

TEST REPORT

Number: B/2025/225K dated: 04.06.2025

Subject: Testing of UnicPel 18 heat output 18 kW solid fuel heating boiler

Testing performed for: Mareli Systems LTD

Lyulin, bl.821, ap.1:

Sofia 1336 Bulgaria

Testing performed at: Zakłady Badań i Atestacji „ZETOM” im. Prof. F. Stauba w Katowicach

Sp. z o.o. - Research and Calibration Laboratory "ZETOM" Katowice

Customer order index: Test Order dated: 12.05.2025

The order was registered at the laboratory under the number: B/2025/225K

Testing started on: 13.05.2025 Testing completed on: 14.05.2025

The report contains: 20 pages

3 copies have been issued to:

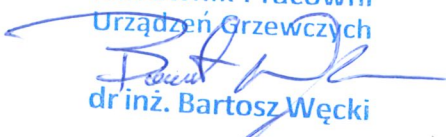
1. Mareli Systems LTD
2. Mareli Systems LTD
3. LT

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FINDINGS

A. Obligatory:

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3. This test report may only be used in its entirety.
4. All test and measurement results presented in this Report apply only to the tested objects and do not constitute an approval of their quality.
5. The work was performed in accordance with the respective work plan, in accordance with the requirements of the management system according to the Quality Manual of the Research and Calibration Laboratory.
6. When making reference to this Report, use the following (or equivalent) sentence:

Tested by the "ZETOM" Research and Calibration Laboratory in Katowice, which is accredited by the Polish Centre for Accreditation in Warsaw within the scope defined in the appendix to Certificate No. AB 024

B. Additional (listed in the Report) p.**C. Anomalies** (listed in the Report) p.

When using the report's content, the Report Owner is obliged to cite that it is using results obtained by the Testing and Calibration Laboratory of Zakłady Badań i Atestacji “ZETOM” Prof. F. Stauba w Katowicach Sp. z o.o., accredited by the Polish Centre for Accreditation.

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1. Basis of testing

1.1. Name of the ordering party's document:	Ordering Party Mareli Systems LTD for the performance of tests at the Test and Calibration Laboratory "ZETOM" Katowice
1.2. Identification of the ordering party's document:	Order no. B/2025/225K
1.3. Regards:	Execution of testing

2. Purpose of testing

The purpose of the order was to perform accredited testing to confirm compliance with the requirements of PN-EN 303-5:2021+A1:2023-05.

3. Object of testing

Object name:	Solid fuel boiler UnicPel 18 heat output 18 kW
Ordering Party:	Mareli Systems LTD, Lyulin, bl.821, ap.1: Sofia 1336 Bulgaria
Supplier/Manufacturer :	Mareli Systems LTD, Lyulin, bl.821, ap.1: Sofia 1336 Bulgaria
Place of manufacture:	Mareli Systems Industrial Zone Simitli, 2730; Region Blagoevgrad; Bulgaria
Method of delivery to test facilities:	Ordering Party
Date of receipt of test objects:	12.05.2025
Description of the packaging:	pallet

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4. Characteristics of the tested boiler based on the manufacturer's data

4.1. Technical specification based on operating manual

Table 1. Technical parameters of the boiler

Nr	Boiler parameters	Unit	Value
1	Rated output	kW	18
2	Permissible fuel	-	Wood pellets
3	latitude	mm	630
	depth	mm	840
	height	mm	1460
4	Boiler weight	kg	275
5	Charging hopper capacity	kg	108
6	Boiler water capacity	l	45
7	Required flue gas draught	Pa	12
8	Maximum operating temperature	°C	90
9	Permissible operating pressure	bar	2
10	Power supply	V/Hz	230/50

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4.2. Boiler description

The UnicPel 18 boiler, with a nominal power of 18 kW, is designed for the combustion of wood biomass in the form of pellets. The boiler consists of a water jacket and an automatic fuel feeder along with a fuel hopper. The water jacket of the boiler is made from steel sheets joined together by welding. The internal sheets of the boiler jacket, where the heat exchange between flue gases and water occurs, have a thickness of 5 mm. The remaining sheets of the jacket are 4 mm thick. In the lower part of the boiler, a drop-in combustion chamber is located. At the rear, in the lower part of the boiler, all system connections are situated, including those for the water, flue gas, and air supply systems. The boiler jacket and doors are thermally insulated. Combustion waste is collected in the ash pan space below the combustion basket. The furnace has an access hatch with doors for ash removal. The convective section is formed by a heat exchanger with a cuboid shape, featuring a tubular exchanger at the top. The heat exchange section consists of a two-pass system of vertical fire tubes. From the last pass of the fire tubes, the flue gases exit into the flue gas outlet. The combustion chamber, along with the ash pan, has a water jacket on the side surface, and at the bottom, there is a smoke chamber. The boiler is equipped with a drawer that facilitates ash removal through the lower front doors of the boiler. In the upper part of the boiler, there is an access hatch to the upper smoke chamber, where a manually operated mechanism for shaking off deposits from the fire tubes is also located. All hatches are closed with thermally insulated doors or covers. The flue gas outlet (fan stub) is the element connecting the last pass of the heat exchanger's fire tubes to the chimney. It is located behind the boiler and directed backwards. The flue gas outlet stub has a circular shape with a diameter of 80 mm. The boiler has threaded stub connections for the supply and return side, as well as a stub for the combustion air intake. The fuel hopper, with a capacity of 108 kg of pellets, is located at the top of the boiler, directly above the screw feeder. It is made of steel sheet and shaped to ensure the fuel slides down. The thermal insulation and casing are made of mineral wool placed in cassettes of steel sheets, which are either coated or painted on both sides.

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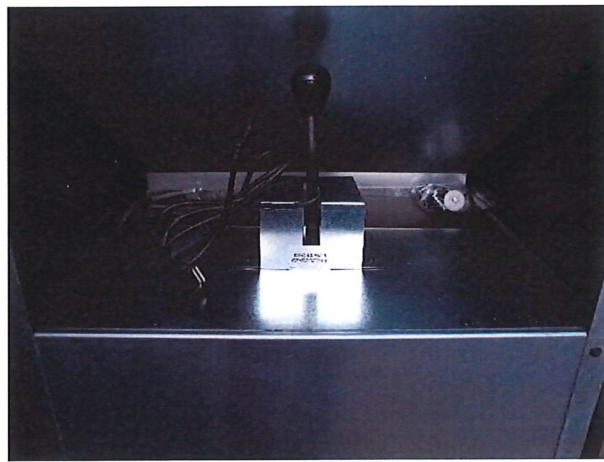
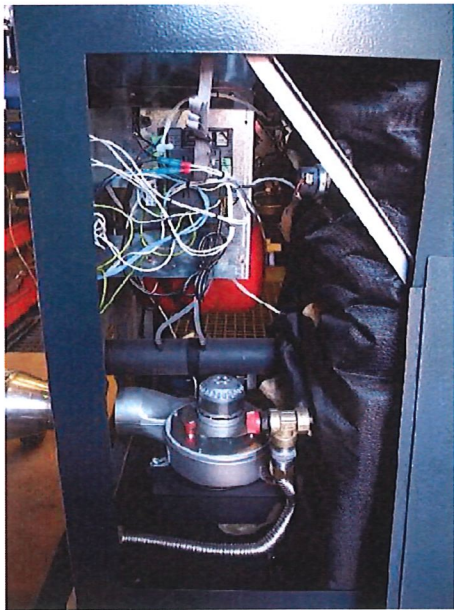
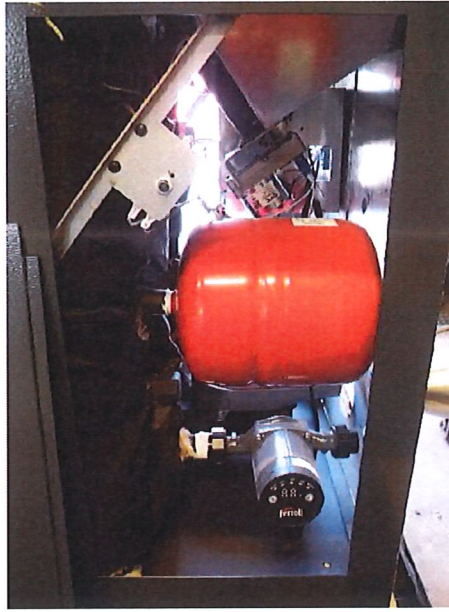
4.3. Photos of the boiler

The boiler is available in two color versions:

4.3.1. Color version 1



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4.3.2. Color version 2







4.4. Important systems

- Drop-in burner
- Controller:NG01 (TiEmme elettronica)
- IPS AVX21502B101

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4.5. Rating plate

<p>Mareli Systems LTD Industrial Zone Simitli, 2730 Region Blagoevgrad Bulgaria www.mareli-systems.com</p>		 Mareli Systems	
<p>PELLET BOILER , UnicPel 18</p>			
<p>EN 303-5:2021+A1:2023-05</p>			
NOMINAL THERMAL POWER	18		kW
THERMAL POWER RANGE	4,80	18,21	kW
NOMINAL HEAT LOAD	18,21		kW
HEAT SUPPLY RANGE	5,23	19,67	kW
MAX WORKING PRESSURE	2		bar
MAX OPERATING TEMPERATURE	90		°C
WATER CAPACITY	45		l
ELECTRIC POWER SUPPLY	230V, 50Hz, 5A		(V,Hz,A)
POWER CONSUMPTION AT NOM POWER	400		W
FUEL CLASS / FUEL TYPE	WOOD PELLET EN ISO 17225-2		A1
OPERATION MODE	NON CONDENSING		
BOILER CATEGORY	1		
BOILER CLASS	5		
SERIAL NUMBER / YEAR PRODUCTION	0504250001 / 2025		
			
<p>MADE IN BULGARIA</p>			

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5. Testing

5.1. Selection of heating boiler for testing

The boiler assigned for testing was selected by the Ordering Party in accordance with PN-EN 303-5:2021+A1:2023-05 item 5.1.2, item 5.1.3 and item 5.1.4

5.2. Testing location

The tests were performed at a measurement station prepared in accordance with PN-EN 303-5:2021+A1:2023-05 item 5.6.2 at Zakłady Badań i Atestacji „ZETOM” im. Prof. F. Stauba w Katowicach Sp. z o.o. – Research and Calibration Laboratory.

5.3. Test schedule

The research program included the scope of research according to: PN-EN 303-5:2021+A1:2023-05 standard.

5.4. Test fuel

According to PN-EN 303-5:2021+A1:2023-05 item 5.3, test fuel was supplied by the boiler manufacturer.

Table. 2. Test fuel analysis results (wood pellets)

	Symbol	Unit	Value	Uncertainty
Moisture content	W^a	%	4,8	$\pm 0,3$
Moisture content	W_t^r	%	5,4	$\pm 0,8$
Ash content	A^d	%	0,2	$\pm N$
Ash content	A^r	%	0,2	$\pm N$
Ash content	A^a	%	0,2	$\pm N$
Volatiles content	V^{daf}	%	84,84	$\pm 1,7$
Heat of combustion	Q_s^a	kJ/kg	19540	± 260
Heat of combustion	Q_s^a	kJ/kg	19972	± 424
Heating value	Q_i^r	kJ/kg	17987	± 420
Carbon content	C_t^a	%	50,2	$\pm 2,5$
Hydrogen content	H_t^a	%	6,01	$\pm 0,45$
Nitrogen content	N_a	%	0,07	$\pm N$

The fuel test was performed in the accredited research laboratory CLP-B Sp. z o.o. accreditation no. AB300; Test report no 7394/VI/25

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5.5. Measuring instruments and measurement methods

The measurement equipment used during the test meets the requirements specified in PN-EN 303-5:2021+A1:2023-05 item 5.2

Equipment	Identification No.
• Gas analyzer	0000014
• TOC analyzer	0000011, 0000013
• Aspirator	3100013 i 3100014
• Barometer and hygrometer	3100012
• Moisture analyzer	3003009, 3003005
• Electronic scales	3003010
• Platform scales 0 – 60kg	3003007
• Platform scales 0 – 1500 kg	3003011, 3003012
• Thermoelement	3200056, 3200057, 3200058, 3200059 i 3200060 3200010, 3200011, 3200012, 3200013, 3200014, 3200095, 3200096, 3200097, 3200098, 3200099, 32000100
• Pressure transducers	3100015, 3100020, 2800026, 2800025
• Pyrometer	3200052
• Wattmeter	2400003, 2400004
• Flowmeter	2800027, 2800028
• Prandtl probe	0000025
• Aspiration terminals	2100041, 2100042, 2100048, 2100049, 2100050, 2100051, 2100052, 2100053, 2100054, 2100055

Dust measurements were performed using the gravimetric (filtration) method.

5.6. Boiler operation regulator settings

3. Boiler operating regulator settings

	Rated output	Minimum output
Power setting	P5	P1
Feed time, s	5,5	1,9
Blow-in setting	308	225

5.7. Essential boiler components installed during the test

- Drop-in burner
- Controller: NG01 (TiEmme elettronica)
- IPS AVX21502B101

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6. Test results

Expanded uncertainty of measurement is determined for k=2 and confidence level approx. 0.95. The estimated measurement uncertainty does not include the sampling stage component. At the customer's request, compliance was assessed using the guidelines of ILAC-G8:09/2019 and the simple acceptance method.

The test results listed below do not allow the tested object to be admitted to the UK market.

Table 4. Conditions during testing

	Unit	Result	Uncertainty	Requirements
Ambient temperature during testing				
Rated output	°C	24,4	± 0,3	15 – 30
Minimum output	°C	25,2	± 0,3	15 – 30
flue gas negative pressure				
Rated output	Pa	12,1	± 0,6	10±3
Minimum output	Pa	10,4	± 0,5	10±3
Testing duration				
Rated output	h	6		≥ 6
Minimum output	h	6		≥ 6
Fuel jet				
Rated output	kg/h	3,94	-	-
Minimum output	kg/h	1,05	-	-

Table 5. Flue gas parameters

	Unit	Result	Uncertainty
Flue gas temperature at rated output	°C	122,52	±3,13
Flue gas temperature at minimum output	°C	83,81	±3,13
Flue gas mass flow at rated output	kg/h	67,80	±1,62
Flue gas mass flow at nominal output	kg/h	23,76	±0,72

Table 6. Determination of water flow resistances

	Unit	Result	Uncertainty
for			
Dt = 10 K	mbar	5,84	±0,03
Dt = 20 K	mbar	2,94	±0,03

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Table 7. Determination of heat load and thermal efficiency of the boiler

	Unit	Result	Uncertainty	Requirements
Heat output determination method	-	direct		direct / indirect
Rated heat output	kW	18,214	± 0,186	18 ± 1,44
outlet water temperature t_v	°C	72,0	± 0,1	70 - 90
outlet water temperature t_R	°C	60,0	± 0,1	-
ambient temperature t_L	°C	24,4		15 - 30
difference $Dt=t_v-t_R$	K	12,10	-	10 - 25
condition $0.5(t_v+t_R)-t_L$	K	41,60	-	≥ 35
water flow	kg/h	1283,945	± 6,42	-
Minimum heat output	kW	4,795	± 0,049	≤ 5,4
outlet water temperature t_v	°C	70,4	± 0,1	70 - 90
outlet water temperature t_R	°C	65,8	± 0,1	-
ambient temperature t_L	°C	25,2		15 - 30
difference $Dt=t_v-t_R$	K	4,50	-	-
condition $0.5(t_v+t_R)-t_L$	K	42,90	-	≥ 35
water flow	kg/h	899,932	± 4,5	-
boiler thermal efficiency	-	direct		direct
auxiliary electricity consumption	-	EN 15456	-	EN 15456
Nominal heat output	W	26,24	-	-
Minimum heat output	W	12,35	-	-
electricity consumption by fuel feed unit	W	19,75	-	-
standby status	W	3,12	-	-

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Table 8. Pollution emissions volume and thermal efficiency

	Unit	Result	Uncertainty	Requirements
Rated output				
Boiler heat output	kW	18,214	± 0,186	18 ± 1,44
Furnace heat output	kW	19,668	± 0,005	-
Boiler thermal efficiency	%	92,610	±1,064	≥ 88,26 class 5
Emission				
CO ₂ *)	%	8,43	±0,14	-
CO **)	mg/m ³	317,78	±24,68	500 Class 5
NOx **)	mg/m ³	162,39	±18,04	-
OGC **)	mg/m ³	16,56	±0,97	20 Class 5
dust **)	mg/m ³	19,19	± 1,36	40 Class 5
Minimum output				
Boiler heat output	kW	4,795	± 0,049	≤ 5,4
Furnace heat output	kW	5,230	± 0,01	-
Boiler thermal efficiency	%	91,680	±1,148	≥ 87,73 class 5
Emission *)				
CO ₂ *)	%	6,87	±0,14	-
CO **)	mg/m ³	266,59	±33,35	500 Class 5
NOx **)	mg/m ³	160,51	±22,14	-
OGC **)	mg/m ³	16,81	±1,17	20 Class 5
dust **)	mg/m ³	19,39	± 1,29	40 Class 5

*) average measured value **) emissions listed above refer to dry exhaust gases containing 10% oxygen in a normal state, at a temperature of 273.15 K and a pressure of 1013.25 mbar.

Table 9. External surface temperature

	Unit	Result	Uncertainty	Requirements
Surface temperature				
Right Side	°C	34,3	±1,5	≤ 51
Left side	°C	33,5	±1,5	≤ 51
Back	°C	32,2	±1,5	≤ 51
Front	°C	29,9	±1,4	≤ 51
Top	°C	33,6	±1,5	≤ 51
door temperature	°C	29,7	±1,4	≤ 51
feed temperature	°C	35,7	±1,5	≤ 85
hopper temperature	°C	36,0	±1,5	≤ 85

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Table 10. Testing the operation of the heating boiler temperature regulator and safety temperature limiter

	Unit	Result	Uncertainty	Requirements
Verification of temperature regulator functioning				
Boiler power	kW	18,351	± 0,188	18 ± 1,44
outlet water temperature	°C	74,1	± 0,1	≤ 75
water flow at rated output	m ³ /h	1,106	± 0,006	-
reduced heat output	kW	7,231	± 0,074	7,2 ± 0,36
temperature setting	°C	80,0	-	-
outlet water temp. after temperature controller activation	°C	82,6	-	< 100
Verification of temperature limiter functioning				
Boiler power	kW	17,998	± 0,184	18 ± 1,44
outlet water temperature	°C	73,3	± 0,1	≤ 75
water flow at rated output	m ³ /h	1,100	± 0,006	-
reduced heat output	kW	7,281	± 0,075	7,2 ± 0,36
temperature setting	°C	80,0	-	-
STB activation temperature after bridging	°C	90,0	± 0,1	< 100
maximum boiler temperature	°C	92,4	± 0,1	< 110

Table 11. Testing of fast deactivation system operation

	Unit	Result	Uncertainty	Requirements
Sudden heat dissipation failure				
Boiler power	kW	18,378	± 0,188	18 ± 1,44
outlet water temperature	°C	73,7	± 0,1	≤ 75
water flow at rated output	m ³ /h	1,100	± 0,006	-
dissipated heat output	kW	-	-	-
temperature setting	°C	80,0	-	-
temperature regulator activation	°C	82,8	± 0,1	100
temperature limiter activation	°C	-	-	-
maximum boiler temperature	°C	85,4	± 0,1	< 110
CO concentration	%	0,065	-	≤ 5
Voltage loss failure				
Boiler power	kW	18,108	± 0,186	18 ± 1,44
outlet water temperature	°C	70,6	± 0,1	≤ 75
water flow at rated output	m ³ /h	1,099	± 0,005	-
boiler temperature after voltage loss	°C	84,1	± 0,1	-
CO concentration	%	0,157	-	≤ 5

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Table 12. Safety tests at loss of air supply

	Unit	Result	Uncertainty	Requirements
fuel overfilling	-	boiler shut down, extinguishing		-
fuel supply blocked	-	boiler shut down, extinguishing		-
air supply loss - fan failure CO concentration	%	0,43	-	≤ 5
air supply system failure CO concentration	%	0,48	-	≤ 5
heat conduction feed outer surface temperature	°C	35,7	±1,5	≤ 85

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7. Confirmation of compliance with PN-EN 303-5:2021+A1:2023-05

No.	Item of the standard	Requirements	Conformity statement
<i>Thermal requirements</i>			
1.	PN-EN 303-5:2021+A1:2023-05 item 4.4.2.2	<p>Boiler thermal efficiency</p> <p>The thermal efficiency of the boiler is calculated based on the NCV (net calorific value) and at the test according to 5.6, 5.7 and 5.9, should not be lower than the efficiency specified in the formula given in Figure 1 for the relevant class. For boilers with a rated heat output exceeding 100 kW, the required efficiency for class 4 is specified at 84% and for class 5 at 89%. For class 3 boilers with a rated heat output exceeding 300 kW, the required efficiency is specified at 82%.</p> <p>Class 5, Q<100 kW: $\eta_K = 87 + \log Q$ (in percentage values) η_K - required boiler efficiency η_N - efficiency at rated heat output, calculated based on test results</p>	<p>Compliant</p> <p>$\eta_N = 92,61 \%$ $\eta_K = 88,26 \%$</p>
2.	PN-EN 303-5:2021+A1:2023-05 item 4.4.3	<p>Exhaust flue gas temperature</p> <p>In the case of boilers, in which the temperature of the flue gas at the rated heat output exceeds the ambient temperature at less than 160 K, the manufacturer should provide information on the execution of the chimney in order to prevent the possibility of soot accumulation, insufficient chimney draught and condensation in the flue ducts</p>	<p>Compliant</p> <p>Temp. Flue gas at rated output = 122,52 °C Ambient temp. = 24,4 °C Temp. of flue gas at rated output - Ambient temp. = 98,12 K</p>
3.	PN-EN 303-5:2021+A1:2023-05 item 5.7.2	<p>Heat output determination</p> <p>During the testing, the heat output declared by the manufacturer should be maintained at a constant level, with a tolerance of ±8%</p> <p>Rated heat output declared by the manufacturer 18 ±1,44 kW</p>	<p>Compliant</p> <p>$Q_N = 18,214 \text{ kW}$</p>
4.	PN-EN 303-5:2021+A1:2023-05 item 4.4.6	<p>Minimum heat output</p> <p>The minimum heat output of heating boilers with automatic fuel feed should be at most 30% of the rated heat output. Settings should be done automatically by the adjustment equipment</p>	<p>Compliant</p> <p>$Q = 4,795 \text{ kW}$ 26,64%</p>

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5.	<p>PN-EN 303-5:2021+A1:2023-05 item 4.4.7.1</p>	<p>Measured values for pollution emissions</p> <p>The combustion should be low-emission. This requirement is met when the results of emissions provided in Table 7 are not exceeded during operation at rated heat output, and in the case of boilers with the operating heat output range during operation at rated heat output and minimum heat output, during testing according to 5.8 and calculated according to 5.9.4. Values in mg/m³n.</p>	<p>CO emission 317,78</p> <p>OGC emission 16,56</p> <p>Dust emission 19,19</p> <p>NOx emission 162,39</p>	<p>Compliant Class 5</p>
	<p>At rated output</p>	<p>CO emission 266,59</p> <p>OGC emission 16,81</p> <p>Dust emission 19,39</p> <p>NOx emission 160,51</p>	<p>At minimum output</p>	
	<p>PN-EN 303-5:2021+A1:2023-05 item 4.4.7.2</p>	<p>Calculated values of seasonal emission of pollutants</p> <p>Solid-fuel boilers must meet requirements provided in Table 8. These requirements must be met for the basic fuel and every other fuel appropriate for a solid-fuel boiler. Values in mg/m³n.</p>	<p>CO emission 274,27</p> <p>OGC emission 16,77</p> <p>Dust emission 19,36</p> <p>NOx emission 160,79</p>	<p>Compliant</p>
<p>Safety requirements</p>				
6.	<p>PN-EN 303-5:2021+A1:2023-05 item 4.3.7</p>	<p>External surface temperature</p> <p>During testing according to 5.11, the temperature of the outer surfaces of the boiler (with the boiler base and doors, and with the exception of the chimney flue and the openings used to supervise the operation of the boiler with natural draught), should not exceed the ambient temperature by more than 60K. The boiler base temperature requirement does not apply if, according to the manufacturer's written recommendations, the heating boiler should be installed on a non-flammable foundation. During testing according to 5.11, the surface temperature of service handles and all parts that may be touched during operation of the heating boiler should not exceed the following values:</p> <ul style="list-style-type: none"> - 51°C for metals and similar materials; - 56°C for porcelain and similar materials; - 60°C for plastics and similar materials 	<p>Compliant</p> <p>Temp. Ambient temp. = 25,1 °C</p> <p>External surface temperature</p> <p>Right side 34,3°C</p> <p>Left side 33,5°C</p> <p>Back 32,2 °C</p> <p>Front 29,9 °C</p> <p>Top 33,6 °C</p> <p>Door temperature</p> <p>29,7 °C</p>	

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7.	PN-EN 303-5:2021+A1:2023-05 item 5.13	<p>Testing the operation of the heating boiler temperature controller and safety temperature limiter</p> <p>With a properly functioning temperature regulator, the measured outlet water temperature should not exceed 100°C, and the safety temperature limiter or safety temperature sensor and the relief heat discharge device should not be activated.</p> <p>After bridging the temperature controller, repeat the test. It is verified whether the safety temperature limiter switches combustion off no later than when the highest temperature declared by the boiler manufacturer is achieved and whether there is a safety hazard</p>	<p>Compliant</p> <p>82,6 °C</p> <p>Compliant</p> <p>90 °C</p> <p>Maximum outlet water temperature 92,4 °C</p>
8.	PN-EN 303-5:2021+A1:2023-05 item 5.14	<p>Testing fast-disabled system operation</p> <p>Sudden heat dissipation failure - the maximum temperature should be less than 110°C, and the concentration of CO should not exceed 5% by volume</p> <p>Voltage loss - the maximum boiler temperature after loss should be less than 110°C, and the concentration of CO should not exceed 5% by volume</p>	<p>Compliant</p> <p>86,1 °C</p> <p>0,028 %</p> <p>Compliant</p> <p>84,1 °C</p> <p>0,157 %</p>
9.	PN-EN 303-5:2021+A1:2023-05 item 5.16.3	<p>Safety test at air supply loss</p> <p>Fan failure - CO concentration should not exceed 5% by volume</p> <p>Failure of the air supply system as a result of closing the adjustable openings supplying air to the heating boiler</p>	<p>Compliant</p> <p>0,43 %</p> <p>Compliant</p> <p>0,48 %</p>
10.	PN-EN 303-5:2021+A1:2023-05 item 4.3.3.2	<p>Heat conduction</p> <p>The temperature of the external surfaces of the fuel feed (without insulation) or combined fuel tank under any operating conditions and during failures should not exceed 85°C.</p>	<p>Compliant</p> <p>Feed 35,7 °C</p> <p>Hopper 36,0 °C</p>
Electrical safety /test outside accreditation scope/			
11.	PN-EN 303-5:2021+A1:2023-05 item 4.3.13.2	<p>Insulation resistance</p> <p>> 2 MΩ</p> <p>Continuity of protection circuit</p> <p>< 0.5 Ω</p> <p>Leakage current</p> <p>< 0.35 mA</p> <p>Insulation electric strength</p>	<p>Compliant</p> <p>3,05 GΩ</p> <p>Compliant</p> <p>0,29 Ω</p> <p>Compliant</p> <p>0,18 mA</p> <p>Compliant</p>

8. Conclusion

The test results presented in the report apply only to the tested UnicPel 18 heat output 18 kW only when fired with wood pellets, the parameters of which are given in Table 2.

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