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Električni pretočni grelniki vode - Metode za merjenje lastnosti - 1. del: Splošne zahteve

Electric instantaneous water heaters - Methods for measuring the Performance - Part 1: General requirements

Elektro-Durchfluss-Wassererwärmer - Teil 1: Allgemeine Anforderungen

Chauffe-eau électriques instantanés - Partie 1: Exigences générales

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Electric instantaneous water heaters - Methods for measuring the Performance - Part 1: General requirements

Chauffe-eau électriques instantanés - Partie 1: Exigences générales

Elektro-Durchfluss-Wassererwärmer - Prüfverfahren zur Messung der Gebrauchseigenschaften - Teil 1: Allgemeine Anforderungen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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

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European Committee for Electrotechnical Standardization
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Contents

European foreword

This document (EN 50193-1:2016) has been prepared by CLC/TC 59X "Performance of household and similar electrical appliances".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-05-23
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2019-05-23

This document supersedes EN 50193-1:2013.

EN 50193-1:2016 includes the following significant technical changes with respect to EN 50193-1:2013:

— Alignment of the terms and formulas with those detailed in Commission communication in the framework of the implementation of Commission Regulation (EU) No 814/2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water heaters and hot water storage tanks and of Commission Delegated Regulation (EU) No 812/2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device (2014/C 207/03).

— Clarification of the Smart Control Factor and the issues surrounding its application for Electric Instantaneous Water Heaters.

— Updates to the references and bibliography.

— Addition of an informative annex for alternative test methods under development.

— Addition of Annexes ZZA and ZZB.

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

For the relationship with EU Directive(s) see informative Annex ZZA and ZZB, which are integral parts of this document.

1 Scope

This European Standard applies to **electric instantaneous water heaters** for domestic hot water heating for household and similar applications, which show both of the following characteristics:

– fulfilling at least one load pattern from Annex A;

– heating up to temperatures below the boiling temperature.

This European Standard specifies terms, definitions and measurement methods for the assessment of energy efficiency.

This European Standard does not take into account requirements regarding the safety of the appliances.

2 Normative references

The following documents, in whole or in part, are normatively reference 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 22768-1, *General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (ISO 2768-1)*

EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation (ISO 228-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
instantaneous water heater
appliance intended to heat water while it flows through the appliance

3.1.1
electric instantaneous water heater
electric powered **instantaneous water heater**

3.1.2
closed instantaneous water heater
instantaneous water heater intended to operate at the pressure of the water system, the flow of water being controlled by one or more valves in the outlet system

3.1.3
open-outlet instantaneous water heater
instantaneous water heater in which the flow of water is controlled by a valve in the inlet pipe, there being no valve in the outlet pipe

3.1.4
hydraulic instantaneous water heater
instantaneous water heater each of whose heating elements are switched on or off, depending on the water flow rate or water pressure

3.2
temperature selector
actuator which presets the temperature set point value of the water outlet and which can be adjusted by the user

3.3
temperature control
actuator which adjusts the temperature of the outlet water by means of varying the flow of water through the appliance or by varying the power applied to the heater(s) or by a combination of the two

3.4
independent flow control
actuator which adjusts the flow of water through the appliance with no significant change in the outlet water temperature

3.5
flow regulator
actuator which limits the flow of water through the appliance regardless of variations in line pressure

3.6
flow restrictor
device which defines a flow of water through the appliance for a set pressure

3.7
power selector
actuator which presets electrical power of the unit and which can be adjusted by the user

Note 1 to entry: The water outlet temperature depends on flow rate and/or inlet temperature.

3.8
load profile/load pattern
a means of illustrating the power consumption of an **instantaneous water heater** over a 24 hour period

3.9
smart control
a system that can demonstrate a reduction in energy consumption

3.10
useable water
water at or above the temperature T_m for the relevant draw-off and load pattern specified in the tables of Annex A

4 General test conditions

4.1 Measurement Equipment

The table below gives the accuracy of measurement equipment.

Table 1 — Measurement Equipment Accuracy

Measurement parameters	Unit	Measurement uncertainty (accuracy)	Remarks
Ambient temperature	°C/K	± 1 K	5)
Time	s	± 0,1 s	2)
Cold inlet water temperature	°C/K	± 0,2 K	2) 101)
Hot outlet water temperature	°C/K	± 1 K	1) 2)
Water flow rate	l/min	±0,1 l/min or ±1%	2) 4)
Water pressure	Mpa	± 5 %	3)
input power	kW	± 1 %	2)
Input power	W	± 1 %	5)
Voltage	V	± 0,5 %	2)
Current	A	± 0,5 %	2)

1) Thermocouple with a diameter of maximum 0,5 mm, in midstream, positioned directly at the outlet and inlet of the appliance.

2) The measured values shall be expressed rounded to one decimal place.

3) The measured values shall be expressed rounded to three decimal places.

4) Whichever is higher

5) The measured values shall be expressed rounded to integer.

101) The cold water temperature T_{cold} shall be 15°C$^{\pm 5K}$ for the performance tests according to clause 102ff (EN 50193-2-1).

4.2 Number of appliances to be tested

The tests shall be performed on the same appliance.

4.3 General conditions

Unless otherwise specified, the appliance shall be installed, commissioned and operated in accordance with the information provided in the installation and operating instructions.

Commissioning procedures shall be repeated following a supply voltage interruption, if required by the installation and operating instructions.

The supply voltage shall be maintained at the main terminal at 230 V ± 1 % or at 400 V ± 1 % as defined by the manufacturer's installation guide, while the heating elements are switched on. The supply frequency shall be at a nominal 50 Hz ± 1 %.

The measured voltage and frequency of the power supply used during testing shall be reported.

The tests shall be carried out in a draft free environment at an ambient temperature of 20˚C ± 5˚C. The environment shall not deviate by more than 2K during the test period.

The flow rates provided to the appliance for the test shall be maintained within a tolerance of ± 0.3l/min or ± 3% whichever is higher but shall be not be below the minimum required for the individual draw-off. The flow rates supplied during the test shall be reported.

Unless otherwise specified cold inlet water temperature shall be 10 °C ± 1 °C

4.4 Test setup

The appliance shall be installed in accordance with the installation instructions.

The load pattern should be chosen according to manufacturer classification. The load profile selected can be the maximum or one below the maximum load profile the water heater can fulfil.

The measurement setup shall correspond to Annex B.

5 Energy efficiency

5.1 Test methods

5.1.1 General

The following tests are required to enable the values of Q_{elec}, Q_{cor} and AEC to be calculated using the formulas described in 5.2 for a chosen tapping pattern as defined in Annex A. Losses resulting during idling are not taken into account.

5.1.2 Static efficiency

This test shall measure the static loss of the appliance P_{loss} at nominal load P_{nom} under steady state conditions.

If the appliance has a **power selector**, the selector should be adjusted to the highest value. If the appliance has an **independent flow control**, it shall be adjusted to achieve the value stated in the manufacturer's installation instructions, or where this is not stated, it shall be set to the highest value.

If the appliance has a temperature control, the selector shall be adjusted to the highest value.

For the purpose of this test result is independent from the water inlet temperature; therefore this test can be carried out with a cold water inlet temperature in the range of 10 to 25°C. The inlet water temperature and flow rate must be such that the appliance is caused to operate at full power continuously.

The value of P_{nom} is the power consumption of the appliance measured after a minimum of 30 minutes of operation under full load conditions.

The value of P_{loss} is the sum of all internal power losses (product of current and voltage losses between the terminals and the heating elements) of the appliance measured after a minimum of 30 minutes of operation under full load conditions.

For instantaneous water heaters with semiconductor power switches (e.g Triacs) the voltage across the semiconductor power terminals is subtracted from the measured voltage losses, if the semiconductor power switches are thermally connected to the water pipe. In this case, the heat developed by the semiconductor power switches is transferred to useful energy to heat up the water.

The static efficiency is calculated from the formula:

$$\eta_{static} = \frac{P_{nom} - P_{loss}}{P_{nom}}$$

where

P_{nom} nominal power consumption of the appliance in kW

P_{loss} measured internal static losses of the appliance in kW

η_{static} static efficiency of the appliance as a factor

5.1.3 Start-up losses

This test shall measure the time t_{start_i} which elapses between energizing the heating elements and the delivery of **useable water** and the power consumption P_{static_i} of the appliance at steady state during the delivery of **useable water** for each different draw-off of the chosen **load pattern** of Annex A. The test method assumes the power consumption of the appliance during the start-up period is equal to the power consumed in steady state conditions of the appliance for the specific draw-off *i.*

If the appliance has a **power selector**, the selector should be adjusted to the highest value. If the appliance has an **independent flow control**, it shall be adjusted to achieve the value stated in the manufacturer's installation instructions, or where this is not stated, it shall be set to the highest value.

If the appliance has a temperature control, the selector should be adjusted to the highest value.

The prescribed minimum flow rate f_i of each individual draw-off of the tapping pattern is used as defined in Annex A. If this is not achievable increase the flow rate until the appliance is able to provide hot water continuously with static heating conditions This increased flow rate is used for the individual draw-off instead of the prescribed minimum flow rate. It may be necessary to determine the required flow rate for each individual draw-off where the product may not be able to run continuously at the prescribed minimum flow rate by experimentation before beginning the full series of draw-offs for the chosen load pattern of Annex A.

Three measurements shall be performed for each specific draw-off type *i* and the mean value calculated from these measurements. Each of these measurements shall be performed with the product flushed. This should be done by flowing cold water through the product without the heating elements being energised and monitoring the inlet and outlet temperatures until the difference between the inlet and outlet temperatures is within 1K.

The start-up loss for each specific draw-off *i* is calculated from the formula:

$$Q_{start_i} = P_{static_i} \times \frac{t_{start_i}}{3600}$$

where

t_{start_i} measured start-up time in seconds

P_{static_i} measured steady state power consumption in kW for specific draw-off *i*

Q_{start_i} start-up losses in kWh for specific draw-off *i*

5.1.4 Determination of the smart control factor SCF

SCF = 0

NOTE The calculation of the water heating energy efficiency of water heaters is based on tapping profiles. These tapping profiles are based on the energy content of the withdrawn water.

In the case of electric instantaneous water heaters (EIWH) different technologies exist, hydraulically and electronically controlled products. Electronic electric instantaneous water heaters (EEIWH), through an electronic control system are better able to fine-tune the electrical power consumption to heat up the water to the requested water temperature, without the need of mixing cold water. This results in a reduction of the energy consumption when comparing EEIWHs to simple hydraulic electric instantaneous water heaters (HEIWH) for a real daily usage.

The fact that the load profiles provided refer to energy content of the withdrawn water regardless of actual withdrawal flow rate or temperature either of which may be above the minimum requirement for an individual tapping. It is not possible to show any difference in efficiency between simple instantaneous water heaters and those which are able to regulate the energy input during the delivery of water

For this reason the SCF = 0.

5.1.5 Determination of smart control compliance

If SCF is ≥ 0,07 the value of smart shall be one.

In all other cases the value smart shall be zero.

5.2 Calculation methods

5.2.1 General

The following calculation methods enable the values of Q_{elec}, Q_{cor} and AEC to be calculated using the results from the tests described in 5.1 for a chosen tapping pattern as defined in Annex A.

5.2.2 Daily energy demand

The daily energy demand Q_{elec} is the sum of losses and useful energy of all individual draw-off *i* per day as defined in Annex A.

The daily energy demand is calculated from the formula:

$$Q_{elec} = \sum_{i=1}^{n} \left(Q_{start_i} + \frac{Q_{tap_i}}{\eta_{static}} \right)$$

Where

Q_{elec} is the daily energy demand in kWh

Q_{start_i} is the start-up losses for specific draw-off *i* in kWh determined in 5.1.3

Q_{tap_i} is the predefined useful energy content per draw-off *i* in kWh as specified for the relevant **load pattern** in Annex A.

η_{static} is the static efficiency of the appliance determined in 5.1.2

5.2.3 Correction factor

The correction factor is calculated from the formula:

$$Q_{cor} = -k \times CC\left(Q_{elec} - Q_{ref}\right)$$

where

k is the stated k-value in the regulation

CC is the Primary energy factor

Q_{elec} is the daily energy demand determined in 5.2.2

Q_{ref} is the daily (24h) useful energy content as specified for the relevant load pattern in Annex A.

NOTE 1 k is currently 0.23 for load profiles 3XS to XL and is 0 for profiles XXL to 4XL in the regulation

NOTE 2 The value of CC is currently 2.5 in the regulation

5.2.4 Energy efficiency

The efficiency of the appliance is calculated from the formula:

$$\eta_{\text{iwh}} = \frac{Q_{ref}}{CC \times Q_{elec} \times (1 - SCF \times smart) + Q_{cor}} \times 100\%$$