BRITISH STANDARD

BS EN
60379:2004

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

The European Standard EN 60379:2004 has the status of a British Standard

ICS 91.140.65

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 60379:2004. It was derived by CENELEC from IEC 60379:1987. It supersedes BS 3999-2:1991 which will be withdrawn on 2006-11-01.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags 〉C〈 〉C〈.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household appliances, to Subcommittee CPL/59/3, Performance of water heaters, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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EUROPEAN STANDARD
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EN 60379

February 2004

ICS 91.140.65

Supersedes HD 500 S1:1988

English version

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

(IEC 60379:1987, modified)

Méthodes de mesure de l'aptitude à la fonction des chauffe-eau électriques à accumulation pour usages domestiques
(CEI 60379:1987, modifiée)

Verfahren zum Messen der Gebrauchseigenschaften von elektrischen Warmwasserspeichern für den Hausgebrauch
(IEC 60379:1987, modifiziert)

This European Standard was approved by CENELEC on 2003-11-01. 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.

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

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CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Foreword

The text of the International Standard IEC 60379:1987, prepared by SC 59C, Heating appliances, of IEC TC 59, Performance of household electrical appliances, together with the common modifications prepared by the Technical Committee CENELEC TC 59X, Consumer information related to household electrical appliances, was submitted to the formal vote and was approved by CENELEC as EN 60379 on 2003-11-01.

This European Standard supersedes HD 500 S1:1988. It only modifies some clauses for clarification, for better reproducibility and for better information to the consumer.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2004-11-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-11-01

This European Standard, based on HD 500 S1:1988, has been prepared by the Technical Committee CENELEC TC 59X due to the draft implementing Directive of the European Commission and the European Free Trade Association on the indication of the energy consumption of electric storage water heaters. According to this draft implementing Directive the energy consumption to be declared in kWh/year refers only to standing loss without water withdrawal and the classification of the energy efficiency is derived from this standing loss.

Clauses and subclauses which are additional to those in IEC 60379 are prefixed "Z".

Technical differences to HD 500 S1:1988 are:

a) definition of the rated capacity (in order to clarify the term "storage temperature" used in the draft implementing Directive);

b) general conditions for measurement;

c) verification of the rated capacity;

d) standing loss at 24 h;

e) tolerances and control procedures;

f) no declaration to provide;

g) accuracy of instrumentation;

h) tolerances;

i) mixed water quantity at 40 °C.

Endorsement notice

The text of the International Standard IEC 60379:1987 was approved by CENELEC as a European Standard with agreed common modifications.

Contents

SECTION ONE — GENERAL

1 Scope

This standard applies to electric storage water-heaters for household purposes.

This standard does not apply to:

— water-heaters using other sources of energy (e.g. solar energy);

— water-heaters with more than one heated volume;

— water-heaters without thermal insulation.

〚C〛 The common modifications supplement, as far as necessary, test methods which shall be applied in accordance with a Commission's Directive, which is based on standing loss only, implementing Council Directive 92/75/EEC with regard to energy labelling of household electric storage water heaters. Clauses defining permitted tolerances to values declared by the manufacturer and control procedures for checking these declared values are added. 〚C〛

2 Object

The purpose of this standard is to state and define the principal performance characteristics of electric storage water-heaters which are of interest to the user and to describe the standard methods for measuring these characteristics.

This standard is concerned neither with safety nor with performance requirements.

SECTION TWO — DEFINITIONS AND LETTER SYMBOLS

For the purpose of this standard, the following definitions and letter symbols apply.

3 Terms used to designate appliances

3.1 Storage water-heater

An appliance intended for heating water in a thermally well-insulated container, for the long-term storage of the heated water, and provided with a device to control the water temperature

4 Terms used to classify appliances[1)]

4.1
unvented water-heater
a water-heater designed to work under the pressure of the water supply mains, the flow of water being controlled by one or more valves in the outlet system

4.2
cistern-fed water-heater
a water-heater supplied from a cistern in which the flow of water is controlled by one or more valves in the outlet system and which is provided with a vent open to the atmosphere and so arranged that the expanded water can return to the feed cistern

4.3
open outlet water-heater
a water-heater in which the flow of water is controlled by a valve in the inlet pipe and so arranged that the expanded water can overflow through the outlet pipe

4.4
vented water-heater
a water-heater open to the atmosphere, so that under no condition of use can the pressure at the surface of the water be other than atmospheric

[1)] See Figure 1.

4.5
cistern-type water-heater
a cistern-fed water-heater which has a feed cistern as an integral part of the appliance

5 Terms relating to characteristics of appliances

〚C〛 5.1 Capacity

5.1.Z1
rated capacity
the storage capacity assigned to the water-heater by the manufacturer and marked on it

5.1.Z2
actual capacity
the water capacity determined by measurement. 〚C〛

5.2
rated input
the electrical input assigned to the water-heater by the manufacturer and marked on it

5.3
standing loss per 24 h
the energy-consumption of a filled water-heater, after steady-state conditions have been reached, when connected to the electrical supply, during any 24 h when no water is withdrawn

5.4
rated voltage
the voltage (for three phase-supply, the voltage between phases) assigned to the appliance by the manufacturer

〚C〛 5.Z1
mixed water quantity at 40 °C
quantity of water at 40 °C, which has the same heat content (enthalpy) as the hot water which is delivered above 40 °C at the output of the water heater 〚C〛

6 Symbols

For the purpose of this standard the symbols used have the following meanings:

		See Clause:
A	= deviation of dial-calibration	**18**
E	= energy consumption per 24 h	**14**
F_m	= mixing factor	**17**
Q_{pr}	= standing loss per 24 h	**14**
t_R	= reheating-time	**16**
$t_{R,\,50}$	= reheating-time for a water temperature rise of 50 K	**16**
θ	= temperature indicated on thermostat dial	**11**,**18**
$\Delta\theta$	= cyclic variation (differential) of thermostatic control	**19**
θ_{amb}	= ambient temperature during the tests	**8**
θ_C	= temperature of cold water	**8**,**15**
θ_{Ai}	= water temperature after a thermostat cut-out	**10**,**14**
θ_A	= mean water temperature after a thermostat cut-out	**10**,**14**
θ_{Ei}	= water temperature after a thermostat cut-in	**10**,**14**
θ_E	= mean water temperature after thermostat cut-in	**10**,**14**
θ_M	= mean water temperature without withdrawal	**11**,**14**
θ'_P	= mean water temperature for the determination of θ_P	**10**,**15**
θ_P	= mean water temperature when determining the hot water output	**15**
θ_R	= water temperature after reheating	**16**
θ_W	= mean water temperature after withdrawal without replenishment	**16**,**17**

[C〉 C_R	= rated capacity	**5.1.Z1**
C_A	= actual capacity	**5.1.Z2**
t_{Ai}	= cut-out time	**15**
t_{Ei}	= cut-in time	**15**
D	= duration period for the tests	**15**
θ_{A1}	= switching-off temperature of the thermostat at the beginning of the test	**15**
θ_{An}	= switching-off temperature of the thermostat at the end of the test	**15**
C_m	= mixed water output at 40 °C	**17** 〈C]

SECTION THREE — GENERAL NOTES ON MEASUREMENTS

7 List of measurements

The performance of water-heaters is determined by the following measurements:

	See Clause:
— verification of rated capacity	**13**
— standing loss per 24 h	**14**
— hot-water output	**15**
— reheating time	**16**
— mixing factor	**17**
— deviation of dial-calibration	**18**
— cyclic variation (differential)	**19**
[C〉— stored water temperature	**10** 〈C]

A diagram of measurements is given in Figure 4.

8 General conditions for measurements

Unless otherwise specified, measurements are carried out on the water-heater, operating:

— in a substantially draught-free room;

— at an ambient temperature, θ_{amb} of 20 ± 2 °C.

[C〉 The ambient temperature is calculated from measurements at a single point in front of the centre of the water-heater halfway between the water-heater and the wall, and at half the height of the water-heater: 〈C]

— at a relative air-humidity not exceeding 85 %.

The values for temperature and relative humidity are only valid at steady-state conditions and not at the moment when hot water is withdrawn from the water-heater:

[C〉 *Text deleted* 〈C]

— mounted as described in Clause **9**, supplied with water at a temperature θ_C of 15 ± 2 °C and provided from a source having a substantially steady pressure and installed according to the manufacturer's instructions;

— at a thermostat-setting as described in Clause **11**;

[C〉 — the supply voltage shall be maintained at 230 V with a relative tolerance of 1 %;

— the supply frequency shall be 50 Hz with a relative tolerance of 1 %. 〈C]

9 Mounting of the water-heater

Wall-mounted water-heaters are mounted on a panel situated at least 150 mm from any structural wall.

They are positioned so that there is a clear space of at least 250 mm above and below the heater and at least 700 mm at the sides and front.

Floor-mounted water-heaters are placed on the floor or on any stand supplied with them. A false floor may be used to facilitate measurements.

Water-heaters for building-in are built in according to the manufacturer's instructions.

10 Measurement of stored water temperatures

10.1 Measurements of water temperature without withdrawal of water are made with a thermocouple placed inside the upper section of the container. However, for metal containers the thermocouple may be placed on the outer surface of the container (see Figure 3).

The mean water temperature after a thermostat cut-out θ_A is the average value of n temperatures θ_{Ai} recorded after each cut-out of the thermostat and is given by:

$$\theta_A = \frac{\sum_{i=1}^{i=n} \theta_{Ai}}{n}$$

The mean water temperature after a thermostat cut-in θ_E is the average value of n temperatures θ_{Ei} recorded after each cut-in of the thermostat and is given by:

$$\theta_E = \frac{\sum_{i=1}^{i=n} \theta_{Ei}}{n}$$

10.2 Measurements of temperature of withdrawn water are made in the outflow which is to be continuous. The temperature is measured to an accuracy of ±0.5 K and, if a thermometer is used, it is to be a type that records quickly and accurately in any position.

Temperature readings are preferably taken continuously. Alternatively, they may be taken at equal intervals evenly spread over the discharge, for example 10 readings at 5 %, 15 %, etc. of the rated capacity. If there is a sharp drop in temperature, additional readings may be necessary in order to correctly calculate the average value θ'_P.

11 Thermostat setting

The thermostat of water-heaters where adjustment is provided is set so that the mean water temperature θ_M, as measured in Clause **14**, is 65 ± 3 °C.

The thermostat-setting is to remain unchanged throughout the measurements. If the thermostat has a dial to indicate the temperature, the equivalent dial-reading θ is to be recorded.

For water-heaters where regulation of the water-heater thermostat is not provided for the user, no adjustment to the thermostat setting is made.

12 Measurement of energy consumption

The electrical energy consumed is measured by means of a watthour meter and recorded in kilowatt-hours to the nearest 0.01 kWh.

〚C〛 Z1 Accuracy of instrumentation

Instruments having the following or better accuracy shall be used for the tests:

Mass
Instruments shall be accurate to ±1 %.

Ambient temperature
Instruments shall be accurate to ±1 K.

Water temperature
Instruments shall have a resolution of at least 0,2 K and an accuracy of ±1 K including non-linearity error, at the nominal temperature measured.

Water volume
Instruments shall be accurate to ±1 %. 〚C〛

〈C〉 **Water flow rate**
Instruments shall be accurate to ±5 %.

Electrical power
Instruments shall have less than 10 W zero point inaccuracy, and provide less than 2 % inaccuracy at the highest nominal value according to rated input power data specified by the manufacturer.

Time
Instruments shall be accurate to ±1 %. 〈C〉

SECTION FOUR — METHODS OF MEASUREMENT

〈C〉 13 Verification of the actual capacity

The heating of the storage water-heater is switched off. Then the storage water-heater is filled with cold water in accordance with the manufacturer's instruction and the water supply is cut off. It is then emptied through the water inlet or if it is not possible, through the drain plug opening. 〈C〉

Water in the feed cistern of a cistern-fed water-heater is excluded from the quantity withdrawn.

The water withdrawn is measured and the result stated in litres, to the nearest one-tenth litre.

14 Standing loss per 24 h

The water-heater is filled with cold water. The electrical supply is then switched on for a few cycles of operation of the thermostat until steady conditions have been reached.

Starting and ending at a cut-out of the thermostat, the energy E_1 consumed during time t_1 (hours) is measured over a period of not less than 48 h. The water temperatures θ_{Ei} at each thermostat cut-in and θ_{Ai} at each thermostat cut-out are measured by means of a thermocouple positioned as in Clause **10**.

The energy consumption E per 24 h is calculated according to the following formula:

$$E = \frac{E_1 \cdot 24}{t_1}$$

The mean water temperature θ_M is calculated by the formula:

〈C〉
$$\theta_M = \frac{1}{D}\sum_i \frac{\theta_{Ai} + \theta_{Ei}}{2}(t_{Ai} - t_{Ei})$$
〈C〉

Standing loss per 24 h Q_{pr} is calculated according to the formula:

〈C〉
$$Q_{pr} = \frac{45}{\theta_M - \theta_{amb}} \cdot E + \frac{1,16 \cdot C_A \cdot (\theta_{A1} - \theta_{An})}{1\ 000}$$
〈C〉

〈C〉 Q_{pr} is expressed in kWh per 24 h related to a temperature rise of 45 K.

It shall be given with two decimals for values below 1 kWh per 24 h and with one decimal for values equal or exceeding 1 kWh per 24 h. 〈C〉

15 Hot water output

Immediately following measurement according to Clause **14**, the water-heater is switched off after a cut-out of the thermostat.

Then,

— a quantity of water equal to the rated capacity is withdrawn through the outlet at a constant rate of flow by supplying cold water; the flow of water from open outlet water-heaters is controlled by the inlet valve. The flow in any other type of water-heater is kept constant by means of a valve fitted in the outlet.

The rate of flow is adjusted:

- to 2 l/min for water-heaters with a rated capacity less than 10 l;
- to 5 l/min for water-heaters with a rated capacity of 10 l up to 50 l;
- to 10 l/min for water-heaters with a rated capacity of more than 50 l up to 200 l;
- to a value corresponding to 5 % of the capacity per min for water-heaters with a rated capacity exceeding 200 l.

The temperature is measured in the manner described in sub-clause **10.2** and the average temperature of withdrawn water θ'_P established.

The mean water temperature θ_P is calculated from the following formula:

$$\theta_P = 50 \frac{\theta'_P - \theta_C}{\theta_A - \theta_C} + 15$$

— The hot-water output is recorded as the rated capacity at θ_P (... litres at... °C).

16 Reheating time

Immediately following determination θ_P according to Clause **15**

— the electrical supply is switched on;

— the heating time t_R from switch-on until the first cut-out of the thermostat when the temperature of the water θ_R as measured according to sub-clause **10.1** is within 10 K of θ_A.

The reheating time required for heating up the water from 15 °C to 65 °C is calculated from the following formula and expressed in hours and minutes:

$$t_{R,50} = t_R \cdot \frac{50}{\theta_R - \theta_C}$$

then,

— the water-heater is switched off and the water supply turned off;

— the water is withdrawn through the inlet but if this is not possible, the water may be withdrawn through the drain plug;

— the mean water temperature by withdrawal without replenishing with cold water is recorded as θ_W.

[C] 17 Mixing factor, mixed water output at 40 °C [C]

The mixing factor F_m is determined by comparing the mean water temperature with and without cold water flowing into the water-heater.

The mixing factor is expressed as a percentage and given by the formula:

$$F_m = \frac{\theta_W - \theta_P}{\theta_W} \cdot 100$$

[C] The mixed water output at 40 °C is calculated as follows:

$$C_m = C_R \cdot \frac{\theta_P - 15}{25}$$ [C]

18 Deviation from dial calibration

This measurement applies only to thermostats which can be adjusted by the user and with an exposed dial.

The deviation of dial calibration, A, is determined by comparing the dial reading with the mean water temperature and is given by the formula:

$$A = \theta - \theta_M$$

19 Cyclic temperature variation (differential)

The cyclic temperature variation of the thermostat $\Delta\theta$ is expressed by the formula:

$$\Delta\theta = \theta_A - \theta_E$$

[C〉 Z2 Tolerances and control procedure

Z2.1 Rated capacity

The value measured according to Clause **13** shall not be less than the rated capacity.

Z2.2 Standing loss

The measurement may be performed with a specific regulation in order to obtain a temperature rise of (45 ± 3) K.

The standing loss measured according to Clause **14** shall not be greater than the value declared by the manufacturer plus 15 %.

If the result of the test carried out on the first appliance is greater than the declared value plus 15 % the test shall be carried out on a further three appliances.

The arithmetic mean of the values of these three appliances shall not be greater than the declared value plus 10 %.

Z2.3 Hot water output

The value measured according to Clause **15** shall not be lower than the hot water output declared by the manufacturer. 〈C]

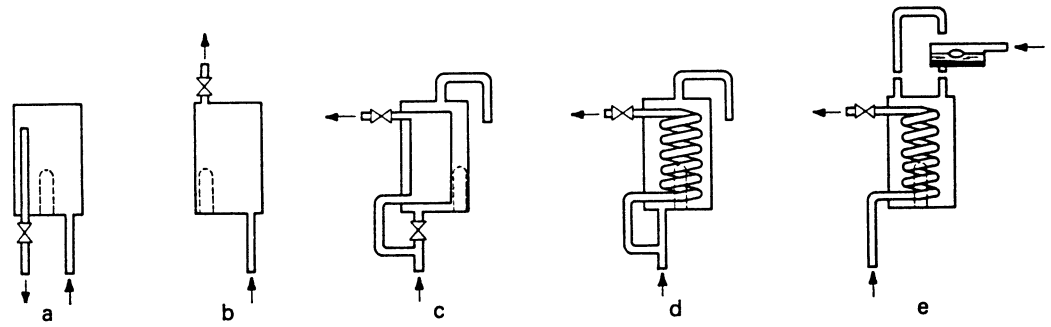

Figure 1A — Unvented water-heaters (see sub-clause **4.1**)

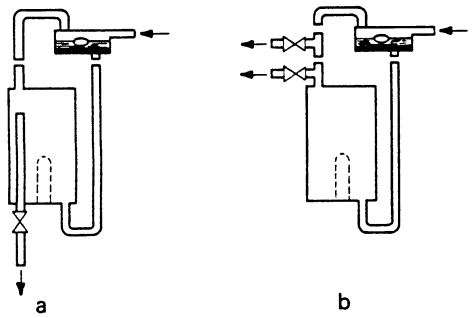

Figure 1B — Cistern-fed water-heaters (see sub-clause **4.2**)

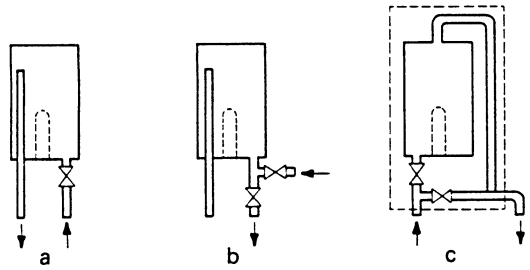

Figure 1C — Open outlet water-heaters (see sub-clause **4.3**)

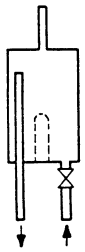

Figure 1D — Vented water-heater (see sub-clause **4.4**)

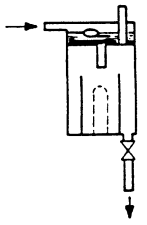

Figure 1E — Cistern-type water-heater (see sub-clause **4.5**)

Figure 1 — Schematic representation of storage water-heaters

〈C〉 *Figure 2 deleted* 〈C〉

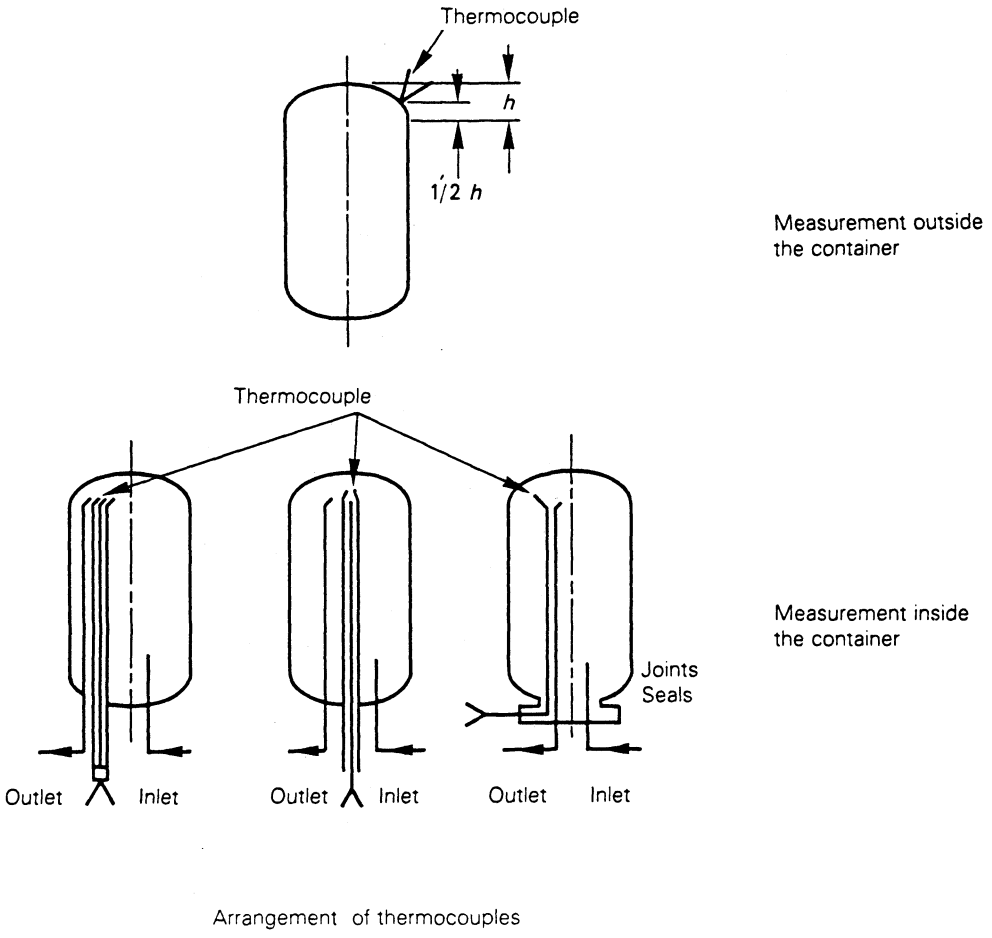

Figure 3 — Measurement of water temperature using a thermocouple

〈C〉

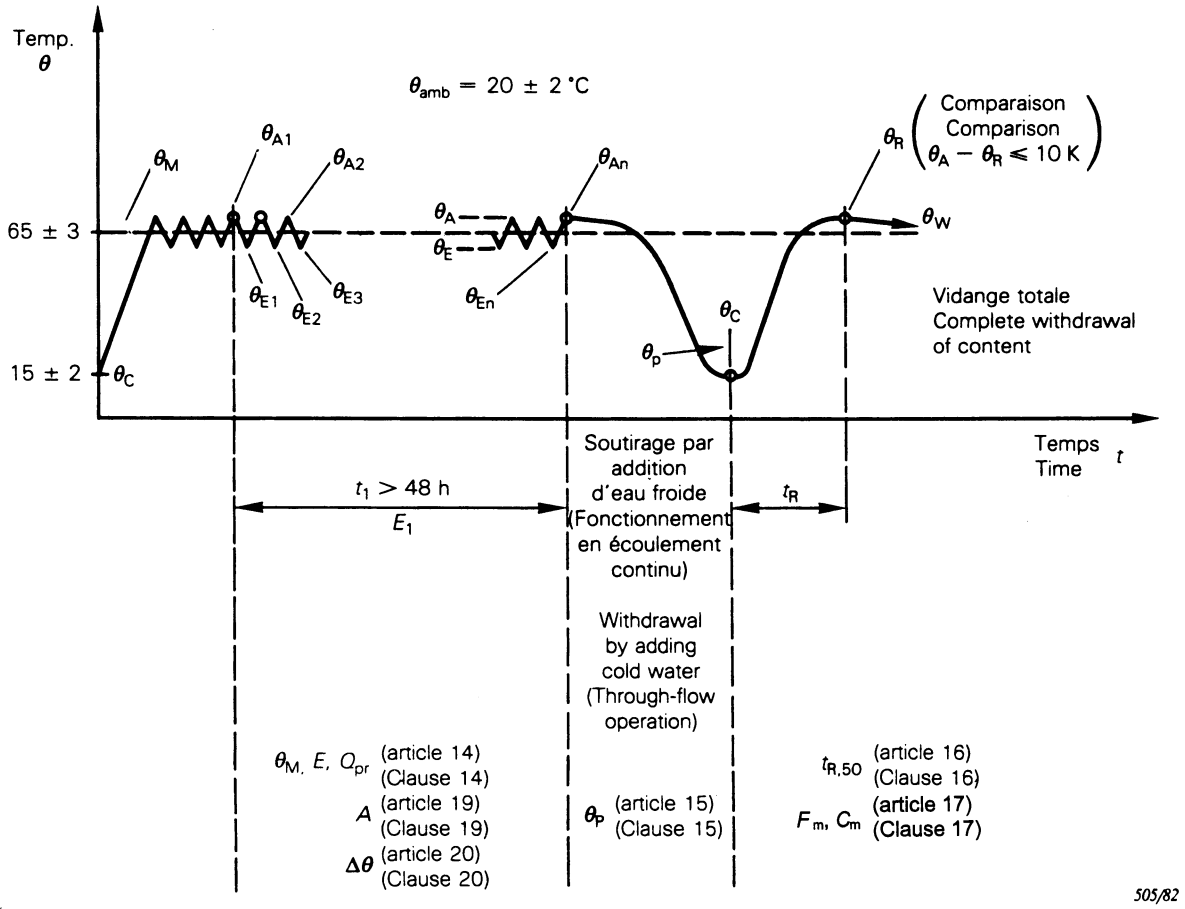

Figure 4 — Measurements for thermal storage water-heaters

〈C〉

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