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Water supply — Specification for indirectly heated unvented (closed) storage water heaters

bsi.

National foreword

This British Standard is the UK implementation of EN 12897:2016. It supersedes BS EN 12897:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/504/-/10, Hot & Cold Water Storage.

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Water supply - Specification for indirectly heated unvented (closed) storage water heaters

Alimentation en eau - Prescriptions pour préparateurs d'eau chaude par accumulation à chauffage indirect non ouverts à l'air libre (fermés)

Wasserversorgung - Bestimmung für mittelbar beheizte, unbelüftete (geschlossene) Speicher-Wassererwärmer

This European Standard was approved by CEN on 15 April 2016.

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European foreword

This document (EN 12897:2016) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2016, and conflicting national standards shall be withdrawn at the latest by December 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12897:2006.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of Commission Delegated Regulation (EU) No 812/2013 and Commission Regulation (EU) No 814/2013.

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

In comparison with EN 12897:2006, the following significant changes have been made:

— the capacity range extended from 1 000 l to 2 000 l;

— the maximum temperature reduced from 100 °C to 95 °C;

— revisions in durability testing for cylinders using expansion vessels or internal expansion space;

— provision is made in Annex A for the calculation of the V_{40} hot water capacity;

— Annex B has been revised to improve the test methodology and bring the standing heat loss test requirements in line with those required by the EU directives for the Ecodesign and labelling of hot water storage tanks.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

In respect of potential adverse effects on the quality of water intended for human consumption caused by the product covered by this standard:

a) This standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA.

b) It should be noted that, while awaiting the adoption of the verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

1 Scope

This European Standard specifies the constructional and performance requirements and methods of test for indirectly heated, unvented (closed) storage water heaters of up to 2 000 l volume suitable for connection to a water supply at a pressure between 0,05 MPa and 1,0 MPa (0,5 bar and 10 bar), and fitted with control and safety devices designed to prevent the temperature of the stored drinking water from reaching 95 °C.

Whilst storage water heaters intended primarily for direct heating are not covered by this standard, it does allow the provision of electric heating elements for auxiliary use.

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 1487, *Building valves — Hydraulic safety groups — Tests and requirements*

EN 1488, *Building valves — Expansion groups — Tests and requirements*

EN 1489, *Building valves — Pressure safety valves — Tests and requirements*

EN 1490, *Building valves — Combined temperature and pressure relief valves — Tests and requirements*

EN 1491, *Building valves — Expansion valves — Tests and requirements*

EN 1567, *Building valves — Water pressure reducing valves and combination water pressure reducing valves — Requirements and tests*

EN 1717, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*

EN 13203 (all parts), *Gas-fired domestic appliances producing hot water*

EN 13959, *Anti-pollution check valves — DN 6 to DN 250 inclusive family E, type A, B, C and D*

EN 15332:2007, *Heating boilers — Energy assessment of hot water storage systems*

EN 60379:2004, *Methods for measuring the performance of electric storage water-heaters for household purposes (IEC 60379:1987)*

EN 60730-2-9, *Automatic electrical controls for household and similar use — Part 2-9: Particular requirements for temperature sensing controls (IEC 60730-2-9)*

3 Terms, definitions and symbols

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

3.1 Terms and definitions

3.1.1
indirectly heated unvented (closed) storage water heater
vessel complete with heat exchanger (primary heater) for heating and storage of drinking water where the contents are not vented to atmosphere

3.1.2
rated volume
rated storage volume
V
volume of the water storage vessel in litres as specified in the manual

3.1.3
actual volume
measured volume of the drinking water storage vessel in litres

3.1.4
water side
part of the storage water heater directly in contact with the drinking water

3.1.5
heating side
parts of the storage water heater which contain the heating medium

3.1.6
maximum design pressure
rated pressure
maximum pressure to which the unvented storage water heater is designed to be subjected in use

3.1.7
maximum inlet pressure
specified maximum cold water inlet pressure for the water heater

3.1.8
maximum safety temperature
maximum temperature that the stored water can reach under a fault condition

3.1.9
maximum operating temperature
maximum temperature that can be set for normal operation

3.1.10
primary heater
heat exchanger system fitted to the hot water storage vessel through which a heating medium (such as water from a boiler) flows to heat the stored drinking water

3.1.11
double-walled primary heater
primary heater with concentric walls such that any leak through one wall will not allow the heating fluid to contaminate the drinking water

3.2 Symbols

Symbol	Unit	Description
θ'_p	[°C]	Average temperature of the water drawn off at ≥ (θ_c + 30) °C
V_{40}	[l]	Mixed water quantity delivered at 40 °C.
θ_c	[°C]	Average temperature of inlet cold water during the test
θ_{set}	[°C]	Target hot water temperature for hot water performance testing = θ_c + 50 K
θ_{pri}	[°C]	Primary flow temperature = θ_c + 70 K
θ_w	[°C]	Target temperature of stored water for heat loss testing
e	[°C]	Mean of all the differentials between θ_w and measured ambient air temperature
θ_a	[°C]	Measured ambient temperature at a given position
V_{hot}	[l]	Volume of water drawn off at ≥ (θ_c + 30)°C
Q_c	[kWh/24h]	Corrected 24 h heat loss
Q_{st}	[kWh/24h or W]	Declared standing heat loss
Q_m	[kWh]	Power consumption meter reading
t	[minutes]	Time taken to reheat the storage water heater from $\theta_{c\ to}$ θ_{set}
P	[kW]	Calculated heat exchanger performance

4 Requirements

4.1 Constructional requirements

4.1.1 Inspection access

Unvented storage water heaters shall be provided with means for internal inspection (see Annex C). This can also be achieved by using a connection intended and dimensioned for another purpose where the use of a suitable inspection instrument such as an endoscope is acceptable.

4.1.2 Draining

Unvented storage water heaters shall permit *in situ* draining. The method of draining shall be given in the manufacturer's instructions.

4.1.3 Hydraulic connections

Hydraulic connections shall be of a type that allows the storage water heater to be disconnected from the pipework.

4.2 Temperature control

The temperature of the stored drinking water shall be regulated either by control of the heat source or sources or by control of the water heater.

4.3 Mechanical resistance and stability

4.3.1 Pressure resistance of water storage vessel

When tested in accordance with 6.2, the water heater shall withstand a pressure of 2,0 times the maximum design pressure (as specified by the manufacturer) for a period of not less than 10 min without showing any leakage or cracking.

4.3.2 Pressure resistance of primary heater

When tested in accordance with 6.2, the primary heater or heaters shall withstand a pressure of 2,0 times the maximum design pressure, as specified by the manufacturer, for a period of not less than 10 min without showing any leakage or cracking.

4.3.3 Durability

4.3.3.1 General

Water heaters shall be tested for durability by pressure cycle testing to either 4.3.3.2 or 4.3.3.3 as appropriate. See Figure 2 for details. The storage water heater shall show no signs of leakage or cracking after testing.

For water heaters without inlet pressure and system expansion control and where the internal pressure is likely to reach maximum design pressure due to water expansion after heat input, the test in 4.3.3.2 shall be applied.

For water heaters designed for use with expansion vessels or internal expansion space such that the rise in internal pressure due to expansion is controlled to below maximum design pressure, then the alternative 4.3.3.3 shall be used.

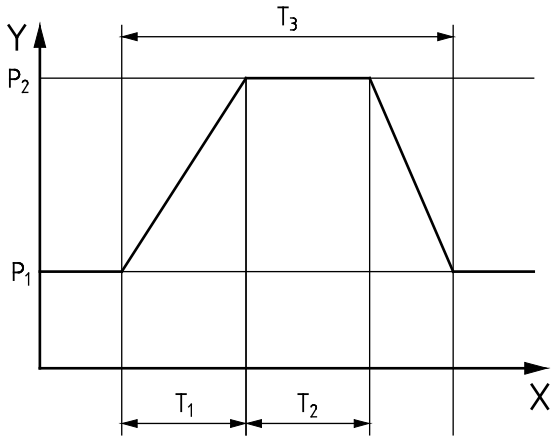
If 4.3.3.3 is used then the installation manual supplied with the water heater shall specify the pressure reduction and expansion control devices required.

4.3.3.2 Water heaters without inlet pressure and system expansion control

The water heater shall be subjected to either 20 000 periodic cycles at 1,2 × maximum design pressure or 100 000 periodic cycles at 1,0 × maximum design pressure.

4.3.3.3 Water heaters designed for use with expansion vessels or internal expansion space

For water heaters supplied for use with inlet pressure controls and expansion control systems and these control systems are supplied with the water heater then the water heater shall be subjected to either 20 000 periodic cycles at 1,5 × maximum inlet pressure or 100 000 periodic cycles at 1,3 × maximum inlet pressure. This procedure is illustrated by Figure 1.



Key

Y pressure

X time

Figure 1 — Diagram of test pressure cycle variations

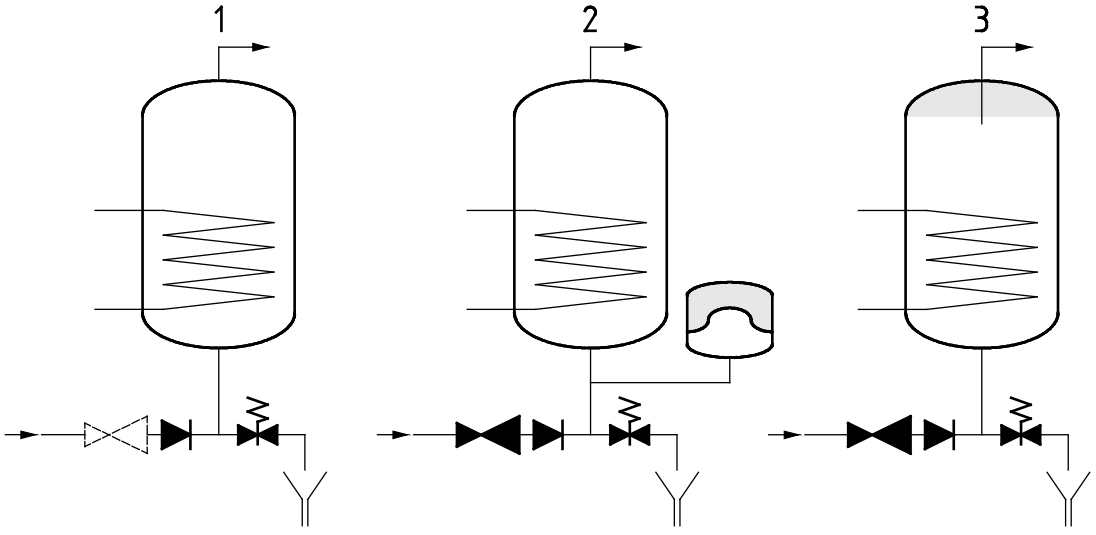
$T_1 \geq 15\ s \leq 30\ s$

$T_2 \geq 15\ s \leq 20\ s$

$T_3 \geq 45\ s \leq 60\ s$

P_1 = Minimum inlet pressure as defined in the technical documents or 0,1 MPa (1 bar) whichever is the lower value.

P_2 = Test pressure as defined in 4.3.3.2 or 4.3.3.3 as appropriate.



Key

1 optional inlet pressure control with expansion valve (4.3.3.2)

2 mandatory inlet pressure control with external expansion vessel (4.3.3.3)

3 mandatory inlet pressure control with internal expansion space (4.3.3.3)

Figure 2 — Pressure control options

4.3.4 Leakage test on double-walled primary heater

When a water heater is provided with a double-walled primary heater, it shall be constructed such that any leakage from the heating side shall be routed to outside the heat exchanger without coming into contact with the stored drinking water.

4.4 Safety equipment

4.4.1 General

Control and safety devices shall operate in the following sequence:

1) thermostatic control device;

2) energy cut out device;

3) where required, temperature pressure relief valve or safety relief valve.

Water heaters shall, where required, either be factory fitted, supplied with or fitted in accordance with the manufacturer's instructions with all devices necessary for the operation of the water heater and the prevention of contamination of the drinking water supply.

All tests, unless specified within the test method, shall be carried out with all devices necessary to control the temperature of the water and all devices necessary for the operation of the water heater and the prevention of contamination of the drinking water supply, fitted.

4.4.2 Energy cut-out device

Where required, water heaters shall be fitted with one or more non-self-resetting energy cut-outs conforming to EN 60730-2-9 connected to the heat source to ensure that the heat input is interrupted in the event of failure of the control thermostat and before the temperature of the stored water reaches 95 °C.

4.4.3 Temperature relief valve

Where required, a temperature relief or a temperature and pressure relief valve shall conform to EN 1490 and be positioned in the water heater so that it prevents the temperature of the stored water from exceeding 100 °C.

4.4.4 Pressure relief/expansion valve

Where required, water heaters shall be fitted, on the cold-water inlet, with either:

a) an expansion valve conforming to EN 1491,

b) an expansion group conforming to EN 1488,

c) a pressure safety valve conforming to EN 1489, or

d) a hydraulic safety group conforming to EN 1487.

4.4.5 Pressure reducing valve

Where required, a pressure reducing valve conforming to EN 1567 shall be used.

4.4.6 Provision for expansion

Where it is a local requirement that expansion water is contained within the hot water system, water heaters shall either:

a) have an expansion capability within the storage vessel, or

b) be supplied with, or fitted in accordance with the manufacturer's instructions with an expansion vessel.

4.4.7 Backflow prevention

Where required, a protective device against backflow conforming to EN 1717 shall be used. If non-return valves are used, they shall comply with EN 13959.

5 Marking

Water heaters shall be permanently marked, by means of a plate or label to be visible after installation, with, as a minimum, the following information:

a) number and year of this standard, EN 12897:2016;

b) manufacturer's name, trademark or identification mark;

c) manufacturing number or serial number, indicating year of manufacture;

d) maximum design pressure on the drinking water side;

e) maximum design pressure on the heating side;

f) rated storage volume;

g) rated volume of the heat exchanger(s);

h) standing heat loss in kWh/24h or W.

In the case of water heaters that are incorporated into heating boilers, the characteristics of the storage water heater and the heating boiler may be shown on a common rating plate or label.

6 Evaluation of conformity

6.1 General

6.1.1 Compliance testing

The compliance of the product with the requirements of this European Standard and with the stated values (including classes) shall be demonstrated by:

— initial type testing; and

— factory production control by the manufacturer, including product assessment.

For the purposes of testing, products may be grouped into families, where it is considered that the selected property is common to all products within that family.

6.1.2 Market surveillance

Storage water heaters are type tested for compliance purposes by means of a specially manufactured unit without the heat exchanger and with an electric immersion heater fitted as specified in B.1 of this standard.

For surveillance check testing of production storage water heaters fitted with heat exchangers, the test may be carried out using either an existing immersion heater or one fitted in an existing connection provided that it meets the positional conditions specified in B.1 and heats at least 85 % of the storage water heater's contents.

In the event of any doubt then the results from the special type test unit shall take precedence.

6.2 Initial type testing

6.2.1 General

Initial type testing shall be performed to show conformity with this European Standard. Tests previously performed in accordance with the provisions of this European Standard (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account. In addition, initial type testing shall be performed at the beginning of the production of a new product type (unless a member of the same family) or at the beginning of a new method of production (where this may affect the stated properties).

Whenever a change occurs in the product design, the raw material or supplier of the components, or the production process (subject to the definition of a family), which would change significantly one or more of the characteristics, the type tests shall be performed for the appropriate characteristic(s).

6.2.2 Actual volume

The actual volume shall be determined for each model in a manufacturer’s product range using a suitable measuring or calculation technique with an accuracy of ± 1 %. This may be done by weighing the heater empty and full of water and calculating the volume of the water. Where a water heater has an internal air space, this test shall be done with the storage water heater at normal maximum inlet pressure, i.e. the set pressure of the pressure-reducing valve.

6.2.3 Rated storage volume

The rated storage volume shall be within the percentage of the actual volume given in Table 1.

Table 1 — Tolerance on storage volume

Storage volume l	**Tolerance**
$V \leq 100$	−2 % +5 %
$100 < V \leq 500$	−5 % +5 %
$500 < V \leq 2\,000$	−5 % +10 %

6.2.4 Hot water volume

The hot water volume shall be determined according to the procedure described in A.4.2 to A.5.1 for each model in a manufacturers product range. At least 75 % of the cylinder's actual capacity shall be drawn off as hot water at (θ_c+ 30) °C or above and the mixed water volume at 40 °C (V_{40}) shall be declared.

6.2.5 Primary heating power (heat exchanger performance)

The primary heating power (heat exchanger performance) shall be determined according to the procedure given in A.4.2 to A.5.2 for each model in a manufacturer's product range. If the vessel is to be integrated into another appliance which is to be tested to any part of the EN 13203 series, this test is not required.

This shall be performed following the procedure given in A.4.2 to A.5.2.

6.2.6 Durability testing

The mechanical resistance and stability of the vessel shall be tested in accordance with 4.3.3.

6.2.7 Double-walled primary heaters

When a water heater is provided with a double-walled primary heater, drill a (2 ± 0,1) mm hole through the partition wall in contact with the heating side at the most critical location in the primary heater (normally the furthest point from the connections). Fill the primary heater and subject it to a water-pressure of (50 ± 5) kPa. Maintain that pressure for (300 ± 5) s. Water shall emerge to atmosphere from the water heater.

6.2.8 Standing heat loss

The standing heat loss shall be determined in accordance with the procedure given in either:

— Annex B;

— EN 60379:2004, Clause 14;

— EN 15332:2007, 5.4.

6.2.9 Pressure resistance

This test shall be performed on a sample taken from production after lining (where applicable) but before insulation. Connections may be fitted with temporary sealing arrangements. For tank-in-tank water heaters the water side shall be filled to the heat source side maximum inlet pressure before conducting the test on the heat source side.

Raise the internal pressure to 2,0 times the maximum design pressure specified by the manufacturer and maintain the pressure for (600 ± 5) s. There shall be no leakage or cracking of the shell.

6.2.10 Temperature control devices

If the water heater is supplied with a temperature control device it shall be tested in accordance with the procedure in Annex A.

6.2.11 Heat exchanger pressure drop

The heat exchanger pressure drop shall be tested in accordance with the procedure in Annex A.

6.3 Production testing

Following complete fabrication, but before lining for corrosion protection and application of insulation, each water heater shall meet one of the following test requirements.

a) Raise the internal pressure to 1,3 times the maximum design pressure specified by the manufacturer using water or another liquid. Hold at this pressure while checking for leakage. Any leakage or cracking shall be deemed a failure and requires remedial action or rejection.

b) Pressurize with air or an inert gas (e.g. helium) using an appropriate method to detect leakage. Any leakage or cracking shall be deemed a failure and requires remedial action or rejection. In addition, at intervals appropriate to the factory production control a water heater from production shall be tested with liquid as described above.

WARNING The pneumatic testing of unvented storage water heaters is potentially dangerous, therefore, such test equipment requires careful consideration.

6.4 Factory production control (FPC)

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform to the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

NOTE An FPC system conforming to the requirements of EN ISO 9001 (see [2]), and made specific to the requirements of this document, is considered to satisfy the above requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded.

7 Technical documents

7.1 General

Each water heater shall be supplied with a set of assembly instructions along with operating and service recommendations, including maintenance instructions.

7.2 Assembly and maintenance instructions

The assembly instructions shall include, as a minimum, the following information:

a) technical data, including:

   1) maximum inlet pressure (rated pressure) of the primary and the secondary system in Pa or bar;

   2) maximum operating temperature of the heating fluid in °C;

   3) type of corrosion protection and maintenance;

   4) rated storage volume of the water heater;

   5) location and nominal diameter of all connections;

   6) accommodation of expansion water;

   7) pressure drop through the primary heater;

   8) primary flow rate information;

   9) diagram showing position of devices, drain tap, etc.;

   10) V_{40} hot water volume in litres.

b) installation instructions with recommendations on mounting surfaces, distance from walls and protection with regard to frost;

c) method for external pipework connection;

d) type and size of safety devices and drain tap;

e) necessary temperature control devices, including the wiring diagram;

f) type of inspection access if provided.

7.3 Operating instructions

The operating instructions shall include, as a minimum, the following information:

a) name and address of the manufacturer;

b) marking information given in Clause 5;

c) information on recommended maintenance;

d) information on the disassembly, recycling and disposal of the product.

Annex A
(normative)

Hot water safety and performance testing

A.1 Tests required

The following table shows the performance testing requirements.

Table A.1 — Performance testing requirements

Test clause	Test description
A.3.1.9 and A.4.1	Hot Water Capacity
A.3.1.9 and A.4.3	Hot Water Capacity V_{40} equivalent
A.3.1.8 and A.4.2	Reheat Performance (primary heating power)
A.3.1.7	Primary Heater Pressure Drop
A.5	Temperature Control

A.2 Test apparatus and tolerances

A.2.1 General

The apparatus shall be constructed in accordance with the schematic diagram shown in Figure A.1. The water heater shall either be supported on a flat base of 20 mm thick medium density fibreboard or wall mounted using the manufacturer's instructions.

The length of any interconnecting pipework shall be kept to the minimum practicable and the primary and draw off pipework insulated. If desired additional valves may be fitted for servicing and set up purposes. The tests should be carried out with any safety devices such as temperature and or pressure relief valves required to meet local requirements fitted.

All temperature measuring devices shall have an accuracy of ± 1 °C.

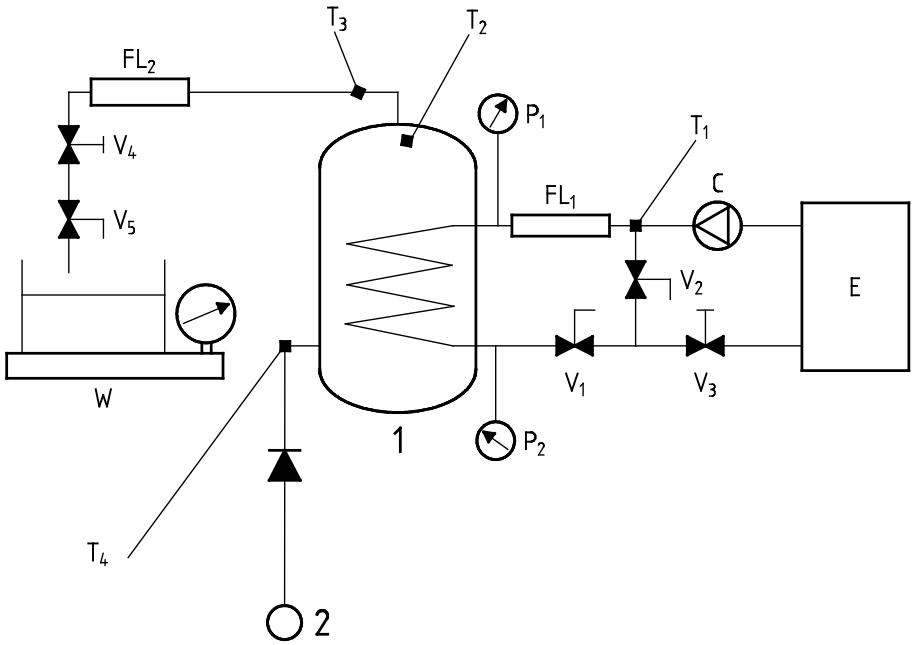
In order to facilitate testing the reference incoming water temperature θ_c is 10 °C. If the incoming water temperature is higher or lower, the other test temperatures shall be adjusted by the same amount to maintain the temperature differences. The incoming water temperature shall be in the range (8 to 18) °C.

NOTE For testing to Commission Delegated Regulation (EU) No 812/2013, a temperature of (10 ± 1) °C is required.

All flow measurement devices shall have an accuracy of ± 1 %.

All mass measurement devices shall have an accuracy of ± 1 %.

All pressure measurement devices shall have an accuracy of ± 2 %.



Key

FL_1, FL_2	flowmeters
E	energy source
C	circulator
V_1, V_2, V_5	quarter turn valves
V_3, V_4	flow control valves
P_1, P_2	pressure gauges
W	weighing device
T_1, T_2, T_3, T_4	temperature sensors
1	water heater under test
2	water supply

Figure A.1 — Apparatus

A.2.2 Description of components

A.2.2.1 Heat Source - A thermostatically controlled heat source (E) capable of providing a primary water flow temperature of (θ_{pri} ± 2) °C

where

$\theta_{pri} = \theta_c + 70$.

Where test A.5.5 is required, a flow temperature θ_{pri} of 110 °C will also be required (for test A.5.5 only).

The primary flow rate will in practice depend on the specification and design of the boiler and heating system to which the water heater will finally be fitted. Typically the system will be designed for temperature drops between primary flow and return temperatures of between 10 K and 20 K.

In order to provide a basis for comparison, the default flow rate used in these tests is 0,25 l/s but this may be changed to suit the recommendations of the manufacturer and/or intended conditions of use but shall remain constant throughout the test procedure. The actual flow-rate used for the testing shall be indicated in 7.2 a) 8).

A.2.2.2 Circulator - A circulator (C) capable of maintaining a primary flow of 0,25 l/s ± 1 % unless otherwise specified by the manufacturer.

A.2.2.3 Flow Meter - A flowmeter (FL_1) calibrated for water at 80 °C at the specified flow rate. The second flow meter (FL_2) is optional and is used to speed up calibration of the test rig.

A.2.2.4 By-Pass Arrangement - A primary by-pass arrangement (V1 and V2) employing two full flow lever operated, quarter turn spherical valves.

A.2.2.5 Outlet Valve - A full flow lever operated, quarter turn spherical valve (V5).

A.2.2.6 Flow Control Valves – Two needle valves (V3 and V4) or similar devices for regulating the primary and secondary flows respectively.

A.2.2.7 Pressure Gauges – Two pressure gauges (P1 and P2) or similar device/s such as a differential manometer capable of measuring the pressure drop across the primary heat exchanger.

A.2.2.8 Temperature Sensors – Four thermometers or thermocouple type devices. The devices shall be positioned as follows:

— **(T_1)** positioned in the primary flow pipe from the circulator to sense the primary water temperature immediately prior to the tee off to the by-pass arrangement;

— **(T_2)** positioned inside or on the storage water heater to sense the stored water temperature at a point 25 mm below the hot water outlet;

— **(T_3)** positioned in the outlet pipe to sense the temperature of hot water leaving the storage water heater, this shall be sited no more than 150 mm from the storage water heater outlet;

— **(T_4)** positioned in the cold water inlet to sense the temperature of cold water entering the storage water heater, this shall be sited no more than 150 mm from the storage water heater inlet.

A.3 Performance tests

A.3.1 Hot water performance

A.3.1.1 The storage water heater, including insulation if fitted, shall be set up for testing as shown in Figure A.1 and the following procedure followed:

A.3.1.2 The water heater and its primary circuit shall be filled and all excess air expelled, (additional air separation devices may be fitted in order to facilitate this operation). The primary circuit shall now be allowed to heat up to a flow temperature of θ_{pri} °C with valves V_1, V_2 and V_3 open and any excess air allowed to escape.

A.3.1.3 Valve V_2 shall be closed, valves V_1 and V_3 shall be opened and valve V_3 adjusted to give the required primary flow rate (normally 0,25 l/s) . Once this is achieved then valve V_2 shall be opened and V_1 closed.

A.3.1.4 With the water heater connected to a suitable cold water supply, valves V_4 and V_5 shall be opened and any excess air expelled from the system until water flows freely from the outlet pipework.

A.3.1.5 With valve V_5 fully open the outlet flow shall be adjusted according to Table A.2 by means of valve V_4. This domestic flow rate can be measured either by using flow meter FL_2 or by timing the rate

of increase in discharged water mass using a timer in conjunction with weighing machine W. Valve V_5 should then be closed.

Table A.2 — Domestic hot water flow rate

Volume (l)	Flow rate (l/s)
$V \leq 100$	0,15
$100 < V \leq 250$	0,25
$250 < V \leq 500$	0,50
$500 < V \leq 750$	0,75
$750 < V \leq 2\,000$	1,00

A.3.1.6 The test cycle shall start with the temperature of water θ_c measured at $T_2 \geq 8$ °C and ≤ 18 °C. This can either require fresh water to be drawn off via valve V_5 or (in exceptionally cold conditions) the storage water heater to receive a "pulse" of heat from the primary circuit.

A.3.1.7 With valve V_5 and V_1 closed and V_2 open, the primary circuit shall be heated to temperature T_{pri}. Once stable primary conditions are established valve V_1 shall be opened and valve V_2 closed immediately afterwards and a timer shall be started. During the reheat period the pressure drop across the coil shall be recorded by means of noting the difference between P_1 and P_2 or using an equivalent measuring device.

A.3.1.8 When the temperature at T_2 reaches θ_{set} ($\theta_{set} = \theta_c + 50$ K), the heat source shall be disconnected by opening Valve V_2 and immediately closing valve V_1. The time taken shall be noted and recorded as the reheat time. Wait for 3 min before proceeding to A.3.1.9.

A.3.1.9 For the test to establish hot water capacity the draw off shall commence by opening valve V_5, the timer shall be started as V_5 is opened and the flow rate maintained according to Table A.2. The temperature at T_3 of draw off shall be noted in 5 l increments. The results of this test are used in the calculation in A.4.1.

A.3.1.10 For the test to calculate reheat performance (primary heating power) then when the temperature at T_3 drops to ≤ (θ_c + 30) °C, at the end of the 5 l increment when this occurs, valve V_5 shall be immediately closed. If desired, the use of the weighing machine and timer combination to record the temperature/draw off volume data may be replaced by an automatic device such as a data logger. The results of this test are used in the calculation A.4.2.

A.3.1.11 For test to calculate hot water volume V_{40} when the volume of water drawn off equals the rated volume of the storage water heater, valve V_5 shall be immediately closed. If desired, the use of the weighing machine and timer combination to record the temperature/draw off volume data may be replaced by an automatic device such as a data logger. The results of this test are used in the calculation in A.4.3.

A.3.2 Primary heater pressure drop

The pressure drop across the primary heater when measured in accordance with A.3.1.7 shall be recorded.

A.4 Interpretation and calculation of hot water performance results

A.4.1 Hot water capacity calculations

Calculations are derived from the hot water draw off profiles as determined by A.3.1.10 and A.3.1.11.The hot water draw off shall be plotted graphically with draw off in litres plotted in 5 l increments on the *X* axis, and temperature at T_3 on the *Y* axis. If automatic recording equipment is used, a continuous plot can be substituted for the 5 l incremental manual plot. For the storage water heater to be deemed as satisfying the requirements of this standard, then at least 75 % of the storage water heaters actual capacity shall be drawn off as hot water at (θ_c + 30) °C or above. The volume drawn off at (θ_c + 30) °C or above shall be determined by reference to the graph of the draw off profile.

A.4.2 Calculation of Reheat performance

The heat exchanger output in kW shall be calculated from the draw off profile established by A.3.1.11 after heating the storage water heater to θ_{set} . The average temperature of the water drawn off at (θ_c + 30) °C or above can be established from the curve and is noted as temperature θ'_p . The volume of water drawn off at (θ_c + 30)°C or above is noted as V_{hot}. The time in minutes taken to reheat the storage water heater from θ_c to θ_{set} (as established by A.3.1.8) is noted as *t.* The heat exchanger performance in kW is expressed as *P* and is calculated as follows.

$$P = \frac{\left(\theta'_{\mathrm{p}} - \theta_{\mathrm{c}}\right) \cdot V_{hot}}{14{,}3 \times t}$$

where

P = the heat exchanger performance in kW;

θ'_{p} = the average temperature of the water drawn off at ≥ (θ_c + 30) °C;

V_{hot} = the volume of water drawn off at ≥ (θ_c + 30) °C;

t = the time in minutes taken to reheat the storage water heater from θ_c to θ_{set};

14,3 = conversion factor (including specific heat of water).

A.4.3 Calculation of V_{40} (equivalent volume of "mixed" water available at 40 °C)

Following measurement of hot water draw off according to A.3.1.11:

The normalized value of the average temperature is calculated according to the following formula:

$$\theta\mathrm{p} = \left(\theta\mathrm{set} - 10\right) \times \frac{\left(\theta'\mathrm{p} - \theta\mathrm{c}\right)}{\left(\theta\mathrm{set} - \theta\mathrm{c}\right)} + 10$$

where

θ_c in °C is the average temperature of inlet cold water during the test,

θ'_p in °C is the average temperature of outlet water and its normalized value is named θ_p in °C.

Quantity of hot water V_{40} in litres delivered with a temperature of at least 40 °C will be calculated by the following formula:

$$V40\left(\mathrm{litres}\right) = \left(V\,hot\right) \times \frac{\left(\theta\mathrm{p} - 10\right)}{30}$$

A.5 Function of safety devices

A.5.1 The storage water heater shall be set up as shown in Figure A.1. Where an electric immersion heater or electric elements for auxiliary heating are included in the specification they shall also be fitted. The wiring to the control thermostat and energy cut-outs shall be disconnected and means (such as an electrical test meter) provided to measure the temperature at which the contacts open.

A.5.2 The flow temperature from the primary heat source shall be set to a temperature of (110 ± 2) °C with a flow rate of 0,25 l/s and the storage water heater heated as before by means of the primary heater.

If an auxiliary immersion heater is fitted then the test shall be performed using direct electrical input in addition to the input from the primary heater. In this case, the thermostat and the cut-outs to be tested are those which control the electrical input to the element.

A.5.3 Set the control thermostat to maximum and record the temperature at which it deactivates the energy supply. At this point the non self-resetting cut out shall not have operated.

A.5.4 The heating shall continue until the non self-resetting cut out operates. This temperature shall be recorded. At this point the temperature relief valve (if fitted) shall not have operated

A.5.5 If a temperature relief valve is fitted heating shall then continue until the temperature relief valve operates. At this point the temperature in the storage water heater as measured at T_2 shall not reach 100 °C. With the heat source still connected, the test shall continue until the temperature relief valve eventually closes.

Annex B
(normative)

Measurement of standing heat loss for factory insulated storage water heaters

B.1 General

This annex specifies the requirements for measuring the heat loss of indirectly heated hot storage water heater. For the purpose of type testing a special storage water heater is used which is identical to the indirect storage water heater except that that the primary heater may be omitted. For test purposes, the storage water heater is fitted with an electrical element or immersion heater at the lowest possible point. At least 85 % of the storage water heater's contents by volume shall be above this heater. If the storage water heater already has a back up immersion heater that meets the above condition and heats ≥ 85 % of the storage water heater's contents then it can be used for this test. If the primary heater is omitted, the primary heat exchanger connections shall remain.

The storage water heater should be tested with factory fitted safety devices such as temperature relief valves in place, these valves may be insulated if this is the normal practice recommended by the manufacturer for installation.

The immersion heater used for testing should normally be rated at 3 kW but for storage water heater of above 250 l capacity a higher output may be used if normally specified by the manufacturer for back up purposes. During the measurement period it is allowed to reduce the rated power of the heating element to get a better accuracy of the measurement results.

The storage water heater shall be provided with a means of filling with cold water and a means of accommodating or discharging expansion water.

All test rig pipework and connections shall be insulated with an insulation material with a thermal conductivity of 0,030 W/(m K) < λ < 0,035 W/(m K) to the thickness given in Table B.1.

Table B.1 — Thickness of insulation according to size of pipe or connection

Inner diameter ≤ 22 mm	20 mm
Inner diameter > 22 mm ≤ 35 mm	30 mm
Inner diameter > 35 mm ≤ 100 mm	Equal to inner diameter
Inner diameter > 100 mm	100 mm

B.2 Apparatus

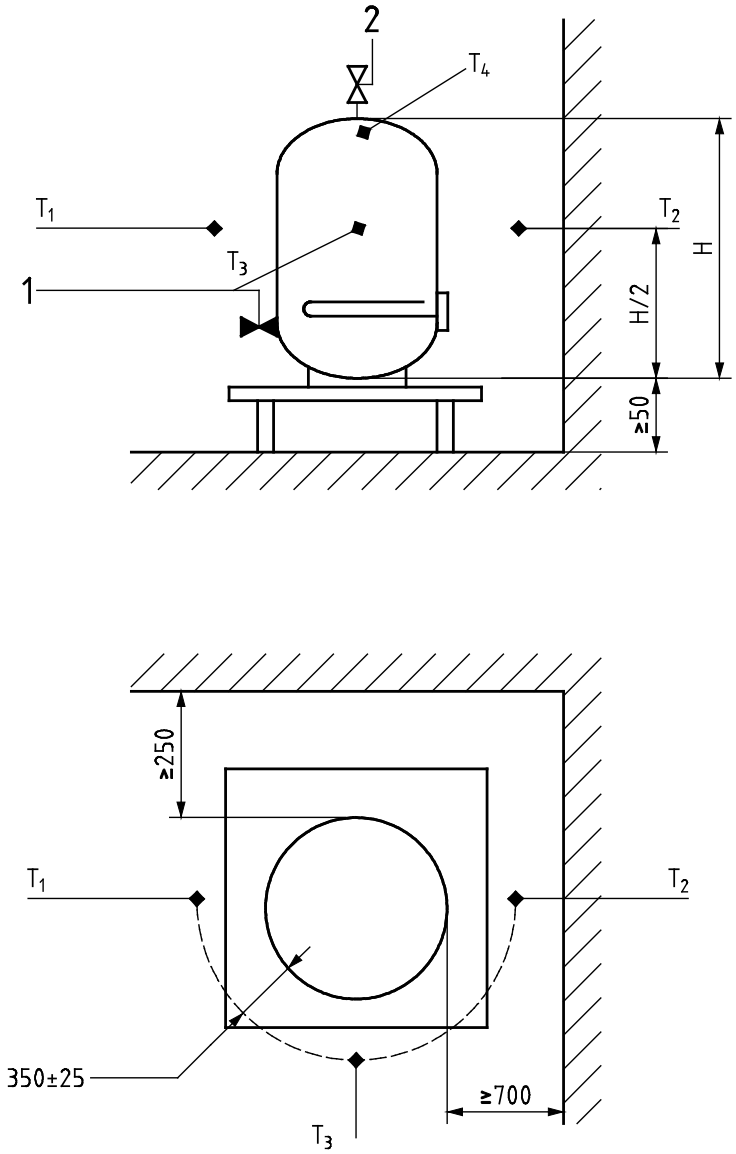
Figure B.1 applies.

B.2.1 Storage water heater support.

Units designed for floor mounting shall be mounted on a base of at least 20 mm thick medium density fibreboard at a height of at least 50 mm. above floor level and positioned such that there is at least 250 mm behind the unit and at least 700 mm from any wall or other vertical surface.

Units designed for wall mounting shall be mounted using the brackets supplied by the manufacturer, the distance from the mounting wall shall be determined by the brackets but the unit shall be at least 700 mm from any other wall or other vertical surface.

Dimensions in millimetres



Key

1 inlet controls

2 outlet valve

Figure B.1 — Standing Heat Loss Test Apparatus

B.2.2 Test connections.

In order to measure the temperature of stored water θ_w, a sensor T_4 shall be positioned such as to register the temperature at a point 25mm ± 20mm below the level of the hot water draw off. This can be inserted via a thermostat pocket fitted in the expansion vent pipe, or by a suitable contact probe on the vessel wall. Consideration shall be given to the effect of the thermal conductivity of the vessel wall on the accuracy of the temperature measurement.

The accuracy of all temperature sensors shall be ± 1 K.

During the test it will be necessary to control the temperature θ_w at T_4 to 65 °C ± 3 °C. The switching differential (hysteresis) on the controller shall not exceed ± 1 °C. This may require an electronic thermostat which may either use the same sensor or an additional sensor mounted in the same vicinity.

Three additional sensors T_1, T_2 and T_3 are required to measure ambient temperature, they shall be positioned at a height of half way up the storage water heater wall and at a distance of (350 ± 25) mm from the exterior of the unit under test. These sensors shall be positioned at the sides and front of the unit as shown in Figure B.1.

During the test the ambient temperature θ_{a1}, θ_{a2} *and* θ_{a3} as measured by readings taken at T1, T2 and T3 shall be 20 °C ± 3 °C .

All four sensors shall be connected to a data logging device capable of recording the individual temperatures at intervals not exceeding 5 min.

In order to measure electricity consumption the supply to the immersion heater shall be connected via a kilowatt hour meter or equivalent device capable of measuring the electricity consumption with an accuracy of ± 0,01 kWh.

B.3 Test Procedure

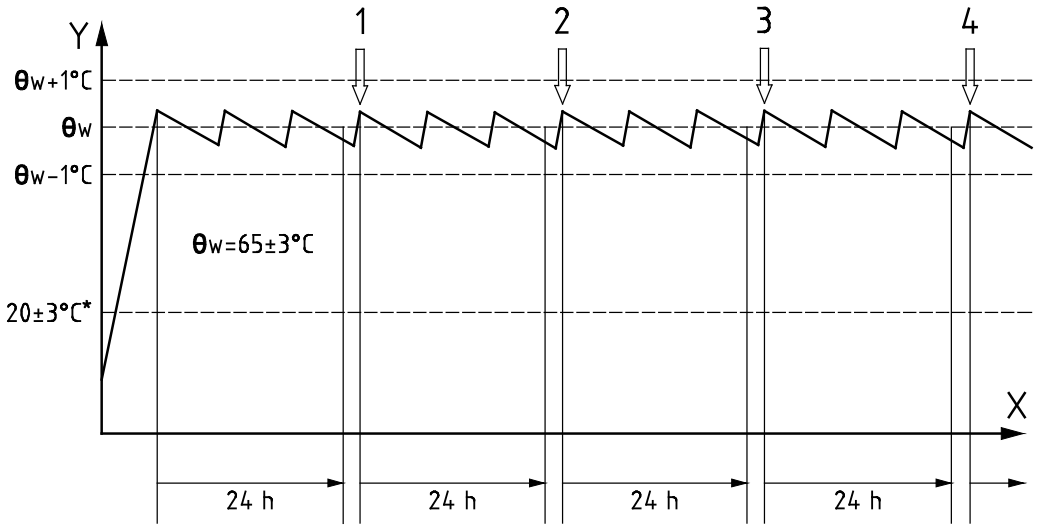
The storage water heater to be tested is filled with water until it emerges from the outlet valve which shall be closed once excess air is expelled.

The immersion heater is then switched on and the temperature of the stored water brought up to (65 ± 3) °C.

Data logging shall monitor all changes in temperature.

The test unit is then allowed to stabilize under thermostatic control for a period of at least 24 h. After 24 h take a kWh reading at the next thermal switching off point. Wait another 24 h and take a kWh reading at the next thermal switching off point. If the difference between these two readings is equal to or less than 3 %, then the system shall be considered to have stabilized. If not, repeat until stability is achieved.

After the 24 h stabilization period, the storage water heater temperature and control thermostat shall be monitored and the thermostat cycling time determined. If the cycling time is greater than one minute then at a point when the thermostat trips out (maximum temperature), a note shall be taken of the time (to the nearest minute) and the reading on the electricity meter noted.



Key

X	time	2	second energy reading
Y	temperature	3	third energy reading
1	first energy reading	4	fourth energy reading

Figure B.2 — Temperature regime (first three cycles)

If the cycling time is less than or equal to one minute then the meter reading can be taken without reference to the thermostat trip point.

Continue the test regime until the standing loss as calculated in B.4 is within 3 % for at least two successive 24 h periods, this may include the measurements taken for stabilization purposes. The standing loss shall be taken as the mean of these results. If it is not possible to achieve a variation of less than 3 % between the results continue the test for at least 168 h and record the results for the last three 24 h periods.

NOTE Figure B.2 shows the test regime for the initial heat up and first three measurement cycles; in reality several more cycles may be required to ensure results within 3 %.

B.4 Calculation of Results

The difference between the two meter readings Q_m gives the power consumption during the test period. For systems where the cycling time is greater than one minute this will exceed 72 h due to the wait for a suitable thermostat trip point and the meter reading needs correcting pro-rata for any additional time. No correction is required if the cycling time is less than or equal to one minute.

As an example if the measurement period was 74 h and 6,5 kWh of power was consumed then the corrected figure will be 6,50 × 72 ÷ 74 = 6,32 kWh (note that figures should be to at least two decimal places).

This corrected figure can now be divided by three to give the heat lost Q_c in kWh/24h i.e. 6,32 ÷ 3 = 2,11 kWh/24 h.

The readings from the data logger should now be analysed in order to establish the mean temperature differential between storage water heater temperature and mean ambient. This is calculated at each data logging interval (maximum of 5 min) as follows.

Differential at each interval is:

$$\theta_w - ((\theta_{a1} + \theta_{a2} + \theta_{a3}) \div 3)$$

The is calculated to arrive at an overall average differential θ_d.

Finally, a correction is made for the difference between the nominal differential of 45 °C and the measured average differential θ_d.

Heat Loss in kWh/24h $Q_{st} = Q_c$ x 45 ÷ θ_d.

The final figure of Q_{st} shall be rounded down for declaration purposes to two decimal places.

For Eco labelling purposes the standing heat loss is required in W (rounded to the nearest whole number).

Heat Loss in W = Q_{st} x 1 000 ÷ 24.

Annex C
(informative)

Inspection access

Table C.1 — Openings for inspection and cleaning (including effective heating surfaces)

Vessel				Openings for cleaning and inspection should be arranged in a way that enables the necessary cleaning for the whole vessel and of the effective heating surfaces. The opening for expandable heating elements may be also used for cleaning and inspection.
Actual volume In *l*		Diameter in mm		
over	up to	over	up to	
-	50	-	-	The connections or openings for heating elements are sufficient.
50	200	-	-	One cleaning opening with a diameter of at least 100 mm. Special agreements are necessary for storage water heaters which are to be tested by accredited experts. It is essential that position and size are agreed separately for each individual case.
200	500	-	-	One cleaning opening with a diameter of at least 120 mm or oval with at least 100 mm × 150 mm.
500	-	-	1 200	One cleaning opening with a diameter of at least 300 mm, or two cleaning openings with diameters of at least 120 mm or oval at least 100 mm × 150 mm. When the length of the cylindrical portion exceeds 2 000 mm, it is essential that a cleaning opening be designed with a diameter of at least 400 mm or oval at least 300 mm × 400 mm.
500	-	1 200	-	One cleaning opening with a diameter of at least 400 mm or oval at least 300 mm × 400 mm.

Table C.2 — Openings for cleaning and inspection

Vessel				Openings for cleaning and inspection should be arranged in a way that enables the cleaning for the whole vessel. The opening for expandable heating elements may be also used for cleaning and inspection.
Actual volume In *l*		Diameter in mm		
over	up to	over	up to	
50	300	-	-	One cleaning opening with a diameter of at least 75 mm.
300	500	-	-	One cleaning opening with a diameter of at least 100 mm or oval with at least 80 mm × 150 mm.
500	-	-	1 200	One cleaning opening with a diameter of at least 250 mm, or two cleaning openings with diameters of at least 100 mm or oval with at least 100 mm × 150 mm. When the length of the cylindrical portion exceeds 2000 mm, it is essential that a cleaning opening be designed with a diameter of at least 400 mm or oval at least 300 mm × 400 mm.
500	-	1 200	-	One cleaning opening with a diameter of at least 400 mm or oval at least 300 mm × 400 mm.

Annex ZA
(informative)

Relationship between this European Standard and the requirements of Commission Delegated Regulation (EU) No 812/2013 of 18 February 2013 supplementing Directive 2010/30/EU regarding energy labelling for water heaters and hot water storage tanks

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to requirements of *Commission Delegated Regulation (EU) No 812/2013 of 18th February 2013 implementing Directive 2010/30/EU of the European Parliament and of the Council with regard to labelling requirements for water heaters and hot water storage tanks.*

Once this standard is cited in the official Journal of the European Union under that Commission Regulation, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard a presumption of conformity with the corresponding requirements of that and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Commission Delegated Regulation (EU) No 812/2013

Clauses and subclauses of this EN	Requirements of Commission Delegated Regulation (EU) No 812/2013	Qualifying remarks/notes
6.2.2	Measurement of storage volume	
6.2.8	Measurement of standing heat loss	Refers to Annex B
7.3 d)	Disassembly, recycling and disposal	
Annex B	Details of standing heat loss measurement	

Warning – Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

Relationship between this European Standard and the requirements of Commission Regulation (EU) No 814/2013 of 2 August 2013 implementing Directive 2009/125/EC with regard to Ecodesign requirements for water heaters and hot water storage tanks

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to requirements of *Commission Regulation (EU) No 814/2013 of 2nd August 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.*

Once this standard is cited in the official Journal of the European Union under that Commission Regulation, compliance with the clauses of this standard given in Table ZB.1 confers, within the limits of the scope of this standard a presumption of conformity with the corresponding requirements of that and associated EFTA regulations.

Table ZB.1 — Correspondence between this European Standard and Commission Regulation (EU) No 814/2013

Clauses and subclauses of this EN	Requirements of Commission Regulation (EU) No 814/2013	Qualifying remarks/notes
6.2.2	Measurement of storage volume	
6.2.8	Measurement of standing heat loss	Refers to Annex B
7.3 d)	Disassembly, recycling and disposal	
Annex B	Details of standing heat loss measurement	

Warning – Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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[6] Essential Requirements (ER) n° 3 “Hygiene, health and environmental protection” of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to constructions products (89/106/EEC)

[7] Commission Delegated Regulation (EU) No 812/2013 of 18 February 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 Text with EEA relevance

[8] Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products

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