SLOVENSKI STANDARD
oSIST prEN 304:2023

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Kotli za ogrevanje - Preskušanje kotlov za ogrevanje z razprševalnimi oljnimi gorilniki

Heating boilers - Test code for heating boilers for atomizing oil burners

Heizkessel - Prüfregeln für Heizkessel mit Ölzerstäubungsbrennern

Chaudières de chauffage - Règles d'essai pour les chaudières avec brûleurs fioul à pulvérisation

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91.140.10	Sistemi centralnega ogrevanja	Central heating systems
97.100.40	Grelniki na tekoče gorivo	Liquid fuel heaters

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 304

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ICS 91.140.10

Will supersede EN 304:2017

English Version

Heating boilers - Test code for heating boilers for atomizing oil burners

Chaudières de chauffage - Règles d'essai pour les chaudières avec brûleurs fioul à pulvérisation

Heizkessel - Prüfregeln für Heizkessel mit Ölzerstäubungsbrennern

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 57.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 304:2023) has been prepared by Technical Committee CEN/TC 57 “Central heating boilers”, the secretariat of which is held by DIN.

This document will supersede EN 304:2017.

For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are an integral part of this document.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annexes ZA and ZB, which is an integral part of this document.

The main technical changes compared to EN 303-2:2017 are the following:

a) new Annex F for calculation clarification was added;

b) new clause marking and instructions was added;

c) updated Normative References;

d) standby heat loss method 1 was deleted.

1 Scope

This document applies to the determination of the performances of heating boilers and combi boilers fired by liquid fuels. The requirements for the heating performances are laid down in EN 303-1 and EN 303-2.

This test code includes the requirements and recommendations for carrying out and evaluating the procedure for testing boilers and also the details of the technical conditions under which the tests will be carried out.

The requirements and the performance of testing for the sanitary hot water production of combi boilers are laid down in EN 303-6.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 267:2020, *Forced draught burners for liquid fuels*

EN 303-1:2017, *Heating boilers — Part 1: Heating boilers with forced draught burners — Terminology, general requirements, testing and marking*

EN 303-2:2017, *Heating boilers — Part 2: Heating boilers with forced draught burners — Special requirements for boilers with atomizing oil burners*

EN 303-6,[1] *Heating boilers — Part 6: Heating boilers with forced draught burners — Specific requirements for the domestic hot water operation and energy performance of water heaters and combination boilers with atomizing oil burners of nominal heat input not exceeding 70 kW*

EN 15456, *Heating boilers — Electrical power consumption for heat generators — System boundaries — Measurements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 303-1:2017 and EN 303-2:2017 and the following apply.

3.1
minimum continuous heat output
P_{minC}
lowest heat output which is maintained automatically by the control device in continuous operation which is specified for each type of fuel in accordance with the requirements of this document

[1] As impacted by EN 303-6/prA1.

4 General conditions for testing

The performance tests of the boiler should be carried out by a test laboratory complying with the requirements of EN ISO/IEC 17025.

The test sample shall correspond to a boiler as placed on the market including all parts and accessories necessary for the operation of the boiler. Boilers to be equipped with different burners shall be tested with one specified forced draught burner.

The boiler and the burner shall be operated in accordance with the operation manual throughout all tests.

When determining the thermal outputs P_N and 30 % P_N of a combi boiler, no sanitary hot water shall be drawn off during the test. The thermal outputs shall be determined from the heating circuit only.

Sanitary hot water tests for combination boiler shall be done according to EN 303-6.

5 Measurement accuracies and uncertainties

The accuracy of the measurement devices for the following parameters shall not exceed:

a) atmospheric pressure 50 Pa;

b) waterside pressure loss 2 % of measured value;

c) water flow rate 1 % of measured value;

d) air volume flow rate 2 % of measured value;

e) time

   1) up to 1 h: 0,2 s;

   2) beyond 1 h: 0,1 % of measured value;

f) auxiliary electrical energy 2 % of measured value;

g) temperatures:

   1) ambient 2 K;

   2) water 1 K;

   3) combustion products 2 K;

   4) surface 2 K;

h) CO, CO_2, O_2, NO_x, C_xH_y:

   1) CO_2-content: 0,1 % volume from full scale;

   2) O_2-content: 0,1 % volume from full scale;

   3) CO-content: 5 ml/m^3;

   4) NO_x-content: 5 ml/m^3;

5) C_xH_y-content: 5 ml/m^3;

i) Mass 0,05 % of the full scale;

j) Pressure flue gas:

1) ≤ 60 Pa: 1Pa;

2) > 60 Pa: 2 % of the measured value.

The full range of the measuring apparatus shall be chosen in such a way that it is suitable for maximum anticipated value. The measurement accuracies indicated above concern individual measurements.

For measurements requiring a combination of individual measurements, the lower accuracies associated with individual measurements may be necessary to attain the total required uncertainty. The test rig shall be set up in such a way that the efficiency can be determined within an uncertainty of 2 % points.

6 Measurements for the heating mode

6.1 General

The amount of useful heat output transmitted to the heat carrier (water) is measured. It can be determined in the boiler circuit or by means of a secondary heat exchanger.

The useful heat output transmitted to the water is determined either by measuring:

a) the mass flow of cold water entering the boiler circuit and the rise of temperature between the outlet water temperature and the inlet water temperature; or

b) the mass flow of the water circulating in the boiler circuit and its temperature rise; or

c) the mass flow and the temperature rise over a secondary heat exchanger corrected by the heat loss of this secondary heat exchanger. The heat produced by the boiler is transferred to the cooling water by means of a secondary heat exchanger. The heat received by the latter is calculated from the mass flow and the temperature rise of the cooling water. The heat losses from the well-insulated connections between the boiler and the secondary heat exchanger and those of the secondary heat exchanger itself, are determined either by preliminary tests or by calculation. The heat output of the boiler is the sum of the two amounts of heat.

6.2 Determination of the nominal heat output

The tests for the determination of the nominal heat output shall be carried out at a firing rate such that the output is at least 100 %, but does not exceed 105 % of the nominal value, and the requirements concerning the nominal heat output shall be met.

If the heat output exceeds 105 %, a second test shall be carried out at a firing rate between 95 % and 100 % of the nominal heat output of the boiler.

The actual value for the nominal heat output shall be determined by linear interpolation between the two test results.

The nominal heat output shall be determined at a water rate that is adjusted to obtain a return water temperature of (60 ± 1) °C and a temperature difference between the flow and return water temperature of (20 ± 2) °C.

NOTE The conditions for determination of the rated heat output in former versions of EN 304 have been a mean flow temperature of between 80 °C and 90 °C, and the mean temperature difference between flow and return has been between 10 K and 25 K. However, this is not in line with the Regulation EU 813/2013.

6.3 Determination of the boiler efficiency at nominal heat output

The boiler efficiency at nominal heat output is measured as the determination of the nominal heat output (see 6.2).

The efficiency shall be determined on the basis of the net calorific value NCV.

The direct method according to 6.5.4.1 shall be applied. The indirect method allows an additional check of test accuracy of the test rig to be made by means of an energy balance.

6.4 Performance of testing

6.4.1 General test conditions

The boiler is installed in accordance with the technical instructions in a well-ventilated, draught free room (air speed less than 0,5 m/s), which has an ambient temperature of (20 ± 5) K. The boiler is protected from direct solar radiation.

The settings of the burner shall not be manually changed after adjustment. No change shall be made to the water flow or any other test parameter during one test period.

The temperature, pressure and composition of the products of combustion shall be measured continuously and shall be recorded with a sampling rate below 10 s.

The flow temperature t_F and the return temperature t_R shall not differ by more than ±0,5 K over the test period at the beginning and the end of the test period.

6.4.2 Draught adjustment

6.4.2.1 Boilers operating under negative pressure

For boilers operating under negative pressure the draught at the boiler outlet shall be adjusted so that there is a negative pressure in the combustion chamber. The draught shall be measured.

6.4.2.2 Boilers operating under positive pressure

In positive pressure boilers the pressure shall be set at the boiler outlet close to 0 Pa. The pressure difference between combustion chamber and boiler outlet shall be measured.

6.4.3 Establishment of steady-state conditions

The boiler shall be operated for at least 1 h before the start of the performance and efficiency test at the output intended for the test without any further interference.

The steady-state condition is reached once the water temperatures t_F and t_R do not differ by more than ± 0,5 K.

6.4.4 Test period

The test period shall be at least 60 min.

6.5 Calculation

6.5.1 General

The calculations shall be based on the mean values of the individual readings of all recorded parameters during the test period of 2 consecutive 30 min test sequences which meet the requirements of 6.4.4.

6.5.2 Nominal heat output

The necessary formulae relevant to the individual test methods are given in A.5.

6.5.3 Boiler heat input

For these calculations, formulae in A.6 are to be used.

6.5.4 Boiler efficiency

6.5.4.1 Direct method

In the direct method the boiler efficiency shall be determined by:

$$\eta_K = \frac{P}{Q_B} \times 100 \quad (1)$$

P and Q_B as described in Annex A.

NOTE P equals either P_N or 30 % P_N.

6.5.4.2 Indirect method

The indirect method is used for checking purposes only. The indirect boiler efficiency is given by:

$$\eta_k = 1 - q_A - q_U - q_S \quad (2)$$

where

q_A is the loss assensible heat of the products of combustion (values relative to the heat input);

q_U is the loss as incomplete combustion (values relative to the heat input);

q_S is the loss as radiation, convection and conduction (values relative to the heat input).

These heat losses are calculated in A.8.

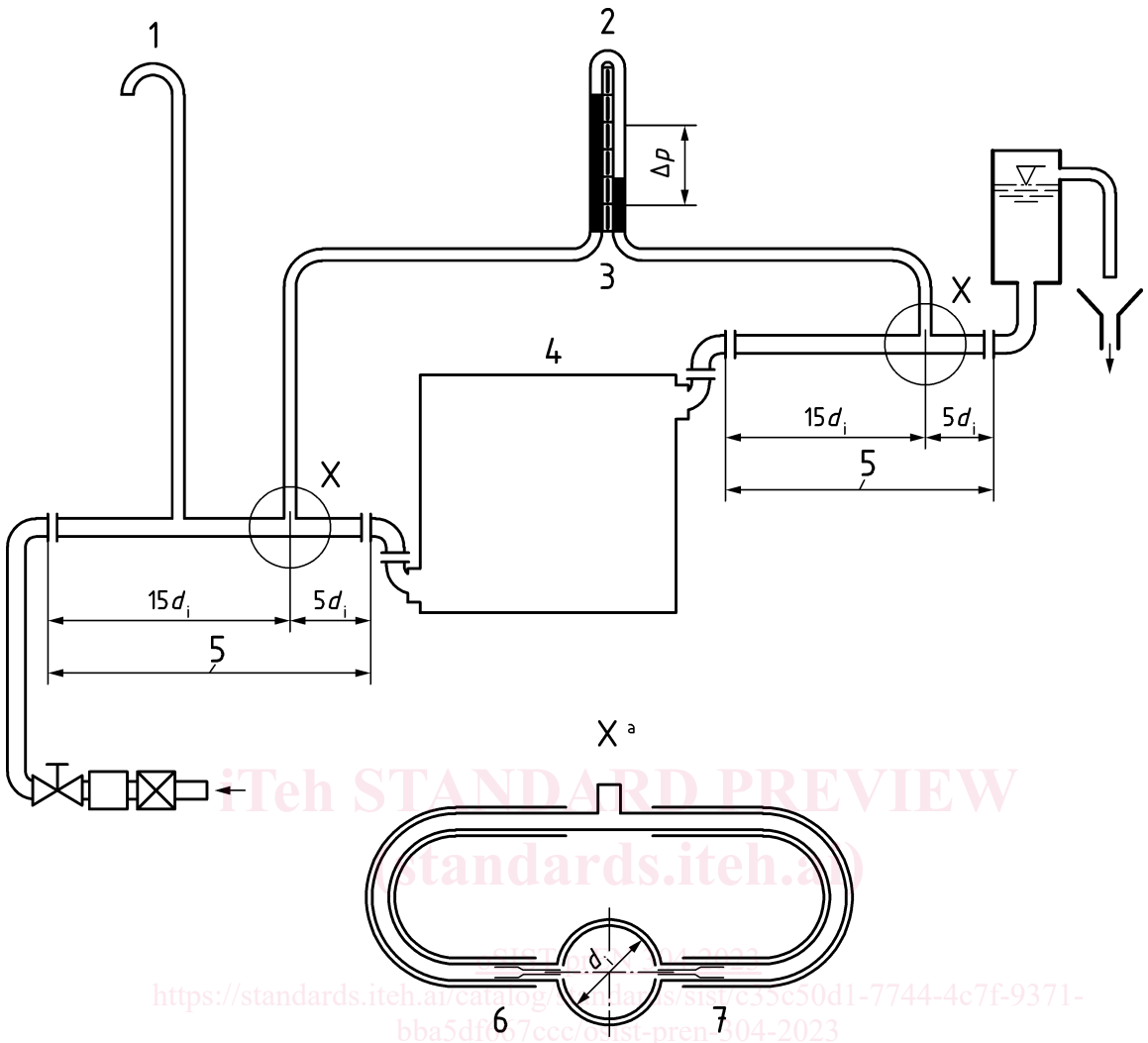
6.6 Determination of the waterside resistance

The hydraulic resistance of a boiler (measured in mbar) shall be determined for the water rate corresponding to operation of the boiler at the nominal heat input with a water flow temperature of 80 °C and a temperature difference between the flow and the return water of 20 K.

Other conditions are accepted if documented.

The test is carried out with the water at ambient temperature.

The test rig is specified in Figure 1. Before or after the test, the two test pipes are connected directly to each other in order to determine their own resistance for the specified flow rate.



Key

1 vent
2 differential manometer
3 flexible tubes
4 boiler
5 test pipe
a section at “X” rotated through 90°
6 flexible pipe
7 orifice ⌀ 3 mm smoothed internally

Figure 1 — Determination of the hydraulic resistance

6.7 Determination of the standby heat loss

6.7.1 General

No useful heat shall be extracted for heating or sanitary hot water production.

6.7.2 Standby heat loss

The test installation is described in Figures 3, 4 and 5.

The circuits joining the different parts of the installation shall be insulated and as short as possible. The inherent losses of the test installation and the thermal contribution of the pump for the different flow rates shall be determined at the beginning to be able to take account of them (see Annex B).

The boiler is fitted with the largest diameter test flue stated by the manufacturer in the technical instructions and equipped with a burner but is not in operation. Normally the test is carried out with a burner without air dampers. If a burner with air dampers is used this shall be stated in the test report.

NOTE The ideal distance is 1 m.

The average boiler water temperature is brought to a mean temperature of (30 ± 5) K above ambient temperature. The pump (11, Figure 2) and the boiler pump, if any, are stopped, the exchanger circuit (12, Figure 2) is shut off.

With the water circulating continuously by means of the pump (5, Figure 2) of the test rig, the thermal contribution of the electric boiler is adjusted so as to obtain, in the steady-state condition, a difference of (30 ± 5) K between the mean water temperature and the ambient temperature.

Throughout the test the variation in room temperature shall not exceed 2 °C/h.

The following parameters shall be recorded:

— P_{m} in kW, the electrical power consumed by the auxiliary electric boiler, corrected for the losses of the test rig and the thermal contribution of the pump (5, Figure 2);

— T in °C, the mean water temperature equal to the mean of the temperature indicated by the two probes (2, Figure 2) at the return and the flow of the boiler during the test;

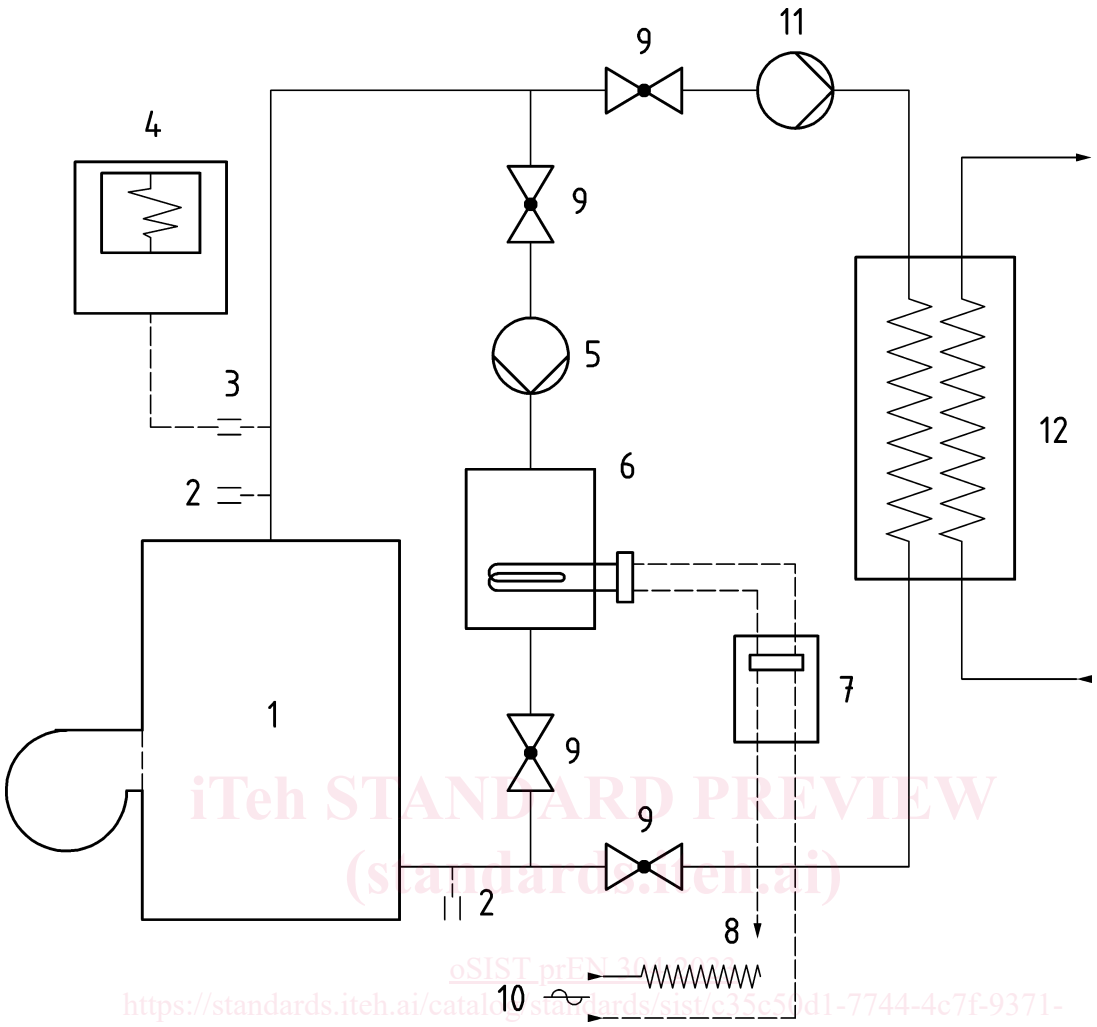
— T_{A} in °C, the mean ambient temperature during the test.

The standby heat loss, expressed for a mean water temperature of 30 K above an ambient temperature of 20 °C are given in kW, by:

$$P_{stby} = P_m \left[\frac{30}{T - T_A} \right]^{1,25} \tag{6}$$

Determination of the heat losses from the test rig and the heat contributions of the circulating pump of the test rig are given in Annex E.

The standby losses of combi boilers with storage tank measured in method 2 of this document are determined as described in EN 15502-1:2012+A1:2015, 9.4.2.



Key

1 boiler with the burner
2 temperature probes
3 low inertia thermocouple
4 recorder
5 pump with a rate such that the temperature difference between the two probes is between 2 °C and 4 °C at the maximum test temperature
6 auxiliary electric boiler
7 device for measuring the electric power
8 voltage regulator
9 1/4 turn valves
10 electrical supply
11 additional pump (if necessary)
12 heat exchanger

Figure 2 — Test installation to determine the heat emissions of the boiler when the burner is off and the thermal capacity of the boiler

6.8 Efficiency at 30 % of the nominal heat output

6.8.1 General

To determine the efficiency at a load corresponding to 30 % of the nominal heat output, or the arithmetic mean of the maximum and minimum heat output for range-rated boilers, one of the following methods shall be used:

The boiler is operated as for the determination of the useful efficiency at nominal heat input or at the arithmetic mean of the maximum and minimum heat input in the case of range-rated boilers.

Throughout the test, the water volume rate is maintained constant within ± 1 %, taking into account the temperature variations, and the pump operates continuously.

The efficiency shall be determined on the basis of the net calorific value NCV.

The direct method according to 6.5.4.1 shall be applied.

6.8.2 Efficiency at 30 % - Method 1 (time dependent method)

The boiler is installed as described in A.4, fitted to the thermally insulated test rig shown schematically in Figure 2 or Figure 3 (or any other test rig giving at least comparable results and equivalent measurement accuracies).

For standard boilers, the return temperature is held constant at (47 ± 1 °C), with a maximum variation in this temperature during the measurement period of ± 1 K. For low temperature boilers the test is carried out at (37 ± 1) °C and for condensing boilers the test is carried out at (30 ± 1) °C.

If the boiler control does not permit operation at a return temperature as low as 47 °C, the test is made with the lowest return temperature compatible with the operation of the boiler.

A timer is connected to the terminals of the room thermostat so as to obtain a complete operating cycle of 10 min.

The shutdown and operating times are calculated as indicated in Table 1.

The temperatures are measured continuously directly on the flow and return of the boiler.

The boiler is considered to be in thermal equilibrium when the efficiency measurement of three consecutive cycles, combining any two results from three, does not vary by more than 0,5 percentage points. In this case, the result is equal to the average value of at least three consecutive measurement cycles. For any other case, the average value shall be calculated from at least 10 consecutive cycles.

The respective fuel and water consumption's over complete cycles are measured.

Temperatures t_1 and t_2 are measured continuously.

The heat output P and the heat input Q_B as calculated according to Annex A. A variation of ± 2 % points, with respect to the 30 % of the nominal heat output is permitted. For variations up to ± 4 % points, it is necessary to carry out two measurements, one above and one below 30 % of the nominal heat output. The efficiency corresponding to 30 % is determined by linear interpolation.

6.8.3 Efficiency at 30 % - Method 2 (load dependent method)

The boiler is installed as described in A.4, fitted to the thermally insulated test rig shown schematically in Figure 2 or Figure 3 (or any other test rig giving at least comparable results and equivalent measurement accuracy's).

The boiler flow and return temperatures and the operating on and off cycles are given by the boiler control when a heat input leading to a heat output of the boiler of (30 ± 2) % of the nominal heat output (or the arithmetic mean of the maximum and minimum output for range-rated boilers) is drawn through the heat exchanger.