Strojírenský zkušební ústav, s.p.
(Engineering Test Institute, Public Enterprise)
Hudcova 424/56b, 621 00 Brno, Czech Republic

L 1045.1

TEST REPORT
31-9690/T

Product:	Hot-water boiler for solid fuel (wood pellets – C1) with automatic fuel supply
Type designation:	ECO TOP 33
Versions:	
Customer:	Topling d.o.o. Vojvode Stepe br. 6 78340 Prnjavor Bosnia and Herzegovina
Manufacturer:	Topling d.o.o. Vojvode Stepe br. 6 78340 Prnjavor Bosnia and Herzegovina
Person responsible for review and evaluation:	Ing. Stanislav Buchta
Report issue date:	2016-06-20
Distribution list:	1 copy to the Engineering Test Institute 1 copy to the Customer

The tests were conducted on the basis of Order B-53642 dated 2015-08-10 (received on 2015-08-11), Contract B-53642/31 and amendment D1, D2 and D3 of Contract B-53642/31.

I. Product description, intended use and mode of application

The Hot-water boilers for solid fuel (wood pellets – C1) with automatic fuel supply, ECO TOP 33 is intended for heating of large residential buildings and similar buildings. The boiler is designed for burning of wood pellets – C1. The boiler assembly comprises the boiler body, boiler burner, feed screw and the fuel chamber (storage of fuel). The boiler body is made of welded steel components. The boiler body is thermally insulated with mineral felt.
Further detailed descriptions of individual assembly groups are provided in the enclosed technical documentation to Task 31-9690.

II. Sample tested

Boiler output versions that are the subject of the proceedings:

(table 1)

Boiler output version	Heat output	Place of testing
ECO TOP 33	33 kW	SZU

Visual inspection, testing and evaluation were carried out by Ing. Pavel Fojtů, Test Engineer, at the test station of SZU in Brno, in 05/2016.

The tests were performed with the measurement and test equipment with valid calibration.

III. Measuring and test equipment

No.	Description	Inventory number	Calibration valid until	Accuracy
1.	Combustion product analyser, Horiba, type 680 P	92-0004	calibration prior to each measurement	see CRM 103000237769 see CRM 103000237770
2.	Weighing machine	02-2290	10/2017	see CS 6051-CS-H-0651-10
3.	Water meter, NW 20	02-1575	03/2017	see CS ACS-P/006/2009
4.	Data collection system	02-2241	12/2017	see CS 110002
5.	Moisture meter, thermometer	11-6258	11/2017	see CS 7630F/09
6.	Barometer	11-2541	11/2017	see CS 613-CS-K011-08
7.	Draught gauge	11-7275	01/2018	see CS 0144F/11
8.	Stop watch	99-0760	10/2017	see CS 2850E-07
9.	Calorimeter, IKA, type C 5000	02-2236	03/2017	± 0,12 MJ/kg
10.	Elemental analyser, Perkin Elmer, type 2400 CHNS	02-2107	03/2017	± 0,2 % rel.
11.	Gravimat, SHC 501	02-2328	12/2017	see CS 090177 (8,9), 090180
12.	Laboratory weighing machine	02-1458	06/2017	see CS 6051-CS-H376-09
13.	Weighing machine, Ohaus MB 45	02-2274	06/2017	see CS 6051-CS-H374-09
14.	Manometer	18-3336	06/2017	see CS 130052
15.	Prandtl tube, 0.3 m	ME 484	11/2017	see CS 5012-CS-RS090-09
16.	Psychrometer H 4220	92-0005	12/2017	see CS 090176
17.	Electrometer	03524781	03/2022	see CS 002/12/E

IV. Results of tests and evaluation

No.	Requirement	Technical standard, regulation applied	Source materials	Evaluation	
				Test	Evaluation
1.	**Pressurized component tightness and strength test (1001.1*)**	ČSN EN 303-5:2013 Art. 5.4, 5.4.1, 5.4.2	Page 5	+	
2.	**Surface temperature test (1003*)**	ČSN EN 303-5:2013 Art. 5.12, 5.16.4, 4.3.6	Pages 6 - 7	+	
3.	**Test of heat output, input and efficiency(1004.1*)** **Test of combustion product temperature (1004.2*)**	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 8 - 10	+	
4.	**Combustion efficiency test – emissions (1005.1*)**	ČSN EN 303-5:2013 Art. 4.4.7, 5.7.3, 5.7.4, 5.9, 5.10.4	Pages 11 - 12	+	
5.	**Test of heat output, input and efficiency (1004.1*)** **Combustion efficiency test – emissions (1005.1*)**	ČSN EN 303-5:2013 Annex C, Deviation from Austria, C.2.2, C.2.3	Pages 13 - 14	+	
		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 15 - 26	+	
		ČSN EN 303-5:2013 Annex C, Deviation from Germany, C.5.1, C.5.2	Pages 17 - 18	-	
		ČSN EN 303-5:2013 Annex C C.6 Deviation from Switzerland	Pages 19 - 20	+	
		ČSN EN 303-5:2013 Annex C C.8 Deviation from Italy	-	0	
6.	**Test of control, regulation and safety elements (1006.1*)** **Combustion efficiency test – emissions (1005.1*)**	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 21 - 23	+	

Note:
No.: 1 - 6
(**) Not a test

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

Accredited test number: **1001.1*** 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: ECO TOP 33

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 × *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: - 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	+ + + + + +	Enclosed technical documentation.
Test during production Each boiler shall be tested during the production and the test pressure shall be at least 1.43 × *PS*.	ČSN EN 303-5:2013 Art. 5.4.2	+	

Test evaluation: No leakages or visible permanent deformations appeared during the test.

Accredited test number: **1003*** Test title: **Surface temperature test**

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

Sample tested: ECO TOP 33

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: - 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: ECO TOP 33

Average temperatures of boiler walls, doors and covers (^{0}C):		
Boiler type	ECO TOP 33	
Fuel type	Wood Pellets - C1	
Heat output	Nominal	Minimal
ambient temperature (°C) humidity (%) air pressure (kPa)	22.9 48.8 98.19	23.5 50.1 98.25
Front wall	34.8	32.3
Rear wall	40.1	36.1
Right wall	34.0	33.6
Left wall	32.0	30.8
Upper wall	36.4	35.4
Lower wall	52.6	51.5
Temperatures of control elements (^{0}C):		
Boiler cover (metal)	33.8	
Handle of lower door (metal)	34.9	
Handle of hopper (metal)	27.5	
Lower side of fuel hopper (metal)	27.1	
Interior side of fuel hopper (metal)	50.6	
Fuel feeder	54.8	

Measurement uncertainty: 2 ^{0}C for temperatures within the range of (0 ÷ 250) ^{0}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:	**1004.1***	Test title: **Test of heat output, input and efficiency**
	1004.2*	**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:	ECO TOP 33
Measuring equipment used:	Chapter III - Measuring and test equipment

Test results:

Average measured and calculated values (solid fuels):

Test:		I.	II.
Boiler type:		ECO TOP 33	
Output tested:		Nominal	Minimum
Fuel type:		**Wood pellets - C1**	
Combustion period, (automatic) stoking		Minimally 6 hours	
Nominal heat output (specified by manufacturer)	[kW]	33	33
Flue gas temperature	[°C]	82.3	65.9
Fuel mass added	[kg/h]	6.879	2.090
Inlet water temperature	[°C]	56.3	71.9
Outlet water temperature	[°C]	75.3	85.0
Temperature of the entering cold water	[°C]	12.3	13.6
Cooling water flow rate	[m3/h]	1.4339	0.6140
Draught	[Pa]	10.3	10.2
Ambient temperature	[°C]	22.5	22.1
Relative air humidity	[%]	32.3	42.8
Barometric pressure	[kPa]	98.38	98.69

Analysis of combustion products:

Test (period of burning) :		I.	II.
Oxygen O_2	[%]	8.85	12.70
Carbon dioxide CO_2	[%]	12.42	8.44
Carbon monoxide CO	[ppm]	238	184
Higher hydrocarbons THC/OGC	[ppm]	6	4
Nitrogen oxides NOx	[ppm]	72	51
Sulfur oxides SO_2	[ppm]	0	0

Auxiliary combustion values (solid fuels):

Test (period of burning) :		I.	II.
Stoichiometric oxygen volume	[m^3/kg]	0.896	0.895
Stoichiometric air volume	[m^3/kg]	4.266	4.261
Stoichiometric volume of dry combustion products	[m^3/kg]	4.247	4.242
Maximum content of CO_2	[%]	20.63	20.63
Stoichiometric air multiple	[-]	1.72	2.52
Volume of dry combustion products. actual	[m^3/kg]	7.040	10.343
Content of H_2O in combustion air	[m^3/kg]	0.067	0.126
Content of H_2O in combustion products	[m^3/kg]	0.738	0.797

Calculated values - thermal overview

Test (period of burning) :		I.	II.
Loss of sensible heat of combustion products	[%]	3.6	3.8
Loss of gas underburning	[%]	0.1	0.1
Loss of mechanical underburning	[%]	0.1	0.2
Loss of heat transfer into environment	[%]	1.9	5.5
Total loss	[%]	5.8	9.6
Efficiency – indirect method	[%]	94.2	90.4
Fuel mass added - actual	[kg/h]	6.899	2.097
Heat input	[kW]	33.3	10.1
Heat output	**[kW]**	**31.3**	**9.1**
Uncertainty of determining heat output	[kW]	1.3	0.4
Efficiency – direct method	**[%]**	**93.7**	**90.0**
Output / nominal output	[%]	94.7	27.6

At nominal output, when burning **Wood pellets – C1,** 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 ± 8% tolerance;
Boiler Class 5;
At nominal output, combustion product temperature is less than 160 K above the ambient temperature;
When burning Wood pellets – C1, the period of burning is more than 6 hours;
The minimum heat output is less than 30% of nominal heat output.

Test results:

ECO TOP 33	
Electricity 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.	
Maximum electrical input	507 W
Electrical input at nominal heat output	45 W
Electrical input at minimum heat output	21 W
Electrical input for STAND BY mode	3 W
Maximum electrical input for ignition system	400 W
Maximum electrical input for fuel supply (fuel line)	40 W

Fuel analysis

Fuel type	Wood pellets – C1			
Analytical indicator	Symbol	Unit	Value	Uncertainty
Higher heating value	Q_s	[MJ/kg]	18.72	0.22
Lower heating value	Q_j	[MJ/kg]	17.40	0.22
All water in original condition	W^r_t	[% by weight]	6.00	0.05
Ash	A	[% by weight]	0.25	0.03
Carbon	C	[% by weight]	47.39	0.24
Hydrogen	H	[% by weight]	5.38	0.20
Nitrogen	N	[% by weight]	0.09	0.14
Sulphur	S	[% by weight]	0.000	0.000
Chlorine	Cl	[% by weight]	0.007	0.001
Oxygen – calculation for 100%	O	[% by weight]	40.88	
Conversion factor f_{emis} for emissions in [mg/m3] to [mg/MJ]	f_{emis}	[-]	0.24462	

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. 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".

Accredited test number: **1005.1*** Test title: **Combustion efficiency test - emissions**

Test method: ČSN EN 303-5:2013
Art. 4.4.7, 5.7.3, 5.7.4, 5.9, 5.10.4

Sample tested: ECO TOP 33

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/m³ at 10% O_2								
		kW	Class 3	Class 4	Class 5	Class 3	Class 4	Class 5	Class 3	Class 4	Class 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: ECO TOP 33 – Wood pellets – C1

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]
Nominal	8.85	12.42	238	6	72	32	270	8	134	29
Minimum	12.70	8.44	184	4	51	26	304	8	140	34

Test evaluation:
ECO TOP 33 - Wood pellets - C1 meets at nominal and minimum output the emission requirements for **Class 5,** as per ČSN EN 303-5:2013 Table 6.

Accredited test number:	**1004.1*** **1005.1***	Test title:	**Test of heat output input and efficiency** **Combustion efficiency test - emissions**

Test method:	ČSN EN 303-5:2013 Annex C, Deviation from Austria, C.2.2, C.2.3
Sample tested:	ECO TOP 33
Measuring equipment used:	Chapter III - Measuring and test equipment

Test results:

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	Wood Pellets – C1
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 Pn) %		
>200 kW	89 %		
a) automatically loaded			
up to 10 kW	80 %		
>10 to 200 kW	(72.3 + 7.7 log Pn) %		+
>200 kW	90 %		
NOTE *Pn is the nominal heat output (Qn in this standard)*			

Requirement					**Requirement specification**	**Test evaluation**
Emission limits					ČSN EN 303-5:2013 Annex C, Deviation from Austria, C.2.3	Wood Pellets – C1
Small burners used for solid fuels automatically loaded						
Parameter	Emission limits mg-MJ					
	Wooden Wood Pellets Room heaters	Wooden Wood Pellets Central heaters	Other wooden fuels	Other standardised biogenous fuels		
CO	500[a]	250[a]	250[a]	500[a]		+
NO_x	100	100	100	300		
OGC/THC	30	20	30	20		
Dust	25	20	30	35		
[a] The limit value can be exceeded by 50 % during partial load operation at 30 % of nominal heat output.						

Measurement results: ECO TOP 33 – Wood pellets – C1

Boiler output	Minimum efficiency	Measured efficiency
Nominal	84.0	93.7
Minimum		90.0

Test evaluation:

The measured efficiency of ECO TOP 33 - Wood pellets - C1 is **higher** than required.

Measurement results: ECO TOP 33 – Wood pellets – C1

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]
Nominal	8.85	238	72	6	32	126	62	4	14
Minimum	12.70	184	51	4	26	142	65	4	16

Test evaluation:

The measured emission values for ECO TOP 33 - Wood pellets - C1 **do not exceed** the specified values.

Accredited test number:	**1004.1*** **1005.1***	Test title:	**Test of heat output, input and efficiency** **Combustion efficiency test - emissions**

Test method:	ČSN EN 303-5:2013 Annex C, Deviation from Denmark, C.4.1, C.4.2
Sample tested:	ECO TOP 33
Measuring equipment used:	Chapter III - Measuring and test equipment

Test results:

Requirement		Requirement specification	Test evaluation
Boiler Efficiency		ČSN EN 303-5:2013 Annex C, Deviation from Denmark , C.4.1	Wood Pellets – C1
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	Wood Pellets – C1
Stoking	Fuel	Nominal heat output	Emission limit values [a]				
			CO	OGC/ THC	Dust		
			mg-m^3 at 10% O_2				
		kW	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	80			
		> 150 to 300	1200				
[a] Referring to dry exit flue gas, 0 °C, 1 013 mbar.							

Measurement results: ECO TOP 33 – Wood pellets - C1

Boiler output	Minimum efficiency	Measured efficiency
Nominal	76.1	93.7
Minimum		90.0

Test evaluation:

Measured efficiency for ECO TOP 33 - Wood pellets - C1 is **higher** than required.

Measurement results: ECO TOP 33 – Wood pellets - C1

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]
Nominal	8.85	238	6	32	270	8	29
Minimum	12.70	184	4	26	304	8	34

Test evaluation:

The measured emission values for ECO TOP 33 - Wood pellets - C1 **do not exceed** the specified values.

Accredited test number:	**1004.1***	Test title:	**Test of heat output, input and efficiency**
	1005.1*		**Combustion efficiency test - emissions**

Test method:	ČSN EN 303-5:2013 Annex C, Deviation from Germany, C.5.1, C.5.2
Sample tested:	ECO TOP 33
Measuring equipment used:	Chapter III - Measuring and test equipment

Test results:

<table>
<tr><th colspan="6">Requirement</th><th>Requirement specification</th><th>Test evaluation</th></tr>
<tr><td colspan="6">Emission limits</td><td rowspan="2">ČSN EN 303-5:2013
Annex C,
Deviation from Germany, C.5.1</td><td rowspan="2">Wood Pellets – C1</td></tr>
<tr><td colspan="6">Table 7 – Emission limits
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:</td></tr>
<tr><td></td><td>Fuel acc. to §3 (1)</td><td>Nominal output range kW</td><td>Dust g/m³</td><td>CO g/m³</td><td></td><td></td></tr>
<tr><td rowspan="4">Stage 2: Appliances, which will be installed after 31.12.2014</td><td>Numbers 1 to 5a</td><td>≥ 4</td><td>0.02</td><td>0.4</td><td rowspan="4"></td><td>-</td></tr>
<tr><td rowspan="2">Numbers 6 to 7</td><td>≥ 30 ≤ 500</td><td>0.02</td><td>0.4</td><td rowspan="3"></td></tr>
<tr><td>> 500</td><td>0.02</td><td>0.3</td></tr>
<tr><td>Numbers 8 to 13</td><td>≥ 4 < 100</td><td>0.02</td><td>0.4</td></tr>
<tr><td colspan="8">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.</td></tr>
</table>

Measurement results: ECO TOP 33 – Wood pellets - C1

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]
Nominal	8.85	238	32	0.196	0.021
Minimum	12.70	184	26	0.221	0.025

Test evaluation:
The measured emission values for ECO TOP 33 - Wood pellets - C1 **exceed** the specified values.

Accredited test number:	**1004.1*** Test title: **Test of heat output, input and efficiency** **1005.1*** **Combustion efficiency test - emissions**	
Test method:		ČSN EN 303-5:2013 Annex C C.6 Deviation from Switzerland
Sample tested:		ECO TOP 33
Measuring equipment used:		Chapter III - Measuring and test equipment

Test results:

<table>
<tr><th colspan="3">Requirement</th><th>Requirement specification</th><th>Test evaluation</th></tr>
<tr><td colspan="3">Emission limits</td><td rowspan="5">ČSN EN 303-5:2013
Annex C
C.6 Deviation from Switzerland</td><td rowspan="4">Wood Pellets - C1</td></tr>
<tr><td colspan="3">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:</td></tr>
<tr><td rowspan="2">Type of installation</td><td colspan="2">Particular requirements (emission limits)[a] for carbon monoxide (CO) and particulate matter (dust)</td></tr>
<tr><td>CO (mg-m^3)</td><td>Dust (mg-m^3)</td></tr>
<tr><td>Boilers for log wood and boilers for coal, manual stoking</td><td>800</td><td>50</td></tr>
<tr><td>Boilers for chipped wood and boilers for coal, automatic stoking</td><td>400</td><td>60</td></tr>
<tr><td>Boilers for Wood Pellets, automatic stoking</td><td>300</td><td>40</td><td>+</td></tr>
<tr><td colspan="5">[a] Referred to oxygen basis:
– for boilers for natural state wood 13 % volume;
– for boilers for coal 7 % volume.</td></tr>
<tr><td colspan="4">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.</td><td>0</td></tr>
</table>

Measurement results: ECO TOP 33 – Wood pellets - C1

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]
Nominal	8.85	238	32	196	21
Minimum	12.70	184	26	221	25

Test evaluation:

The measured emission values for ECO TOP 33 - Wood pellets - C1 **do not exceed** the specified values.

Accredited test number:	**1006.1***	Test title:
	1005.1*	**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:	ECO TOP 33
Measuring equipment used:	Chapter III - Measuring and test equipment

Test results:

Requirement	Requirement specification	Test evaluation	Note
Function check of the temperature controller and safety temperature limiter at the boiler 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. 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. The dissipated output shall be reduced to (40 ± 5) % of the nominal heat output of the boiler, circulating pump running in continuous operation; temperature controller adjusted to maximum set value. 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. 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).	ČSN EN 303-5:2013 Art. 5.13	+	

Requirement	Requirement specification	Test evaluation	Note
Function test for the rapidly disconnectable firing system – Sudden absence of heat dissipation 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. 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. The heat consumption is set to 0; water circulation in the boiler is permitted; temperature controller is adjusted to manufacture recommended maximum set value. Check if the safety temperature limiter or the temperature controller switches off the firing system and all hazardous operation states are avoided. - Loss of the electrical power supply 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. 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. The electrical power supply including the circulation is cut off, check that no hazardous operation conditions occur. 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. 5.14	+	
Safety test of consequences of fuel overload and effect of a blockage of the fuel supply 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. 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. The test for blocked fuel line shall be achieved by deactivating the stoking device. **The requirements specified in 4.3.4 shall be satisfied.**	ČSN EN 303-5:2013 Art. 5.16.2	+	

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: – 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:

Temperature controller		
Temperature	**[°C]**	**Note:**
Pre-set	80	Temperature set on the operating thermostat regulator
Shutdown	82	Fan and stoking switched off (suppression mode)
Restoration of operation	69	Fan and stoking restored

Temperature limiter (manual restoration of temperature) STB		
Temperature	**[°C]**	**Note:**
Pre-set	95	Temperature set on the temperature limiter
Shutdown	99	Fan and stoking switched off
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	

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

Tested by: Ing. Pavel Fojtů Date: 05/2016 Signed:

Reviewed by: Ing. Stanislav Buchta Date: 06/2016 Signed:

V. List of source materials

The tests were performed based on

- Order B-53642 dated 2015-08-10 (received on 2015-08-11)
- Contract B-53642/31
- Amendment D1, D2 and D3 of Contract B-53642/31
- 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

Test report compiled by: Ing. Pavel Fojtů

The persons named below are accountable for the accuracy of the above-specified data:

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