



SLOVENSKI STANDARD
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01-junij-2014

Nadomešča:
SIST EN 60379:2005

Učinkovitost gospodinjskih električnih akumulacijskih grelnikov vode

Efficiency of domestic electrical storage water heaters

Wirkungsgrad von elektrischen Warmwasserspeichern für den Hausgebrauch

Efficacité des chauffe-eau électriques à accumulation

Ta slovenski standard je istoveten z: prEN 50440:2014

ICS:

91.140.65 Oprema za ogrevanje vode Water heating equipment

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English Version

**Efficiency of domestic electrical storage water heaters and
testing methods**

Efficacité des chauffe-eau électriques à accumulation et
méthodes d'essai

Effizienz von elektrischen Warmwasserspeichern für den
Hausgebrauch

This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2014-10-10.

It has been drawn up by CLC/TC 59X.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CENELEC in three official versions (English, French, German).
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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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24 **Foreword**

25 This document [prEN 50440:2014] has been prepared by CLC/TC 59X "Performance of household
26 and similar electrical appliances".

27 This document is currently submitted to the Enquiry.

28 This document will supersede EN 60379:2004.

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

31 For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this
32 document.

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1 Scope

This European Standard specifies methods for measuring the performance of electric storage water heaters for the production of sanitary hot water for household and similar use.

The object is to state and define the principal performance characteristics of electric storage water heaters and to describe the test methods for measuring these characteristics.

NOTE 1 This standard does not apply to;

- storage water heaters that use electricity as a secondary source of heating the water;
- storage water heaters that do not use a tank to store hot water
- electric storage water heaters that do not meet the minimum (or maximum) output performance of the smallest (or biggest) load profile, as defined in Table 4.

NOTE 2 This standard does not specify performance or safety requirements. For safety requirements see EN 60335-1 in conjunction with EN 60335-2-21.

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 60379 *Methods for measuring the performance of electric storage water-heaters for household purposes*

3 Terms and definitions

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

3.1

storage water heater

water heater that uses electric heating elements as the means of heating water for long-term storage in a thermally insulated container and provided with a device to control the water temperature

3.2

primary function

to heat water for the production of hot water for household and similar needs

3.3

energized storage water heater

storage water heater that is designed to supply hot water and energised for 24h per day

3.4

off-peak storage water heater

storage water heater that is designed to supply hot water whilst only being supplied with electrical energy at off-peak/low tariff periods

Note 1 to entry: The off-peak storage water heater is required to fulfil the requirements of the tapping pattern between 7:00h and 22:00h without external energy supply, e.g. to enable operation at off-peak/low-tariff periods and/or to operate in conditions of insecurity of energy supply. A product qualifies as "off-peak" if it is only energized for a maximum of 8 consecutive hours anywhere between 22:00h and 7:00h during the test with the 24h tapping pattern.

3.5**load profile**

means the output performance (in terms of flow-rates, temperatures, tapping pattern, etc.) of a storage water heater when fulfilling its primary function under specific ambient conditions (see Tables 3 and 4), as declared by the manufacturer

3.6**energy efficiency**

means the ratio between the delivered energy in the sanitary hot water for its load profile and the consumed electrical energy

3.7**storage volume**

rated quantity of water stored in the appliance

Note 1 to entry: This is declared in litres.

3.8**smart control**

device that automatically adapts the water heating process to individual usage conditions with the aim of reducing energy consumption

4 Symbols and Units**Table 1 – Symbols**

Symbol	Unit	Description
η_{elecwh}	[%]	Energy efficiency of a storage water heater.
Q_{ref}	[kWh]	Delivered energy for the 24h tapping pattern for the load profile of the water heater.
Q_{elec}	[kWh]	Electricity consumption with the relevant 24h tapping pattern.
θ'_p	[°C]	mean water temperature for the determination of θ_p , measured at the outlet
f	[l/min]	Minimum flow rate to be reached during tapping.
T_m	[°C]	Temperature at which hot water starts contributing to reference energy that's to say temperature from which counting of useful energy content starts.
T_p	[°C]	Minimum (peak) temperature to be achieved during tapping.
Q_{testelec}	[kWh]	Electricity consumption over 24h test (step 4).
$Q_{\text{H}_2\text{O}}$	[kWh]	Sum of energy contents of n draw-off.
$V_{\text{full-drawing water}}$	[litres]	Sum of quantity of hot water totally delivered during the tapping period.
V_{40_exp}	[litres]	Measured volume delivered at the mean water temperature.
V_{40}	[litres]	Mixed water quantity delivered at 40 °C.
C_{act}	[litres]	Actual capacity of Water Heater
m_{act}	[kg]	Actual weight of water contained inside the tank of the Water Heater
smart		Presence or not of smart control (value shall be 0 or 1).
SCF		Efficiency gain by smart control function.

5 Calculation of the electrical energy efficiency (η_{elecwh})

The electrical energy efficiency (η_{elecwh}) of a storage water heater is the ratio between the delivered energy in the hot water for the tapping pattern of its load profile and the consumed energy. The consumed energy is the result of the test of the water heater with adjustments for:

- **smart control** that can reduce the energy consumption;

The electrical energy efficiency of a storage water heater shall be calculated as (Equation 1):

$$\eta_{elecwh} = \frac{Q_{ref}}{Q_{elec}(1 - SCF \cdot smart)} \quad (\text{Eq. 1})$$

where:

- Q_{ref} is the delivered energy for the 24 h tapping pattern for the load profile of the water heater, in kWh;
- Q_{elec} is the consumption of electric energy with the relevant 24h tapping pattern, in kWh;
- **smart** indicates the presence of **smart control** and is yes = 1, no = 0;

NOTE SCF=0 in case no **smart control** is detected during testing (9.2).

For electric storage water heaters the declared electric energy efficiency shall be:

$$\eta_{elecwh} \leq 100\% \quad (\text{Eq. 2})$$

which is a necessary condition to apply because the formula (Eq. 1) could give a higher efficiency for electric storage water heaters with **smart control**.

6 Measured parameters

The parameters below shall be established following the measurement methods described in following Paragraph 7 and 9:

- Electricity consumption [kWh/d];
- Electrical energy efficiency [%];
- Storage volume [litre].

7 General conditions for measurements

Measurements shall be carried out with a supply of:

Table 2 – Electricity

Measured quantity	Unit	Value	Permissible deviation (average over test period)	Uncertainty of measurement (accuracy)	Notes
Electricity					
Power	W			± 2 %	
energy	kWh			± 2 %	
voltage, <i>test-period</i> > 48 h	V	230/ 400	± 4 %	± 0,5 %	
voltage, <i>test-period</i> < 48h	V	230/ 400	± 2 %	± 0,5 %	
electric current	A			± 0,5 %	
frequency	Hz	50	± 1 %		

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120 The next table gives additional test conditions and tolerances for test outputs (i.e. thermal energy).

Table 3 – Test conditions and outputs. Set values and tolerances

Measured quantity	Unit	Value	Permissible deviation (average over test period)	Permissible deviations of individual measured values	Uncertainty of measurement (accuracy)	Notes
Time						
Time	s				$\pm 0,1 \text{ s}$	
Maximum sample rate (during the deliver of hot water)	s	3 s			$\pm 0,2 \%$	
Maximum sample rate (during the no-deliver of hot water)	s	60 s			$\pm 0,2 \%$	
Sanitary water						
cold water temperature	$^{\circ}\text{C}/\text{K}$	10°C	$\pm 2 \text{ K}$	$\pm 2 \text{ K}$	$\pm 1 \text{ K}$	
cold water pressure	MPa	0.3 MPa			$\pm 5 \%$	
hot water temperature	$^{\circ}\text{C}/\text{K}$	pattern			$\pm 1 \text{ K}$	a,b
volume flowrate	l / min	pattern			$\pm 1 \%$	
volume measurements	l				$\pm 0,5 \%$	
thermal energy	kWh	pattern	$\pm 2 \%$ (overall)	$\pm 2 \%$ (or $\pm 10\text{Wh}$)	$\pm 2 \%$ (or $\pm 10\text{Wh}$)	c
Ambient air						
Temperature	$^{\circ}\text{C}/\text{K}$	20°C	$\pm 2 \text{ K}$		$\pm 1 \text{ K}$	
<p>a To be measured by "rapid response thermometer", meaning an instrument that registers within 1 s. at least 90% of the final temperature rise from 15 to 100 °C when the sensor is plunged in still water.</p> <p>b Thermocouple with a maximum diameter of 0,5mm, centred in stream, directly at outlet</p> <p>c Apart from the maximum deviation a correction factor $Q_{\text{ref}}/Q_{\text{H2O}}$ is applied, whereby Q_{ref} is taken from Table 4 and Q_{H2O} is the energy content of the useful water actually delivered during the test. "Useful water" is water with a temperature higher than a threshold value T_m for tappings in a profile specified in Table 4.</p>						

121

122 All other installation requirements are made according to the manufacturer's instructions.

123 8 Reference Conditions

124 Table 4 specifies the tapping patterns for the chosen Load Profile. Parameters in the Table are:

- 125 a. *Load Profile* [XXS-4XL, in header row of table];
- 126 b. *h* hour [hh:mm] starting at 0:00 h;
- 127 c. Q_{tap} [kWh] useful energy content of water withdrawal to be achieved in the draw-off;
- 128 d. *f* [l/min] minimum flow rate to be reached during tapping;
- 129 e. T_m [$^{\circ}\text{C}$] temperature from which counting of useful energy content starts;
- 130 f. T_p [$^{\circ}\text{C}$] minimum (peak) temperature to be achieved during tapping;
- 131 g. Q_{ref} [kWh/d] daily (24h) useful energy content of all water draw-offs, effectively the sum of all
- 132 Q_{tap} .

133

134 For all tests a cold water temperature of $10 \pm 2^{\circ}\text{C}$ shall be used.

135 As much as possible, the test method uses a 'black-box' approach, i.e. largely technology independent. This means amongst others that the laboratory uses the original appliance thermostat, in the position specified by manufacturer, and at the factory settings. If the product requires manual thermostat operation to obtain the temperatures in Table 4, this shall be done during the test.

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Table 4 – Water heater load patterns (reference test tapping patterns)

h	XXS				XS				S				h	M				L				XL				h	XXL				3XL				4XL			
	Qtap	f	Tm	Tp	Qtap	f	Tm	Tp	Qtap	f	Tm	Tp		Qtap	f	Tm	Tp	Qtap	f	Tm	Tp	Qtap	f	Tm	Tp		Qtap	f	Tm	Tp	Qtap	f	Tm	Tp	Qtap	f	Tm	Tp
	kWh	l/min	°C	°C	kWh	l/min	°C	°C	kWh	l/min	°C	°C		kWh	l/min	°C	°C	kWh	l/min	°C	°C	kWh	l/min	°C	°C		kWh	l/min	°C	°C	kWh	l/min	°C	°C	kWh	l/min	°C	°C
07.00	0,105	2	25						0,105	3	25		07.00	0,105	3	25		0,105	3	25		0,105	3	25		07.00	0,105	3	25		11,2	48	40		22,4	96	40	
07.05													07.05	1,400	6	40		1,400	6	40						07.05												
07.15													07.15									1,820	6	40		07.15	1,820	6	40									
07.26													07.26									0,105	3	25		07.26	0,105	3	25									
07.30	0,105	2	25		0,525	3	35	-	0,105	3	25		07.30	0,105	3	25		0,105	3	25						07.30												
07.45													07.45					0,105	3	25		4,420	10	10	40	07.45	6,240	16	10	40								
08.01													08.01	0,105	3	25					0,105	3	25		08.01	0,105	3	25		5,04	24	25		10,08	48	25		
08.05													08.05					3,605	10	10	40					08.05												
08.15													08.15	0,105	3	25					0,105	3	25		08.15	0,105	3	25										
08.25													08.25					0,105	3	25					08.25													
08.30	0,105	2	25						0,105	3	25		08.30	0,105	3	25		0,105	3	25		0,105	3	25		08.30	0,105	3	25									
08.45													08.45	0,105	3	25		0,105	3	25		0,105	3	25		08.45	0,105	3	25									
09.00													09.00	0,105	3	25		0,105	3	25		0,105	3	25		09.00	0,105	3	25		1,68	24	25		3,36	48	25	
09.30	0,105	2	25						0,105	3	25		09.30	0,105	3	25		0,105	3	25		0,105	3	25		09.30	0,105	3	25									
10.00													10.00								0,105	3	25		10.00	0,105	3	25										
10.30													10.30	0,105	3	10	40	0,105	3	10	40	0,105	3	10	40	10.30	0,105	3	10	40	0,84	24	10	40	1,68	48	10	40
11.00													11.00								0,105	3	25		11.00	0,105	3	25										
11.30	0,105	2	25						0,105	3	25		11.30	0,105	3	25		0,105	3	25		0,105	3	25		11.30	0,105	3	25									
11.45	0,105	2	25						0,105	3	25		11.45	0,105	3	25		0,105	3	25		0,105	3	25		11.45	0,105	3	25		1,68	24	25		3,36	48	25	
12.00													12.00													12.00												
12.30	0,105	2	25										12.30													12.30												
12.45	0,105	2	25		0,525	3	35	-	0,315	4	10	55	12.45	0,315	4	10	55	0,315	4	10	55	0,735	4	10	55	12.45	0,735	4	10	55	2,52	32	10	55	5,04	64	10	55
14.30													14.30	0,105	3	25		0,105	3	25		0,105	3	25		14.30	0,105	3	25									
15.00													15.00								0,105	3	25		15.00	0,105	3	25										
15.30													15.30	0,105	3	25		0,105	3	25		0,105	3	25		15.30	0,105	3	25		2,52	24	25		5,04	48	25	
16.00													16.00								0,105	3	25		16.00	0,105	3	25										
16.30													16.30	0,105	3	25		0,105	3	25		0,105	3	25		16.30	0,105	3	25									
17.00													17.00								0,105	3	25		17.00	0,105	3	25										
18.00	0,105	2	25						0,105	3	25		18.00	0,105	3	25		0,105	3	25		0,105	3	25		18.00	0,105	3	25									
18.15	0,105	2	25						0,105	3	40		18.15	0,105	3	40		0,105	3	40		0,105	3	40		18.15	0,105	3	40									
18.30	0,105	2	25										18.30	0,105	3	40		0,105	3	40		0,105	3	40		18.30	0,105	3	40		3,36	24	25		6,72	48	25	
19.00	0,105	2	25										19.00	0,105	3	25		0,105	3	25		0,105	3	25		19.00	0,105	3	25									
19.30	0,105	2	25										19.30													19.30												
20.00	0,105	2	25										20.00													20.00												
20.30					1,050	3	35	-	0,420	4	10	55	20.30	0,735	4	10	55	0,735	4	10	55	0,735	4	10	55	20.30	0,735	4	10	55	5,88	32	10	55	11,76	64	10	55
20.45	0,105	2	25										20.45													20.45												
20.46													20.46								4,420	10	10	40	20.46	6,240	16	10	40									
21.00	0,105	2	25										21.00					3,605	10	10	40				21.00													
21.15	0,105	2	25										21.15	0,105	3	25					0,105	3	25		21.15	0,105	3	25										
21.30									0,525	5	45		21.30	1,400	6	40		0,105	3	25		4,420	10	10	40	21.30	6,240	16	10	40	12,04	48	40		24,08	96	40	
21.35	0,105	2	25										21.35													21.35												
21.45	0,105	2	25										21.45													21.45												
Qref	2,100				2,100				2,100				Qref	5,845				11,655				19,070				Qref	24,530				46,760				93,520			

9 Test procedures

9.1 Standard Test Procedure

9.1.1 Introduction

The following paragraphs describe the test procedure to establish the electricity consumption Q_{elec} during a 24h test.

9.1.2 Installation

Install product in test environment according to manufacturer's instructions. Designated floor-standing appliances are to be placed on a floor with low thermal leakage (e.g. 20mm thick medium density fibreboard could be placed under the test object at a distance of 100mm above the floor of the test room).

Wall-mounted products shall be mounted on a panel at least 150 mm from any structural wall with a free space of at least 250 mm above and below the product and at least 700 mm to the sides. Products designated to be built-in shall be mounted according to manufacturer's instructions.

Products with declared Load Profiles 3XL and/or 4XL may be tested on-site, provided test conditions are equivalent, possibly with correction factors, to the ones referenced here.

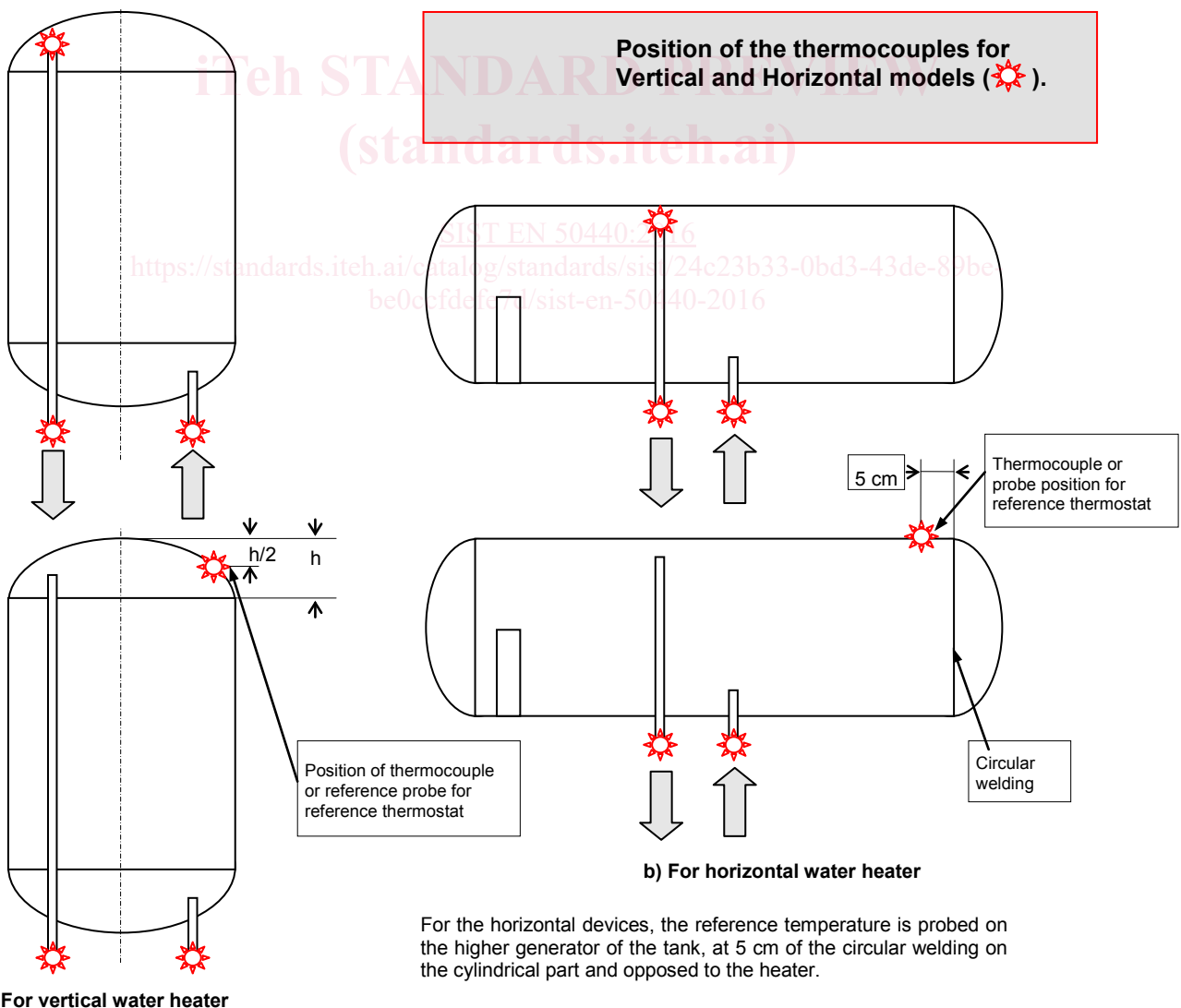


Figure 1 – Position of the thermocouples for Vertical and Horizontal models