SLOVENSKI STANDARD
SIST EN 304:1997/A1:1999
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Kotli za gretje - Pravila za preskušanje kotlov z razprševalnimi oljnimi gorilniki - Dopolnilo A1

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

Heizkessel - Prüfregeln für Heizkessel mit Ölzerstäubungsbrennern

Chaudieres de chauffage - Regles d'essais pour les chaudieres avec bruleurs fioul a pulvérisation

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91.140.10

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English version

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

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

Heizkessel - Prüfregeln für Heizkessel mit Ölzerstäubungsbrennern

This amendment A1 modifies the European Standard EN 304:1992; it was approved by CEN on 6 June 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 304:1992/A1:1998 E

Foreword

This Amendment EN 304:1992/A1:1998 to EN 304:1992 has been prepared by Technical Committee CEN/TC 57 "Central heating boilers", the secretariat of which is held by DIN.

This Amendment to the European Standard EN 304:1992 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 1998, and conflicting national standards shall be withdrawn at the latest by December 1998.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

The following structure is intended for the standards for heating boilers:

prEN 303–1
Heating boilers – Part 1: Heating boilers with forced draught burners – Terminology, general requirements, testing and marking

prEN 303–2
Heating boilers – Part 2: Heating boilers with forced draught burners – Special requirements for boilers with atomizing oil burners

prEN 303–3
Heating boilers – Part 3: Gas-fired central heating boilers – Assembly comprising a boiler body and a forced draught burner

prEN 303–4
Heating boilers – Part 4: Heating boilers with forced draught burners - Special requirements for boilers with forced draught oil burners with outputs up to 70 kW and a maximum operating pressure of 3 bar – Terminology, special requirements, testing and marking

prEN 303–5
Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically fired, with a nominal heat output of up to 300 kW – Terminology, requirements, testing and marking

EN 304
Heating boilers – Test code for heating boilers for atomizing oil burners

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Replace 5.8 by the following:

5.8 Useful efficiency at part load

To determine the useful efficiency at a load corresponding to 30 % of the nominal heat input, or the arithmetic mean of the maximum and minimum heat input for range-rated boilers, the manufacturer has the choice between either the direct method or the indirect method.

It shall be checked that the requirements of 3.2 of prEN 303–2 : 1998 are met.

NOTE: Hints for setting up and evaluation of the test rig see annex E.

5.8.1 Direct method

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.

5.8.1.1 Operating mode No. 1

The boiler is installed as described in A.6, fitted to the thermally insulated test rig shown schematically in figure 1 or figure 2 (or any other test rig giving at least comparable results and equivalent measurement accuracies).

The boiler return temperature is held constant at (47 ± 1 °C), with a maximum variation in this temperature during the measurement period of ± 1 K.

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 2.

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 ten consecutive cycles.

The respective fuel and water consumptions over complete cycles are measured.

Temperatures t_1 and t_2 are measured continuously.

The useful efficiency is calculated using the following formula:

$$\eta_K = \frac{W \cdot (t_2 - t_1) \cdot 4{,}186 + Q}{V \cdot H_i \cdot 10^3} \qquad (1)$$

where:

- W = total mass of water collected during the test in kg;
- t_1 = temperature of the cold water or of the cooling water in the secondary exchanger in °C;
- t_2 = temperature of the collected water in °C;
- Q = heat losses of the test rig corresponding to the maximum water flow temperature (taking into account the thermal input due to the pump) in kJ;
- V = total fuel consumption in kg;
- H_i = calorific value of the fuel used for the test in MJ/kg.

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

5.8.1.2 Operating mode No. 2

The boiler is installed as described in A.6, fitted to the thermally insulated test rig shown schematically in figure 1 or figure 2 (or any other test rig giving at least comparable results and equivalent measurement accuracies).

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 burner working at (30 ± 2) % of the nominal heat input (or the arithmetic mean of the maximum and minimum output for range-rated boilers) is drawn through the heat exchanger. The temperatures are measured continuously at the flow and at the return of the boiler.

The average water temperature shall be no less than 50 °C.

If the boiler control does not permit operation at a return temperature as low as 50 °C, the test is carried out at the lowest return temperature compatible with the operation 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 %. 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 ten consecutive cycles.

The respective fuel and water consumptions over complete cycles are measured.

The efficiency is determined using the formula in 5.8.1.1.

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

5.8.2 Indirect method

5.8.2.1 Measurements

5.8.2.1.1 Useful efficiency at the nominal heat input at 50 °C

The test of 5.5.3, at the nominal heat input (or the arithmetic mean of the maximum and minimum heat input for range-rated boilers), is repeated with a water flow temperature of (60 ± 2) °C and a return temperature of (40 ± 1) °C so that the average water temperature shall be (50 ± 1) °C.

The measured value η_1 is noted.

5.8.2.1.2 Efficiency at the minimum controlled rate

If the boiler is fitted with a control system incorporating a main burner reduced rate, a test is carried out at the minimum heat input allowed by the control for a water flow temperature of (55 ± 2) °C and a return temperature of (45 ± 1) °C so that the average temperature shall be (50 ± 1) °C.

The measured value is designated η_2.

5.8.2.1.3 Standby losses

The test installation is described in figure 3.

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.

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

With the water circulating continuously by means of the pump (5) 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 information shall be noted:

- 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);
- T in °C, the mean water temperature equal to the mean of the temperature indicated by the two probes (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 losses, expressed for a mean water temperature of 50 °C and an ambient temperature of 20 °C are given, in kW, by:

$$P_s = P_m \left[\frac{30}{T-T_A}\right]^{1,25} \qquad (2)$$

NOTE: Determination of the heat losses from the test rig and the the heat contributions of the circulating pump of the test rig see annex F.

5.8.2.2 Calculations

The useful efficiency for a load of 30 % of the nominal heat input (or the arithmetic mean of the maximum and minimum heat input for range-rated boilers) and at an average water temperature of 50 °C is calculated for a control cycle.

The symbols of table 1 are used.

Table 1: Symbols and quantities needed to calculate the efficiency at part load

Operational phases of the main burner	Heat input kW	Operation time s	Measured values at 50 °C
Full rate Reduced rate	Q_1 Q_2	t_1 t_2	Efficiencies η_1 η_2
Controlled off	-	t_3	Standby losses P_s

The efficiency is calculated from the ratio between the useful energy to the energy supplied by the fuel during a ten minutes cycle.

Depending on the means of control, the following operating cycles can be identified, which correspond to the formulae in table 2:

1) permanent operation with $Q_2 = 0{,}3\ Q_1$ (fixed reduced rate or modulating);

2) full rate / controlled off (one fixed rate);

3) reduced rate / controlled off operation (reduced rate or modulation where the minimum heat input $Q_2 > 0{,}3\ Q_1$) (see cycle 5 if, by design, the ignition is carried out at full rate);

4) full rate / reduced rate operation (reduced rate where the minimum heat input $Q_2 < 0{,}3\ Q_1$);

5) full rate / reduced rate / controlled off operation (by design, ignition is carried out at Q_1 for a time t_1, with reduced rate or modulation such that the cycle comprises a controlled shut down ($t_3 > 0$); otherwise cycle 4 above applies).

The efficiency is calculated as indicated in table 2.

Table 2: Calculation of part-load efficiency

Conditions of operation		Heat input	Cycle times	Measurements	Useful efficiency
1	30 % reduced rate	$Q_2 = 0{,}3\ Q_n$	$t_2 = 600$ s	η_2	$\eta_u = \eta_2$
2	Full rate Controlled shutdown	$Q_1 = Q_n$	$t_1 = 180$ s $t_3 = 420$ s	η_1 P_s	$\eta_u = \frac{(\eta_1 Q_1 t_1) - (P_s t_3)}{Q_1 t_1}$
3	Reduced rate Controlled shut down	$Q_2 > 0{,}3\ Q_n$	$t_2 = \frac{180 Q_1}{Q_2}$ $t_3 = 600 - t_2$	η_2 P_s	$\eta_u = \frac{(\eta_2 Q_2 t_2) - (P_s t_3)}{Q_2 t_2}$
4	Full rate Reduced rate	$Q_1 = Q_n$ $Q_2 < 0{,}3\ Q_n$	$t_1 = \frac{180 Q_1 - 600 Q_2}{Q_1 - Q_2}$ $t_2 = 600 - t_1$	η_3 η_2	$\eta_u = \frac{(\eta_1 Q_1 t_1) + (\eta_2 Q_2 t_2)}{Q_1 t_1 + Q_2 t_2}$
5	Full rate Reduced rate Controlled shut down	$Q_1 = Q_n$ Q_2	$t_1 =$ measured value (see annex G) $t_2 = \frac{(180 - t_1) Q_1}{Q_2}$ $t_3 = 600 - (t_3 + t_2) \geq 0$	η_1 η_2 P_s	$\eta_u = \frac{\eta_1 Q_1 t_1 + \eta_2 Q_2 t_2 - P_s t_3}{Q_1 t_1 + Q_2 t_2}$

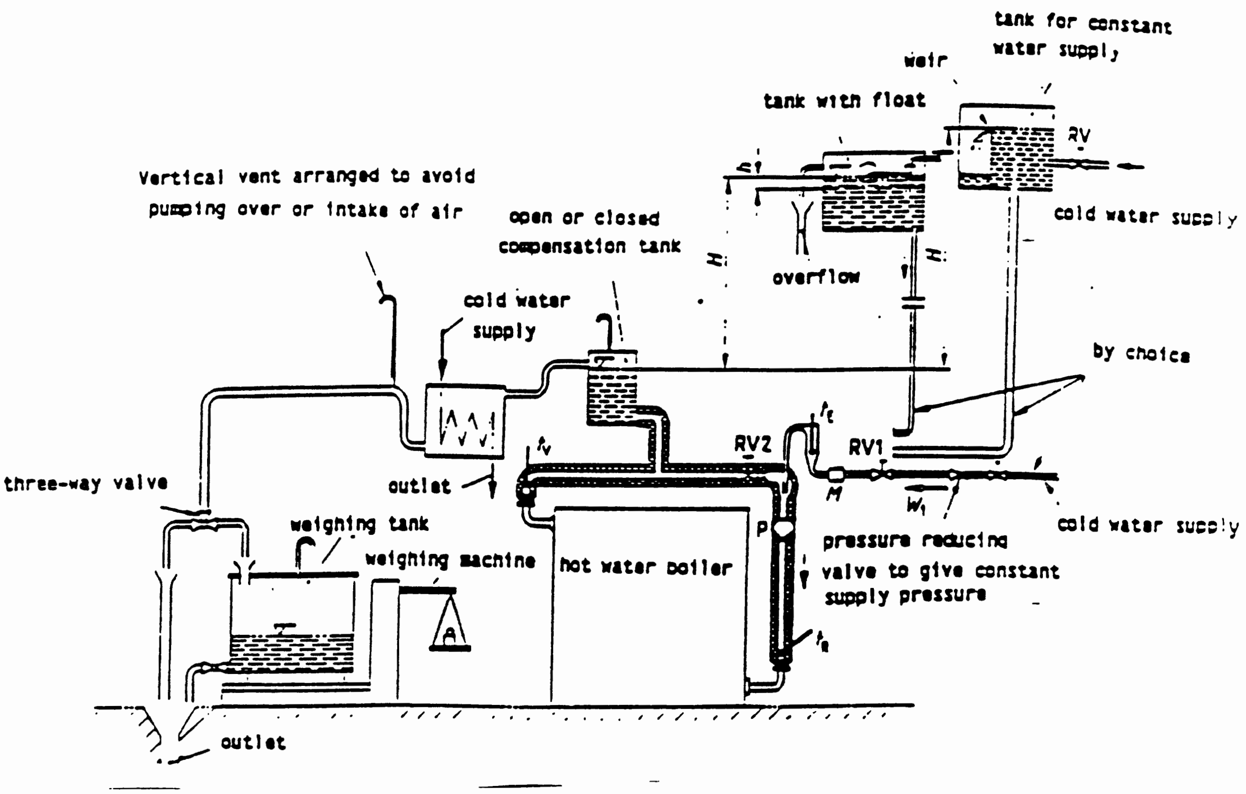

Figure 1: Test rig with short circuit section and 3 possible arrangements for cold water supply

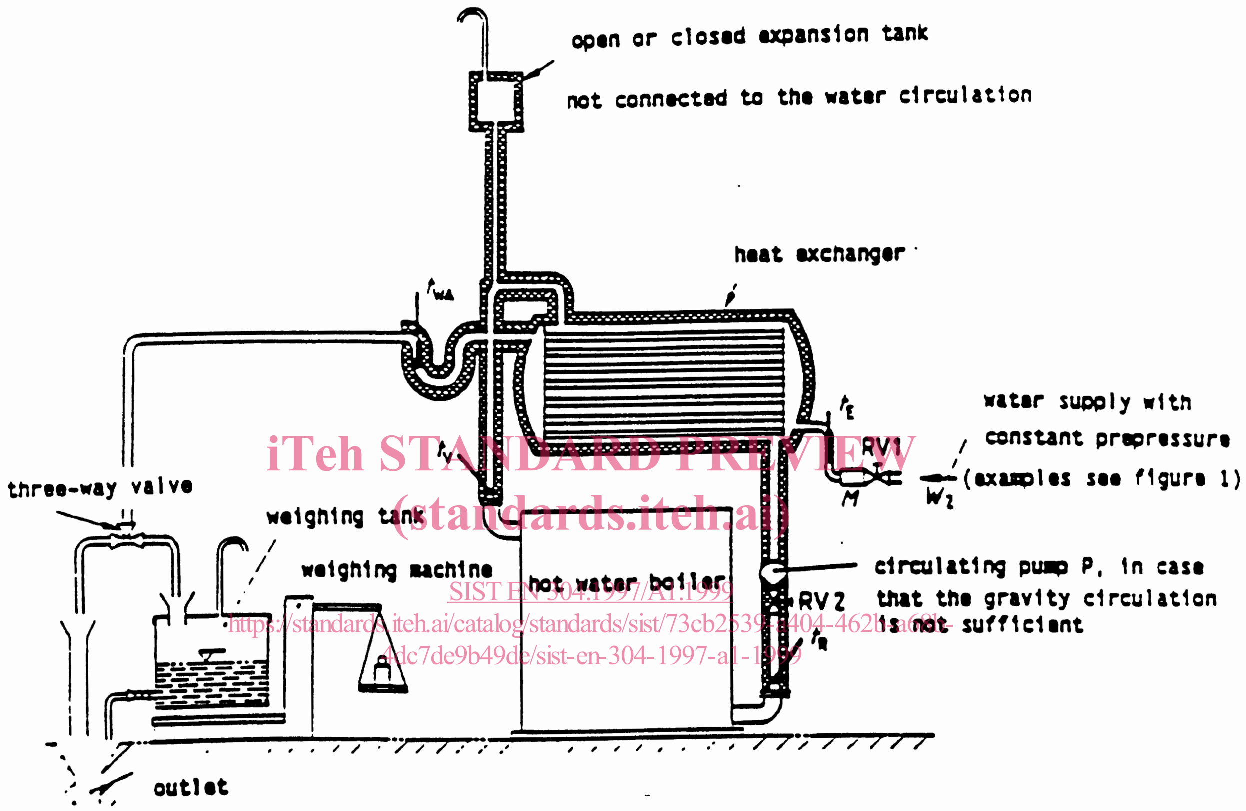

Figure 2: Test rig with heat exchanger