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Saudi Standards, Metrology and Quality Org (SASO)

FINAL DRAFT

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IEC 60335-2-21:2018

الأجهزة الكهربائية المنزلية وما شابهها– السلامة –الجزء 2–21: متطلبات خاصة بالسخانات الكهربائية التخزينية

Household and similar electrical appliances - Safety - Part 2-21: Particular requirements for storage water heaters

ICS: 91.140.65

Foreword

Saudi Standards, Metrology and Quality Organization (SASO) has adopted Standard No. (IEC 60335-2-21) “Household and similar electrical appliances - Safety - Part 2-21: Particular requirements for storage water heaters" issued by (IEC) in English. This standard has been approved as a Saudi Standard with national modifications.

This SASO IEC 60335-2-21:2020 standard is a modified adoption of International Standard IEC 60335-2-21:2018, (Household and similar electrical appliances - Safety - Part 2-21: Particular requirements for storage water heaters). Standard has been varied as indicated to take account of Kingdom of Saudi Arabia conditions. The modifications are specified in Annex BB.

This Standard supersedes and replaces (SASO-GSO-1858: Storage-type electric water heaters for household use) and (SASO-GSO-1859: Methods of test for storage-type electric water heaters for household use) and (SASO-1698: Safety of household and similar electrical appliances – Part 2: Particular requirments – Section 21: Storage water heaters).

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-21: Particular requirements for storage water heaters

FOREWORD

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This Consolidated version of IEC 60335-2-21 bears the edition number 1.1. It consists of the first edition (2012-11) [documents 61/4452/FDIS and 61/4505/RVD] and its corrigendum (2013-04), and its amendment 1 (2018-08) [documents 61/5563/CDV and 61/5650A/RVC]. The technical content is identical to the base edition and its amendment.

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

This part of International Standard IEC 60335 has been prepared by IEC technical committee 61: Safety of household and similar electrical appliances.

This sixth edition constitutes a technical revision.

The principal changes in this edition as compared with the fifth edition of IEC 60335-2-21 are as follows (minor changes are not listed):

– added requirements for immersion heater units (fixed immersion heaters);
– removed reference to ISO 13732-1 from Bibliography.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fifth edition (2010) of that standard.

NOTE 1 When “Part 1” is mentioned in this standard, it refers to IEC 60335-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for storage water heaters.

When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. When this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 The following numbering system is used:

– subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
– unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;
– additional annexes are lettered AA, BB, etc.

NOTE 3 The following print types are used:

– requirements: in roman type;
– *test specifications: in italic type;*
– notes: in small roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in bold.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 12 months or later than 36 months from the date of publication.

A list of all parts of the IEC 60335 series, under the general title: *Household and similar electrical appliances – Safety*, can be found on the IEC website.

The following differences exist in the countries indicated below.

- 6.1: Class 0I appliances are allowed (Japan).
- 6.2: IPX0 water heaters are allowed (France, United Kingdom and USA).
- 7.1: Additional markings are required (Australia, New Zealand and South Africa).
- 7.1: The rated pressure is to be marked in pounds per square inch (USA).
- 7.1: Open outlet water heaters are not required to be marked with rated pressure (USA).
- 7.12.1: Additional instructions are required (South Africa).
- 11.7: The test is different (USA).
- 13.2: An additional leakage current test is required (China).
- 19.1: Appliances incorporating sheathed heating elements are not required to have an outer enclosure of metal but their rated power input is limited to 12 kW (USA).
- 19.101: The test is different (USA).
- 22.47: The minimum pressure is 2,1 MPa. The test is not carried out on water heaters having a capacity less than 2 l or on appliances having containers open to the atmosphere (USA).
- 22.101: Pressure reducing valves have to be designed for an inlet pressure of 2 MPa (South Africa).
- 22.102: The temperature limit is 95 °C (South Africa).
- 22.102: The temperature limit is 85 °C (USA).
- 22.101: The minimum rated pressure is 1,0 MPa (Denmark, Finland, Norway and Sweden).
- 22.103: Closed water heaters having a capacity exceeding 50 l or a rated power input exceeding 2 kW have to incorporate a pressure-relief device sensitive to both pressure and temperature that operates before the water temperature reaches 99 °C (South Africa).
- 22.103: Closed water heaters have to incorporate a temperature relief valve or a combined temperature and pressure-relief valve that operates before the water temperature reaches 100 °C (United Kingdom).
- 22.106: The thermal cut-out of single-phase closed water heaters need only provide single-pole disconnection (Japan).
- 22.106: For all closed water heaters, the thermal cut-out is to provide all-pole disconnection (France, Netherlands,).
- 22.109: A tool is not required for draining the appliance (USA).
- 22.110: Additional requirements apply to plastic or resin-based containers for open outlet, cistern type and low pressure type (South Africa).
- 24.1.4 Additional requirements apply to Thermal cut-outs (South Africa)
- 24.101: Thermal cut-outs are required to have a trip-free switching mechanism (USA).
- 24.102: The maximum water temperature is 99 °C (Japan, Norway, Portugal, United Kingdom and USA).
- 24.102: The temperature limit of 130 °C is only allowed for closed water heaters having a rated pressure of at least 0,4 MPa (South Africa).

INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice and takes into account the way in which electromagnetic phenomena can affect the safe operation of appliances.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules may differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

When a part 2 standard does not include additional requirements to cover hazards dealt with in Part 1, Part 1 applies.

NOTE 1 This means that the technical committees responsible for the part 2 standards have determined that it is not necessary to specify particular requirements for the appliance in question over and above the general requirements.

This standard is a product family standard dealing with the safety of appliances and takes precedence over horizontal and generic standards covering the same subject.

NOTE 2 Horizontal and generic standards covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 standards.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-21: Particular requirements for storage water heaters

Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of electric **storage water heaters** for household and similar purposes and intended for heating water below boiling temperature, their **rated voltage** being not more than 250 V for single-phase appliances and 480 V for other appliances.

Appliances not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

This standard is also applicable to **immersion heater units** intended to be retrofitted in a **heat exchange closed water heater** having provision for retrofitting. Such a unit shall comply with the requirements in Annex AA.

NOTE Australia, Netherlands and New Zealand do not allow i**mmersion heater units** intended to be retrofitted in a **heat exchange closed water heater** unless:

– the **immersion heater unit** has been tested with the tank models and brands listed in the instructions of the **immersion heater unit**;

– the tank models and brands list the models of the **immersion heater units** that can be retrofitted.

As far as is practicable, this standard deals with the common hazards presented by appliances that are encountered by all persons in and around the home. However, in general, it does not take into account

– persons (including children) whose
  - physical, sensory or mental capabilities, or
  - lack of experience and knowledge

  prevents them from using the appliance safely without supervision or instruction;
– children playing with the appliance.

NOTE 101 Attention is drawn to the fact that

– for appliances intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary;

– in many countries additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour and similar authorities;

– in many countries regulations exist for the installation of equipment connected to the water mains.

NOTE 102 This standard does not apply to

– appliances for boiling water (IEC 60335-2-15);

– instantaneous water heaters (IEC 60335-2-35);

– commercial dispensing appliances and vending machines (IEC 60335-2-75);

– appliances intended exclusively for industrial purposes;

– appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

Normative references

This clause of Part 1 is applicable except as follows:

Addition:

IEC 60584-1:2013, *Thermocouples – Part 1: EMF specifications and tolerances*

Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.9 *Replacement:*
normal operation
operation of the appliance after installation in accordance with the instructions and filled with cold water

3.101
storage water heater
stationary appliance for heating and storing water in a container and incorporating devices to control the water temperature

3.102
closed water heater
unvented **storage water heater** intended to operate at the pressure of the water system, the flow of water being controlled by one or more valves in the outlet system

Note 1 to entry: A **closed water heater** is shown in Figure 101a.

Note 2 to entry: The operating pressure may be the output pressure of a reducing or boosting device.

3.103
cistern-fed water heater
storage water heater that is vented to atmosphere and intended to be supplied by water under gravity from a separate cistern, the flow of water being controlled by one or more valves in the outlet system

Note 1 to entry: A **cistern-fed water heater** is shown in Figure 101d.

Note 2 to entry: The water heater may be installed so that the expanded water returns to the cistern.

Note 3 to entry: In a **cistern-fed water heater**, the pressure in the container results from the column of water in the cistern.

3.104
cistern-type water heater
storage water heater having a container supplied by water under gravity from a cistern incorporated in the appliance.

Note 1 to entry: The expanded water can return to the cistern, the flow of water being controlled by one or more valves in the outlet system

Note 2 to entry: A **cistern-type water heater** is shown in Figure 101c.

Note 3 to entry: In a **cistern-type water heater**, the surface of the water is always at atmospheric pressure.

3.105
open-outlet water heater
storage water heater in which the flow of water is only controlled by a valve in the inlet pipe and in which the expanded or displaced water flows through the outlet

Note 1 to entry: An **open-outlet water heater** is shown in Figure 101b.

Note 2 to entry: In an **open-outlet water heater**, the static pressure at the outlet is always at atmospheric pressure.

3.106
low-pressure water heater
storage water heater that is vented to atmosphere and intended to be connected to the water mains through a pressure reducing valve, the flow of water being controlled by one or more valves in the outlet system

Note 1 to entry: A **low-pressure water heater** is shown in Figure 101e.

3.107
rated pressure
water pressure assigned to the appliance by the manufacturer

3.108
heat exchange water heater
storage water heater in which heated water is fed into a heat exchanger, such as a coiled tube or similar device, which is itself immersed in a container with the water to be heated.

Note 1 to entry: The heated water fed into the heat exchanger is heated from a primary heat source such as a solar panel or heat pump.

Note 2 to entry: A **heat exchange water heater** is shown in Figure 101f.

General requirement

This clause of Part 1 is applicable.

General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.2 *Addition*:

NOTE 101 Additional appliances can be required if damage occurs during the tests of 19.2 or 19.3.

5.3 *Addition:*

When the tests are carried out on a single appliance, the tests of 22.47, 22.102, 22.103, and 24.102 are carried out before the tests of Clause 19.

Classification

This clause of Part 1 is applicable except as follows.

6.1 *Modification:*

Water heaters shall be **class I**, **class II** or **class III**.

6.2 *Addition:*

Water heaters for installation outdoors shall be at least IPX4. Other water heaters shall be at least IPX1.

Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 *Addition:*

Appliances, other than **cistern-type water heaters**, shall be marked with the **rated pressure** in pascals.

Appliances shall be marked with the rated capacity in litres.

Closed water heaters shall be marked with a statement that a pressure-relief device is to be fitted in the installation, unless it is incorporated in the appliance.

Closed water heaters having a **rated pressure** less than 0,6 MPa and **low-pressure water heaters** shall be marked with a statement that a pressure reducing valve is to be fitted in the installation.

Open-outlet water heaters shall be marked, close to the outlet connection or on a tag attached to the appliance, with the substance of the following:

WARNING: This outlet acts as a vent and must only be connected to a fitting recommended by the manufacturer. It must not be connected to a tap.

7.12 *Addition:*

The instructions for **closed water heaters** shall state the substance of the following:

– the water may drip from the discharge pipe of the pressure-relief device and that this pipe must be left open to the atmosphere;
– the pressure-relief device is to be operated regularly to remove lime deposits and to verify that it is not blocked;
– how the water heater can be drained.

7.12.1 *Addition:*

The installation instructions shall state the substance of the following:

– the type or characteristics of the pressure-relief device and how to connect it, unless it is incorporated in the appliance;
– a discharge pipe connected to the pressure-relief device is to be installed in a continuously downward direction and in a frost-free environment;
– the type or characteristics of a pressure reducing valve and the installation details (for appliances having a **rated pressure** less than 0,6 MPa).

The instructions for **closed water heaters** incorporating a heat exchanger shall give details on the installation of control devices and the temperature settings that are necessary to prevent operation of the **thermal cut-out** caused by the heat from the exchanger.

The instructions for **cistern-fed water heaters** and **low-pressure water heaters** shall contain the substance of the following:

WARNING: Do not connect any pressure-relief device to the vent pipe of this water heater.

7.101 The water inlet and the water outlet shall be identified. This identification shall not be on **detachable parts**. If colours are used, blue shall be used for the inlet and red for the outlet.

An alternative means of identification may be by means of arrows showing the direction of the water flow.

Compliance is checked by inspection.

Protection against access to live parts

This clause of Part 1 is applicable.

Starting of motor-operated appliances

This clause of Part 1 is not applicable.

Power input and current

This clause of Part 1 is applicable.

Heating

This clause of Part 1 is applicable except as follows.

11.3 *Addition:*

*Where the external **accessible surfaces** are suitably flat and access permits, then the test probe of Figure 103 may be used to measure the temperature rises of external **accessible surfaces** specified in Table 101. The probe is applied with a force of 4 N ± 1 N to the surface in such a way that the best possible contact between the probe and the surface is ensured. The measurement is performed after a contact period of 30 s.*

The probe may be held in place using a laboratory stand clamp or similar device. Any measuring instrument giving the same results as the probe may be used.

11.7 *Replacement:*

*The appliance is operated until steady conditions are established or until the **thermostat** interrupts the current for the first time after 16 h, whichever is shorter.*

11.8 *Modification:*

During the test, the temperature rises are monitored continuously and shall not exceed the values shown in Table 3 and Table 101.

Table 101 – Maximum temperature rises of external accessible surfaces under normal operating conditions

Surface [a]	***Temperature rise*** *K*
Bare metal	*42*
Coated metal [b]	*49*
Glass and ceramic	*56*
Plastic and plastic coating > 0,4 mm [c,d]	*62*

[a] *Temperature rises are not measured on:*

- *tapping connections, pipes, hoses, plumbing fittings, pressure relief valves and sight gauges;*
- *appliances intended for installation on the roof;*
- *surfaces not accessible to the 75 mm diameter probe having a hemispherical end.*

[b] *Metal is considered coated when a coating having a minimum thickness of 90 µm made by enamel or non-substantially plastic coating is used.*

[c] *The temperature rise limit of plastic also applies for plastic material having a metal finish of thickness less than 0,1 mm.*

[d] *When the thickness of the plastic coating does not exceed 0,4 mm, the temperature rise limits of the coated metal or of glass and ceramic material apply.*

Void

Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable.

Transient overvoltages

This clause of Part 1 is applicable.

Moisture resistance

This clause of Part 1 is applicable except as follows.

15.2 *Addition:*

The test is only applicable to ***cistern-type water heaters****.*

15.3 *Addition:*

NOTE 101 If the appliance is too large for the humidity cabinet, the test can be carried out on those parts that contain electrical components.

Leakage current and electric strength

This clause of Part 1 is applicable.

Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

Endurance

This clause of Part 1 is not applicable.

Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 *Modification:*

Instead of the tests specified for appliances incorporating heating elements, the following applies.

*For **closed water heaters**, **low-pressure water heaters** and **open-outlet water heaters**, compliance is checked by the tests of 19.2, 19.3 and 19.4 if applicable. However, 19.101 applies instead for appliances not liable to be emptied in normal use and having all four of the following features:*

– *an outer enclosure of metal or a water container of metal and an outer enclosure of non-metallic material;*

NOTE 101 Non-metallic covers can be used for the supply terminals and controls.

– *non-combustible thermal insulation;*

NOTE 102 Insulation withstanding the needle flame test of Annex E is considered to be non-combustible.

– *a capacity exceeding 30 l;*

– *a **rated power input** not exceeding 6 kW.*

NOTE 103 Appliances are not considered liable to be emptied in normal use if emptying through the inlet is prevented by a check valve, a pipe interrupter or an air gap. These devices can be fitted in the inlet pipe in accordance with the instructions. Emptying through openings provided for servicing purposes only is not considered to be normal use.

NOTE 104 **Cistern-fed water heaters** and **cistern-type water heaters** are not subjected to the tests.

19.2 *Addition:*

The appliance is operated empty, any thermal control that operates during the test of Clause 11 being short-circuited.

NOTE 101 If the appliance is provided with more than one thermal control, these are short-circuited in turn.

19.3 *Addition:*

NOTE 101 If the water heater has been damaged during the previous test, a new appliance is used.

19.4 *Replacement:*

*For **open-outlet water heaters**, the test of 19.2 is repeated but with the container filled with water to a level at least 10 mm above the highest point of the heating element. The appliance is operated at 1,15 times **rated power input** under **normal operation**.*

NOTE 101 If the water heater has been damaged during previous tests, a new appliance is used.

19.13 *Addition:*

There shall be no leakage from the container during the tests.

19.101 *The appliance is tested for 24 h under the conditions specified in Clause 11 but with the container empty.*

Stability and mechanical hazards

This clause of Part 1 is applicable.

Mechanical strength

This clause of Part 1 is applicable.

Construction

This clause of Part 1 is applicable except as follows.

22.6 *Addition:*

The enclosure shall have a drain hole positioned so that the water can drain without impairing electrical insulation, unless condensed water cannot accumulate within the enclosure in normal use. The hole shall be at least 5 mm in diameter or 20 mm^2 in area with a width of at least 3 mm.

Compliance is checked by inspection and measurement.

22.20 *Addition:*

Thermal insulation shall not be used for **basic insulation** of internal wiring.

22.47 *Replacement:*

Appliances shall withstand the water pressure occurring in normal use.

Compliance is checked by subjecting the appliance to a water pressure of

– *twice the **rated pressure**, for **closed water heaters**. If the water heater is supplied through a pressure reducing valve, the container is subjected to twice the working pressure instead;*

NOTE 1 The pressure reducing valve can be incorporated in the water-inlet pipe.

NOTE 2 The working pressure is the maximum pressure in the container measured during the test of Clause 11.

– *1,5 times **rated pressure**, for **cistern-fed water heaters** and **low-pressure water heaters**;*
– *0,15 MPa, for **open-outlet water heaters**;*
– *0,03 MPa, for **cistern-type water heaters**.*

Pressure-relief devices are rendered inoperative. The pressure is raised at a rate of 0,13 MPa/s to the specified value and is maintained at that value for 15 min.

Water shall not leak from the appliance and there shall be no permanent deformation to such an extent that compliance with this standard is impaired.

NOTE 3 Heat exchangers incorporated in an appliance are subjected to a pressure test based on their working pressure.

NOTE 4 Damage to a protective coating on the inside of containers is not considered to be a hazard.

22.101 The **rated pressure** of **closed water heaters** intended for direct connection to the water main shall be at least 0,6 MPa.

The **rated pressure** of **closed water heaters** and **low-pressure water heaters**, intended to be supplied by a pressure reducing valve that is not incorporated in the appliance, shall be at least 0,1 MPa.

The **rated pressure** of **cistern-fed water heaters** shall not exceed 0,2 MPa.

NOTE The **rated pressure** of **open-outlet water heaters** is 0 Pa.

Compliance is checked by inspection.

22.102 Closed water heaters shall be constructed so that repeated drawing off does not cause the water to boil.

Compliance is checked by the following test.

The appliance is operated as specified in Clause 11.

*When the **thermostat** has operated for the first time, water is drawn off at a rate of approximately 2 l/min or 10 % of the capacity of the appliance per minute, whichever is less, until the **thermostat** switches on again.*

*When the **thermostat** next operates, water is drawn off again at the same rate until the **thermostat** switches on, this sequence being repeated until steady conditions are established.*

The temperature of the water, measured by means of a thermocouple at the outlet, shall not exceed 98 °C.

22.103 Pressure-relief devices of **closed water heaters** shall prevent the pressure in the container from exceeding the **rated pressure** by more than 0,1 MPa.

Compliance is checked by subjecting the container to a slowly increasing water pressure.

NOTE The pressure-relief device can be fitted during installation.

22.104 The outlet of **open-outlet water heaters** shall be constructed so that the water flow is not limited to such an extent that the container is subjected to a significant pressure.

NOTE This requirement is considered to be met if the cross-sectional area of the water outlet is not less than that of the inlet.

The vent pipe of **low pressure water heaters** shall have an internal diameter of at least 20 mm.

Compliance is checked by inspection and measurement.

22.105 Cistern-type water heaters shall be constructed so that the container is always at atmospheric pressure by means of a vent having an area of at least 30 mm^2 and a minimum dimension of at least 3 mm.

Compliance is checked by inspection and by measurement.

22.106 Closed water heaters shall incorporate a **thermal cut-out** providing **all-pole disconnection** and which operates independently from the **thermostat**. However, for appliances intended to be connected to fixed wiring, the neutral conductor need not be disconnected.

Compliance is checked by inspection.

22.107 Heating elements and thermal control sensors in contact with the outer surface of the container shall be held in position securely.

Compliance is checked by inspection.

22.108 Appliances for wall mounting shall have reliable provision for fixing to a wall, independent of the connection to the water mains.

Compliance is checked by inspection.

22.109 Appliances having a capacity of more than 15 l that cannot be emptied through a drain fitted in the water pipes shall incorporate means for draining that requires a **tool** for its operation.

Compliance is checked by inspection and by manual test.

NOTE 1 Residual water in the container below the end of the inlet pipe is disregarded.

NOTE 2 The means for draining can be combined with a pressure-relief valve.

22.110 Open-outlet water heaters having plastic containers shall be constructed to ensure that the appliance is only likely to be installed in the intended orientation.

NOTE Appliances marked with the mounting position adjacent to the water connections are considered to meet this requirement.

Compliance is checked by inspection.

22.111 Closed water heaters incorporating a heat exchanger shall be constructed so that during normal use the **thermal cut-out** does not operate due to heat from the exchanger.

Thermostatic valves, by-pass valves and similar controlling devices used for this purpose shall be supplied with the appliance.

Compliance is checked by inspection.

Internal wiring

This clause of Part 1 is applicable.

Components

This clause of Part 1 is applicable except as follows.

24.1.4 *Addition:*

***Thermal cut-outs** incorporated in **closed water heaters** shall comply with the requirements for Type 2.B controls in Clauses 13, 15, 16 17 and 20 of IEC 60730-1, unless they are tested with the appliance.*

24.101 Thermal cut-outs shall be non-self-resetting. They shall have a trip-free switching mechanism or be located so that they can only be reset after removal of a **non-detachable cover**.

Compliance is checked by inspection.

24.102 The operating temperature of the **thermal cut-out** of a **closed water heater** shall ensure that the water temperature cannot exceed 99 °C or that the **thermal cut-out** operates before its temperature exceeds 110 °C.

*Compliance is checked by the test of 24.102.1 for water temperatures not exceeding 99 °C or by the test of 24.102.2 for **thermal cut-outs** having an operating temperature up to 110 °C.*

24.102.1 *The appliance is operated under the conditions specified in Clause 11 until the **thermostat** operates for the first time. A quantity of water equal to 25 % of the capacity of the container is then drawn off so that it is replaced by cold water.*

*Immediately after the **thermostat** operates for the second time, it is short-circuited. The test is continued until the **thermal cut-out** operates. The outlet valve is then opened and the temperature of the water measured at the outlet.*

The temperature shall not exceed 99 °C.

*If compliance relies on the operation of an **electronic circuit**, the test is repeated under the following conditions applied separately:*

– *the fault conditions in a) to g) of 19.11.2 applied one at a time to the **electronic circuit**;*

– *the electromagnetic phenomena tests of 19.11.4.1 to 19.11.4.7 applied to the appliance.*

The temperature of the water at the outlet shall not exceed 99 °C during or after each of the tests.

*If the electronic **circuit** is programmable, the software shall contain measures to control the fault/error conditions specified in Table R.1 and is evaluated in accordance with the relevant requirements of Annex R.*

24.102.2 *The operating temperature of the **thermal cut-out** is measured by means of a thermocouple positioned on its sensing element or as close as possible to it.*

The water temperature for appliances having vertically oriented metallic water containers is measured by a thermocouple attached to the outer surface of the upper dome. If the water container is horizontally oriented, two thermocouples are attached to the outer surface. The position of the thermocouple is shown in Figure 102.

The water temperature for appliances having non-metallic water containers is measured at the most unfavourable position by a thermocouple positioned 50 mm below the upper inner surface of the container. This method may also be used to measure the water temperature of appliances having metallic containers.

*The appliance is operated at 1,15 times **rated power** input under **normal operation** with the outlet valve closed and **thermostats** short-circuited. The test is continued until the **thermal cut-out** operates.*

*The **thermal cut-out** shall operate before its temperature exceeds 110 °C. The water temperature shall not exceed 20 K of the maximum permitted operating temperature of the **thermal cut-out**.*

*If compliance relies on the operation of an **electronic circuit**, the test is repeated under the following conditions applied separately:*

– *the fault conditions in a) to g) of 19.11.2 applied one at a time to the **electronic circuit**;*
– *the electromagnetic phenomena tests of 19.11.4.2 and 19.11.4.5 applied to the appliance.*

The temperature of the water at the outlet shall not exceed 110 °C during or after each of the tests.

Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Modification:*

Appliances shall not incorporate an appliance inlet.

Terminals for external conductors

This clause of Part 1 is applicable.

Provision for earthing

This clause of Part 1 is applicable except as follows.

27.1 *Addition:*

For **class I water heaters**, the sheath of the heating element shall be permanently and reliably connected to the earthing terminal unless

– the container is provided with inlet and outlet pipes of metal that are permanently and reliably connected to the earthing terminal, and
– other **accessible metal parts** of the container in contact with the water are permanently and reliably connected to the earthing terminal.

Screws and connections

This clause of Part 1 is applicable.

Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable.

Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.1 *Addition:*

The temperature rises occurring during the tests of 19.2, 19.3 and 19.101 are not taken into account.

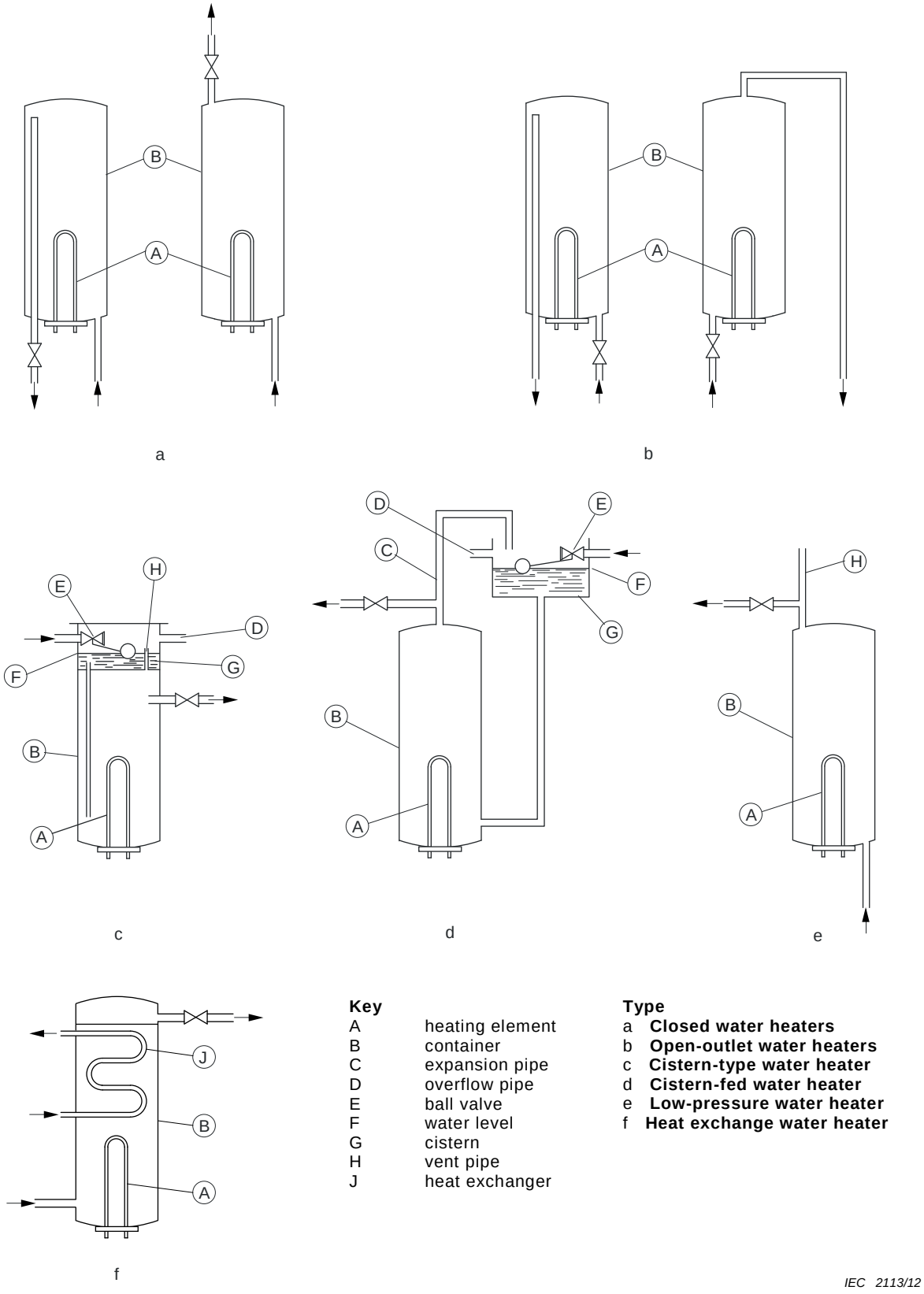
30.2.2 Not applicable.

Resistance to rusting

This clause of Part 1 is applicable.

Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.



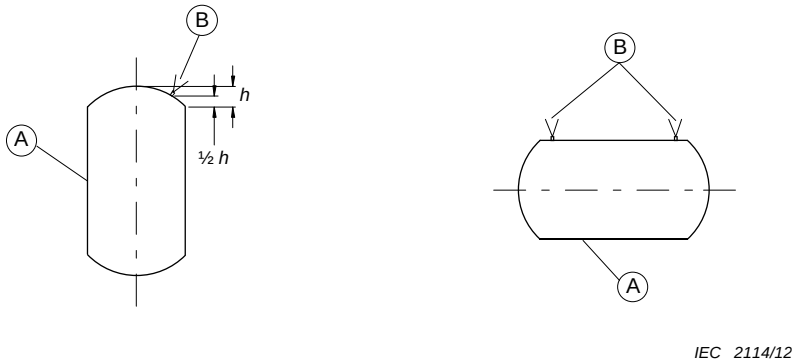
Key

A	heating element
B	container
C	expansion pipe
D	overflow pipe
E	ball valve
F	water level
G	cistern
H	vent pipe
J	heat exchanger

Type

a **Closed water heaters**
b **Open-outlet water heaters**
c **Cistern-type water heater**
d **Cistern-fed water heater**
e **Low-pressure water heater**
f **Heat exchange water heater**

Figure 101 – Examples of types of storage water heaters

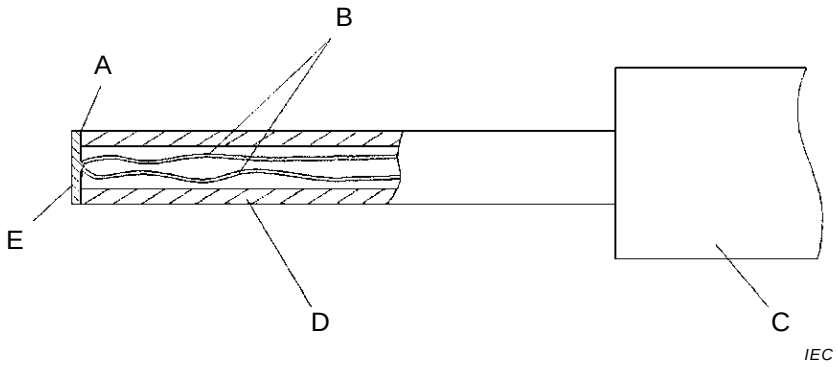


Key

A container

B external thermocouple

Figure 102 – Example of positions of the thermocouples



Key

A adhesive

B thermocouple wires 0,3 mm diameter to IEC 60584-1 Type K (chrome alumel)

C handle arrangement permitting a contact force of 4 N ± 1 N

D polycarbonate tube: inside diameter 3 mm, outside diameter 5 mm

E tinned copper disc: 5 mm diameter, 0,5 mm thick with a flat contact face

Figure 103 – Probe for measuring surface temperatures

Annexes

The annexes of Part 1 are applicable except as follows.

Annex A
(informative)

Routine tests

A.101 Pressure test

The water container is subjected to a pressure test using a fluid.

When a liquid is used, the pressure is

– *for **closed water heaters**, 0,7 MPa for those having a **rated pressure** not greater than 0,6 MPa, and 1,1 times **rated pressure** for others;*
– *for **cistern-fed water heaters** and **low-pressure water heaters**, 1,1 times **rated pressure**;*
– *for **open-outlet water heaters**, 0,05 MPa;*
– *for **cistern-type water heaters**, 0,03 MPa.*

When gas is used, these pressures may be reduced but are to be sufficient to reveal leakage.

Leakage of the fluid is not to occur during the test.

Annex R
(normative)

Software evaluation

R.2.2.5 *Modification*:

For programmable **electronic circuits** with functions requiring software incorporating measures to control the fault/error conditions specified in Table R.1 or Table R.2, detection of a fault/error shall occur before compliance with Clause 19 and 24.102.1 is impaired.

R.2.2.9 *Modification*:

The software and safety-related hardware under its control shall be initialized and shall terminate before compliance with Clause 19 and 24.102.1 is impaired.

Annex AA
(normative)

Additional requirement for immersion heater units intended for the installation in heat exchange closed water heaters

The following requirements of this standard are for **immersion heater units** intended for the installation in a **heat exchange closed water heater**. Other subclauses of this standard not mentioned in this annex are applicable. Where “water heater” is written, the requirement applies for “**immersion heater units**” of this annex.

NOTE Water storage tanks without an integrated heat exchanger can be retrofitted with an **immersion heater unit** if the retrofitting is allowed by the manufacturer of the container. In this case, the manufacturer needs to specify the acceptable **immersion heater units** in the instruction for installation of the water storage tank.

AA.3 Terms and definitions

AA.3.1.9 *Replacement:*
normal operation
operation of the **immersion heater unit** after installation in accordance with the instructions in the smallest tank specified, the tank being thermally insulated and filled with water

NOTE 101 Accessible parts of the **immersion heater unit** are not thermally insulated.

AA.3.201
immersion heater unit
appliance consisting of heating element and controls in a single unit to control the temperature in both normal and abnormal conditions and intended to be retrofitted to a heat exchange closed water heater

AA.5 General conditions for the tests

AA.5.2 *Addition:*

Additional **immersion heater units** may be required for the tests of Clause 19 and 22.102.

AA.5.3 *Addition:*

The test is to be carried out in a water tank according to the instructions of the manufacturer of the **immersion heater unit**.

NOTE Several tests for different mounting positions (vertically from the top or bottom, horizontally) can be required.

AA.7 Marking and instructions

AA.7.1 *Replacement:*

Immersion heater units for multiple supply shall be marked with their **rated power input** for each supply circuit.

Immersion heater units shall be marked with the rated pressure. The rated pressure shall not be lower than 0,6 MPa.

AA.7.12.1 *Replacement:*

The installation instruction shall include the following:

– type, the volume or volume range, and dimensions of the tank in which the immersion heater unit can be installed;
– the positioning of the immersion heater unit within the tank;
– a statement that the installer must check that there is water in the tank before the immersion heater unit is switched on the first time;
– that a pressure-relief device is to be installed in the installation, unless it is not already part of the water tank installation;
– the type and properties of the pressure-relief device and how to install it;
– that a discharge pipe connected to the pressure relief device shall be installed with a steady downward inclination in a frost-free environment.

The instructions for **immersion heater units** for water tanks with an incorporated heat exchanger shall include instructions for the installation of **thermal controls** and their temperature setting in order to prevent the **thermal cut-out** from operating due to the heat of the heat exchanger.

AA.19 Abnormal operation

AA.19.1 *Addition:*

For **immersion heater units**, the tests of 19.2 and 19.3 are applicable.

AA.19.13 *Addition:*

During the test, the **immersion heater unit** shall not show any leakage.

AA.22 Construction

AA.22.47 *Replacement:*

The **immersion heater units** shall withstand the water pressure occurring in normal use.

*Compliance is checked by the following: The **immersion heater units** are exposed to a water pressure which is twice as high as the rated pressure.*

The pressure is raised to the specified value at a rate of 0,13 MPa/s and maintained at this value for 5 min.

*No water is allowed to leak and no permanent deformation of the parts of the **immersion heater unit** intended to withstand the water pressure is allowed to an extent which would impair conformity to this standard.*

AA.22.101 *Replacement:*

The **rated pressure** of **immersion heater units** intended to be exposed directly to the water main shall be at least 0,6 MPa.

AA.22.111 *Replacement:*

Void.

AA.22.112 Immersion heater units shall be supplied with a seal or similar means to ensure that there is no leakage from the tank after installation.

Compliance is checked by inspection during the test of Clause 11.

AA.22.113 The **immersion heater unit** shall not be able to be removed from the tank without the aid of a tool.

Compliance is checked by inspection.

The cover of the compartment containing the supply terminals shall be prevented from rotating by more than 180° with respect to the fixed part of the **immersion heater unit**.

Compliance is checked by inspection.

AA.24 Components

AA.24.102 *Replacement:*

The **thermal cut-out** shall operate before the water temperature exceeds 99 °C and the water temperature shall not exceed the opening temperature of the **thermal cut-out** by more than 20 K.

Compliance is checked by the following test.

*The operating temperature of the **thermal cut-out** is measured with a thermo element that is attached to the sensor element or arranged in its close vicinity.*

If the tank is in a horizontal position, the water temperature is measured at the most unfavourable position by a thermocouple positioned 50 mm below the upper inner surface of the container.

*The **immersion heater unit** is operated at 1,15 times its **rated power input** with the **thermostat** short-circuited but under normal operation conditions and with the output valve of the tank closed.*

*The test is continued until the **thermal cut-out** operates.*

Annex BB : List of National modifications

The text of the international Standard IEC 60335-2-21:2018 was approved by Saudi Standards, Metrology and Quality Organization as a Saudi Standard with agreed national modification as indicated below:

NO	Clause	Addition / Modification
1	**16 Leakage current and electric strength**	**Addition " new paragraph "** The insulation resistance between live parts and the casing of the water heater, when measured at normal room temperature with a voltage of 500 V d.c , shall not be less than 2 mega ohms.
2	**22 Construction**	**22.6 Addition " After 1st paragraph "** **The casing** shall have mechanical and corrosion-resistant properties, under the conditions of normal use, (not inferior to those of 0.8 mm (as a nominal thickness) galvanized steel sheet or of steel sheet of a nominal thickness not less than 0.6 mm coated by a thermal layer coating of a thickness not less than 0.05 mm.) **22.20 Addition " new paragraph "** **Thermal insulation material** shall be of foam type (i.e. C.F.C free Polyurethane or its equivalent) and shall be high heat - resistant, non-conductive, non-flammable, non-absorbent, fire-resistant, non-corrosive and vermin growth-resistant. It shall not deteriorate in service or become depressed and have uninsulated voids during transportation or cause corrosion of any part of the water heater with which it is in contact. The thermal insulation shall be so placed and contained that its efficiency is maintained, contact with wiring terminations or temperature controls is prevented, and attack by vermin is deterred. **22.103 Addition " After 1st paragraph "** For increasing the safety, the closed storage water heaters shall be provided with one of the following two means : • Additional pressure relief device installed at the top of the container separated from the openings for water connections and shall prevent the pressure in the container from exceeding the rated pressure by more than 20 N/cm^2. • A temperature and pressure relief valve “T & P valve”, installed at the top of the container, or with its centre line in the upper 15 cm of the side. This valve shall be installed separated from the openings for water connections. The temperature and pressure relief valve shall prevent the water temperature from exceeding 99 ˚C, and shall prevent the pressure in the container from exceeding the rated pressure by more than 20 N/cm^2. The T & P valve shall be connected with a suitable drainage tubing.

NOTE The temperature and pressure relief valve shall be tested according to annex AD.

22.107 Addition " After 1st paragraph "

Each heating element of the water heater shall be provided with a thermostat for control of water temperature, it shall have no setting higher than 77 ˚C and shall be equipped with a stop to prevent its adjustment beyond maximum setting.

Thermostat shall be such that the temperature of the water at the outlet pipe will not exceed 85 PoPC.

Add the following new sub-clause

22.112 Pilot lamp

The water heater that have bottom water connection shall be provided with a pilot lamp which shall be connected in parallel with the heating unit, to indicate the cutting-in and cutting-out of the electric current in the heating unit.

Add the following new sub-clause

22.113 Thermometer

The water heater that have bottom water connection shall be provided with a thermometer having a suitable scale for indicating the water temperature level within the container.

Add the following new sub-clause

22.114 Container For the Storage - Electric Water Heaters

1- Container shall be made either :

- of copper with a thickness of not less than 1.0 mm and of purity not less than 99.85%, the impurities other than zinc shall not exceed 1%, provided that the phosphor contents shall not exceed 0.04%, **or**
- of steel sheets with a nominal thickness of not less than 1.5 mm, to be internally coated , after its fabrication and welding, with either of the following corrosion-resistant materials:

		a) Enamel coating (Porcelain) at a temperature not less than 800 ^{o}C, provided that the internal enamel layer shall be with a thickness of not less than 0.15 mm. ***b)*** 1.5 mm Galvanized steel sheets , the galvanized layer of which shall not be less than 270 gm/m^2 (for both sides) , subject to the manufacture has to take the necessary measures in order to cover the welded areas (from inside and outside) with an equivalent corrosion- resistant layer . **2-** Both ends of cylindrical containers shall be domed outwards unless the design and gauge of the bottom are sufficient to ensure equal mechanical strength when domed inwards. **3-** Cathodic protection each steel container shall be provided with at least one magnesium anode having a mass of magnesium of not less than 200 g per square meter of container area. The anode, which shall be capable of being replaced, shall be electrically connected to the container. The mass of the magnesium anode may be less than 200 g per square meter of container area, if the manufacturer provided evidence that the suggested mass is adequate to protect the container for not less than 2 years. The water heater shall withstand the water pressure occurring in normal use. There shall be no leak of water, and the container shall not show any permanent deformation which affects safety after subjecting it to a pressure of twice the rated pressure.
3	**FOREWORD**	**Remove :** **DISCLAIMER** This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60335-2-15, *Household and similar electrical appliances – Safety – Part 2-15: Particular requirements for appliances for heating liquids*

IEC 60335-2-35, *Household and similar electrical appliances – Safety – Part 2-35: Particular requirements for instantaneous water heaters*

IEC 60335-2-75, *Household and similar electrical appliances – Safety – Part 2-75: Particular requirements for commercial dispensing appliances and vending machines*