8	91.2
II. period		91.4
Average		91.3

Test evaluation:

Measured efficiency for ABC DELTA 20 - Wood - A is **higher** than required.

Measurement results: ABC DELTA 20 - Wood - A

Boiler output	Average emission values						
	Measured values				Converted values O ₂ =10%		
	O ₂ [%]	CO [ppm]	OGC/THC [ppm]	Dust [mg/m ³]	CO [mg/m ³]	OGC/THC [mg/m ³]	Dust [mg/m ³]
I. period	5.05	89	15	13	76	17	9
II. period	5.00	156	19	12	134	21	8
Average	5.03	122	17	12	105	19	9

Test evaluation:

The measured emission values for ABC DELTA 20 - Wood - A **do not exceed** the specified values.

Measurement results: ABC DELTA 30 - Wood - A

Boiler output	Minimum efficiency	Measured efficiency
I. period	75.9	90.6
II. period		90.7
Average		90.7

Test evaluation:

Measured efficiency for ABC DELTA 30 - Wood - A is **higher** than required.

Measurement results: ABC DELTA 30 - Wood - A

Boiler output	Average emission values						
	Measured values				Converted values O ₂ =10%		
	O ₂ [%]	CO [ppm]	OGC/THC [ppm]	Dust [mg/m ³]	CO [mg/m ³]	OGC/THC [mg/m ³]	Dust [mg/m ³]
I. period	5.00	119	3	21	102	3	15
II. period	4.67	143	3	23	121	3	15
Average	4.83	131	3	22	112	3	15

Test evaluation:

The measured emission values for ABC DELTA 30 - Wood - A **do not exceed** the specified values.



Accredited test number: **T 001*** Test title: **Test of heat output, input and efficiency
Combustion efficiency test - emissions**

Requirement: ČSN EN 303-5:2013
Annex C,
Deviation from Germany, C.5.1, C.5.2

Sample tested: ABC DELTA 20, ABC DELTA 30

Test results: Evaluation of the test results stated in this Test Report only.

Requirement					Requirement specification	Test evaluation
Emission limits						
Table 7 – Emission limits					ČSN EN 303-5:2013 Annex C, Deviation from Germany, C.5.1, C.5.2	
The emission limits are regulated in Chapter 2, paragraphs 4, 5 and Annex 2 of the German Immission Control Ordinance "Erste Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über kleine und mittlere Feuerungsanlagen - 1. BImSchV)". Boilers operated with solid fuels shall only be installed, possess the quality and be put into operation if they fulfil the following specifications of the 1. BImSchV:						
	Fuel acc. to §3 (1)	Nominal output range kW	Dust g/m ³	CO g/m ³		
Stage 2: Appliances, which will be installed after 31.12.2014	Numbers 1 to 5a	≥ 4	0.02	0.4		+
	Numbers 6 to 7	≥ 30 ≤ 500	0.02	0.4		
			> 500	0.02	0.3	
		Numbers 8 to 13	≥ 4 < 100	0.02	0.4	
NOTE Differing from sentence 1 for firing systems (appliances) which will exclusively be fired by fuels according §3 article 1 Number 4 in the form of split logs, the limits according Stage 2 apply for firing systems (appliances) if they are installed after 31.12.2016						

Measurement results: ABC DELTA 20 - Wood - A

Boiler output	Average emission values				
	Measured values			Converted values O ₂ =13%	
	O ₂ [%]	CO [ppm]	Dust [mg/m ³]	CO [g/m ³]	Dust [g/m ³]
I. period	5.05	89	13	0.056	0.007
II. period	5.00	156	12	0.097	0.006
Average	5.03	122	12	0.076	0.006

Test evaluation:

The measured emission values for ABC DELTA 20 - Wood - A **do not exceed** the specified values.



Measurement results: ABC DELTA 30 - Wood - A

Boiler output	Average emission values				
	Measured values			Converted values O ₂ =13%	
	O ₂ [%]	CO [ppm]	Dust [mg/m ³]	CO [g/m ³]	Dust [g/m ³]
I. period	5.00	119	21	0.074	0.011
II. period	4.67	143	23	0.088	0.011
Average	4.83	131	22	0.081	0.011

Test evaluation:

The measured emission values for ABC DELTA 30 - Wood - A **do not exceed** the specified values.



Accredited test number: **T 001*** Test title: **Test of heat output, input and efficiency
Combustion efficiency test - emissions**

Requirement: ČSN EN 303-5:2013
Annex C
C.6 Deviation from Switzerland

Sample tested: ABC DELTA 20, ABC DELTA 30

Test results: Evaluation of the test results stated in this Test Report only.

Requirement			Requirement specification	Test evaluation
Emission limits			ČSN EN 303-5:2013 Annex C C.6 Deviation from Switzerland	
Clause 4.4.7, Table 7 The emission limits are regulated in Annex 4 of the Swiss Ordinance on Air Pollution Control ([OAPC] SR 814.318.142.1) of 1985-12-16 (as at 2010-07-15). Boilers operated with woody biomass shall only be put on the market if they fulfil the following specifications of the OAPC: – declarations of conformity (Figure 20 OAPC); – Figures 1, 212, 23 Annex 4 OAPC; – Figures 31, 32 Annex 5 OAPC. Emissions for boilers operated with coal or wood fuels shall not exceed the following limits:				
Type of installation	Particular requirements (emission limits) ^a for carbon monoxide (CO) and particulate matter (dust)			
	CO (mg·m ⁻³)	Dust (mg·m ⁻³)		
Boilers for log wood and boilers for coal, manual stoking	800	50		+
Boilers for chipped wood and boilers for coal, automatic stoking	400	60		
Boilers for Wood Pellets, automatic stoking	300	40		
^a Referred to oxygen basis: – for boilers for natural state wood 13 % volume; – for boilers for coal 7 % volume.				
The sulphur content of coal, coal briquettes and coke shall not exceed 3 %. Boilers operated with non-woody biomass shall comply with the following specifications of the OAPC: – Figures 741, 742, 743 Annex 2 OAPC; – Figures 81, 82 Annex 3 OAPC. According to Figure 743, Annex 2 OPAC, non-woody biomass, such as biogenic waste and products from agriculture, may only be burnt in boilers with a heat input of at least 70 kW. Such units need an approval and shall meet stronger emission limits according to Figure 742, Annex 2 OAPC.				0



Measurement results: ABC DELTA 20 - Wood - A

Boiler output	Average emission values				
	Measured values			Converted values O ₂ =13%	
	O ₂ [%]	CO [ppm]	Dust [mg/m ³]	CO [mg/m ³]	Dust [mg/m ³]
I. period	5.05	89	13	56	7
II. period	5.00	156	12	97	6
Average	5.03	122	12	76	6

Test evaluation:

The measured emission values for ABC DELTA 20 - Wood - A **do not exceed** the specified values.

Measurement results: ABC DELTA 30 - Wood - A

Boiler output	Average emission values				
	Measured values			Converted values O ₂ =13%	
	O ₂ [%]	CO [ppm]	Dust [mg/m ³]	CO [mg/m ³]	Dust [mg/m ³]
I. period	5.00	119	21	74	11
II. period	4.67	143	23	88	11
Average	4.83	131	22	81	11

Test evaluation:

The measured emission values for ABC DELTA 30 - Wood - A **do not exceed** the specified values.



Accredited test number: **T 001*** Test title: **Function test of control, regulation and safety elements
Combustion efficiency test - emissions**

Test method: ČSN EN 303-5:2013 Art. 5.13, 5.14, 5.16.1, 5.16.2, 5.16.3
ČSN EN 303-5:2013 Art. 5.9, 5.10.4

Sample tested: ABC DELTA 20, 30

Measuring equipment used: Chapter III - Measuring and test equipment

Test results:

Requirement	Requirement specification	Test evaluation	Note
<p>Function check of the temperature controller and safety temperature limiter at the boiler</p> <p>The water-side flow rate shall comply with that specified for the nominal heat output test. The flow temperature of 75 °C shall not be exceeded at the start of the test °C.</p> <p>Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler. A steady state condition shall be reached and the outlet pressure at the flue gas section shall be according to the nominal heat output setting. For manual stoked boilers, the boiler shall be refuelled after reaching steady state with a full batch before starting the test.</p> <p>The dissipated output shall be reduced to $(40 \pm 5) \%$ of the nominal heat output of the boiler, circulating pump running in continuous operation; temperature controller adjusted to maximum set value.</p> <p>When the temperature controller is operating normally, the measured flow temperature shall not exceed 100 °C; the safety temperature cut out or limiter or the device for dissipating excess heat shall not trigger.</p> <p>Repeat the test with the temperature controller out of function. This time, check if the safety temperature limiter-detector switches off the firing system at the highest value specified by the boiler manufacturers and if all hazardous operation states are avoided (see 4.1).</p>	ČSN EN 303-5:2013 Art. 5.13	+	



Requirement	Requirement specification	Test evaluation	Note
<p>Function test for the rapidly disconnectable firing system</p> <p>– Sudden absence of heat dissipation</p> <p>The water-side flow rate shall comply with that specified for the nominal output test. The flow temperature of 75 °C shall not be exceeded at the start of the test.</p> <p>Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler, a steady state condition is reached and the outlet pressure at the flue spigot is according to the rated heat output.</p> <p>The heat consumption is set to 0; water circulation in the boiler is permitted; temperature controller is adjusted to manufacture recommended maximum set value.</p> <p>Check if the safety temperature limiter or the temperature controller switches off the firing system and all hazardous operation states are avoided.</p> <p>- Loss of the electrical power supply</p> <p>The water-side flow rate shall comply with that specified for the nominal heat output test. The flow temperature of 75 °C shall not be exceeded at the start of the test.</p> <p>Adjust the firing so that it corresponds to the nominal heat output Q_N of the boiler, a steady state condition is reached and the outlet pressure at the flue gas section is according to the rated heat output.</p> <p>The electrical power supply including the circulation is cut off, check that no hazardous operation conditions occur.</p> <p>For the evaluation of the temperatures and the CO-concentrations, only mean values at a maximum average time of one minute shall be considered.</p>	<p>ČSN EN 303-5:2013 Art. 5.14</p>	<p>+</p>	
<p>Safety test of consequences of fuel overload and effect of a blockage of the fuel supply</p> <p>The safety of the boiler shall be checked at continuous operation of the boiler with the fuel feed rate of the stoking device set at possible maximum capacity, taking into account failures according to the risk analyses and the electrical safety. If other fuel feed rates lower than the maximum are categorised as critical by the risk analysis, these shall also be tested.</p> <p>The functionality of the safety device for the shut-down of the fuel shall occur by prevention of the ignition after release of fuel if no or insufficient combustion in the combustion chamber occurs.</p> <p>The test for blocked fuel line shall be achieved by deactivating the stoking device.</p> <p>The requirements specified in 4.3.4 shall be satisfied.</p>	<p>ČSN EN 303-5:2013 Art. 5.16.2</p>	<p>+</p>	



Requirement	Requirement specification	Test evaluation	Note
Loss of combustion air supply The safety of the heating boiler shall be checked at maximum heat input under the following conditions: <ul style="list-style-type: none"> – failure of combustion air fan; – failure to close of the adjustable combustion air supply. In each case, only one failure shall be simulated. The CO concentrations in the boiler shall not exceed 5 % volume. The measurement of CO concentration shall be carried out in the flue gas measuring section. Test of combustion air supply loss.	ČSN EN 303-5:2013 Art. 5.16.3	+	

Note:

+	Compliant
-	Non-compliant
0	Not applicable
x	Not assessed

Measurement results: ABC DELTA 30

Temperature controller		
Temperature	[°C]	Note:
Pre-set	85	Temperature set on the operating thermostat regulator
Regulation	88.7	Fan stop
Maximum temperature	91	The highest reached temperature
Restoration of operation	76	Fan restored

Note: Date of testing and ambient conditions - see Test No. T 001* (Test of heat output, input and efficiency)

Temperature limiter (manual restoration of temperature) STB		
Temperature	[°C]	Note:
Pre-set	100	Temperature set on the temperature limiter
Shutdown	96.6	Fan switched off
Maximum temperature	98	The highest reached temperature
Restoration of operation	The boiler irreversibly switched off. In order to restore operation, a manual intervention required, after the temperature drops under the limiter switching temperature	

Note: Date of testing and ambient conditions - see Test No. T 001* (Test of heat output, input and efficiency)

Test evaluation: Proper functioning of safety elements has been verified.



Accredited test
number:

T 001* Test title: **Test of device for dissipating excess heat**

Test method:

ČSN EN 303-5:2013
Art. 4.1, 5.15

Sample tested:

ABC DELTA 30

Measuring equipment used:

Chapter III - Measuring and test equipment

Test results:

Requirement	Requirement specification	Test evaluation	Note
Function test on the device for dissipating excess heat (partly or non-disconnectable firing system) Adjust the firing so that it corresponds to the nominal heat output QN of the boiler, a steady state condition is reached and the outlet pressure at the flue gas section is according to the nominal heat output. Put the temperature controller out of function. Maintain the function of the safety temperature limiter. The heat consumption is set to 0; water circulation in the boiler is permitted. Check if the safety temperature limiter switches off the firing system and the device for dissipating excess heat works properly and all hazardous operation states are avoided. The cold water shall be kept at a temperature of $(10 \pm 5) ^\circ\text{C}$ and a pressure of maximum 2 bar. (Deviations are permissible if they are specified in the installation instructions.) For the evaluation of the temperatures and the CO-concentrations, only mean values at a maximum average time of one minute shall be considered.	ČSN EN 303-5:2013 Art. 5.15	+	
The heat carrier (water) does not become heated to a dangerous extent ($\leq 110 ^\circ\text{C}$);	ČSN EN 303-5:2013 Art. 4.1	+	

Test results:

Measurement and calculated values:	Unit	Value	Limit	Note
Outlet water temperature - max	$^\circ\text{C}$	101.8	110	
Water cooling temperature – inlet to safety valve	$^\circ\text{C}$	17.0		
Water cooling temperature – outlet from safety valve	$^\circ\text{C}$	29.2		
Opening temperature - safety valve	$^\circ\text{C}$	96.7		
Pressure of cooling water	bar	2.0		
Water flow - max	m^3/hour	1.150		

Test evaluation:

During the safety temperature regulator test, the water temperature at the output from the boiler did not exceed 110°C .

Tested by: Ing. Vladimír Foit Date: 2021-06-15

Signed: 

Reviewed by: Mr. Milan Holomek Date: 2021-06-15

Signed: 



V. A list of other referenced documents

- Order B-72214 of 2021-02-08 (Order reg. no. B-72214 delivered on 2021-02-10)
- Contract B-72214/32
- Amendment D1 to Contract B-72214/32
- ČSN ISO 80000-1:2011 Quantities and units – Part 1: General
- ČSN EN 303-5:2013 - Heating boilers - Part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW - Terminology, requirements, testing and marking
- ČSN EN 15456:2008 - Heating boilers - Electrical power consumption for heat generators - System boundaries - Measurements

Test Report compiled by: Ing. Vladimír Foit

Test Report approved by:


Mr. Milan Holomek
Head of Heat and Environment-
Friendly Equipment Test Station



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