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EAST AFRICAN STANDARD

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

EAST AFRICAN COMMUNITY

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Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In the preparation of this East African Standard, the following source was consulted extensively:

BS EN 12897:2006, *Water supply — Specification for indirectly heated unvented (closed) storage water heaters*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

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

1 Scope

This East African Standard specifies the performance requirements and methods of test for indirectly heated, unvented (closed) storage water heaters of up to 1000 l capacity suitable for connection to a water supply at a pressure between 0.05 Mpa and 1.0 Mpa (0.5 and 10 bar), and fitted with control and safety devices designed to prevent the operating temperature of the stored drinking water from exceeding 100 °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

This East African Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to the East African Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to 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 of water pressure reducing valves — Requirements and tests*

CD/K/003:2009, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*

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

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

3 Terms and definitions

For the purposes of this East African Standard, the following terms and definitions apply.

3.1
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

3.2
total capacity

total capacity of the water storage vessel in litre as specified by the manufacturer

3.3
actual capacity
measured capacity of the drinking water storage vessel in litre

3.4
water side
part of the storage water heater directly in contact with drinking water

3.5
heat source side
parts of the storage water heater which contain the heating medium

3.6
maximum design pressure (rated pressure)
maximum pressure to which the unvented storage water heater is subjected in normal use

3.7
operating pressure
specified inlet pressure for the water heater

3.8
operating temperature
temperature at which the water is stored

3.9
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

3.10
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

4 Requirements

4.1 Effect of material on water quality and hygiene of drinking water

All materials used in water heaters in contact with drinking water shall be food-grade.

4.2 Constructional requirements

4.2.1 Inspection access

Unvented storage water heaters shall be provided with means for internal inspection.

NOTE This can 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.

4.2.2 Draining

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

4.3 Temperature control

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

4.4 Mechanical resistance and stability

4.4.1 Pressure resistance of water storage vessel

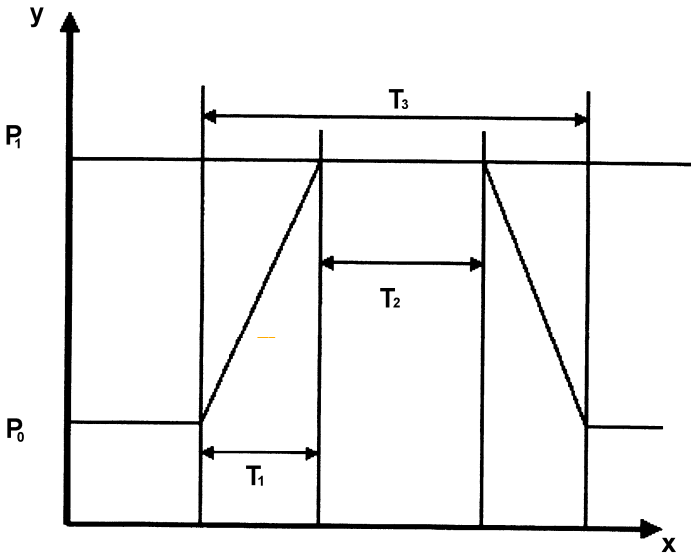
All water heaters, when tested in accordance with 6.2.1, shall withstand a pressure of 2.0 times the maximum design pressure (as specified by the manufacturer) for a period of not less than 10 min without showing any leakage or cracking.

4.4.2 Pressure resistance of primary heater

The primary heater (the coil), when tested in accordance with 6.2.1, 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.

4.4.3 Durability

The water heater shall be subjected to either 20 000 periodic cycles at 1.5 x operating pressure or 100 000 periodic cycles at 1.3 x operating pressure as shown in Figure 1, there shall be no leakage or visible signs of distress. This test shall be carried our after complete fabrication (and lining) but before insulation is applied.



Key
$T_1 \geq 15 \leq 30s$ T2 ≥ 15 ≤ 20s
T3 ≥ 45 ≤ 60s P_0 = Atmospheric pressure
P_1 = 1.5 × operating pressure for 20 000 cycles or 1.3 × operating pressure for 100 000 cycles
x Time y Pressure

Figure 1 — Cycle of pressure variations

4.4.4 Leakage test on double-walled primary heater
When a water heater is provided with a doubled-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.

4.5 Safety equipment

4.5.1 General

To prevent the temperature of the drinking water from exceeding 100 °C control and safety devices shall operate in the following sequence.

i) Thermostatic control device

ii) Energy cut out device

iii) 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, are to be carried out with all devices necessary to keep the temperature of the water from exceeding 100 °C and all devices necessary for the operation of the water heater and the prevention of contamination of the drinking water supply, fitted.

4.5.2 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 T; failure of the control thermostat and before the temperature of the stored water reaches 100 °C.

4.5.3 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.

4.5.4 Pressure relief/expansion valve

Where required, water heaters shall be fitted, on the cold-water inlet, with either; i) an expansion valve conforming to EN 1491, ii) an expansion group conforming to EN 1488, iii) a pressure safety valve conforming to EN 1489 or, iv) a hydraulic safety group conforming to EN 1487.

4.5.5 Pressure reducing valve

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

4.5.6 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

4.5.7 Backflow prevention

Where required, check valves conforming to CD/K/003:2009 shall be used.

4.6 Temperature display

Where required, the water heater shall have a means of displaying the temperature of the drinking water.

5 Marking

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

a) number and year of this standard, CD/K/011:2009;

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

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

d) operating pressure, on the drinking water side and on the heat source side;

e) maximum design pressure;

f) primary heating power input in kW;

g) primary flowrate to achieve the stated primary heating power specified in 5f;

h) actual capacity;

i) standing heat loss in kWh/24 h.

NOTE 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

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

— initial type testing;

— 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.

6.2 Initial type testing

6.2.1 General

Initial type testing shall be performed to show conformity with this East African Standard. Tests previously performed in accordance with the provisions of this East African 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 Nominal capacity

The nominal capacity shall be determined for each model in a manufacturer's product range using a suitable measuring device with an accuracy of ± 1 %. Where a water heater has an internal air space, this test shall be done with the cylinder at normal operating pressure i.e. the set pressure of the pressure-reducing valve.

6.2.3 Hot water capacity

The hot water capacity shall be determined for each model in a manufacturers product range. This shall be done following the procedure described in A.4.2 to A.5.1.

6.2.4 Primary Heating Power (heat exchanger performance)

The primary heating power (heat exchanger performance) shall be determined for each model in a manufacturer's product range. This is not required if the vessel is to be integrated into another appliance for which the tests are separately required.

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

6.2.5 Durability testing

The mechanical resistance and stability of the vessel shall be tested in accordance with 4.4.3.

6.2.6 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.

6.2.7 Standing heat loss

The standing heat loss shall be determined in accordance with the procedure given in either Annex B or IEC 60379.

6.2.8 Pressure resistance

This test shall be performed on a sample taken from production after lining (where required) 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 operating 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.

6.2.9 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.

6.2.10 Heat exchanger pressure drop

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

6.3 Production testing

6.3.1 General

All water heaters shall be tested in accordance with 6.3.2.

6.3.2 Pressure resistance

Following complete fabrication, but before lining for corrosion protection and application of insulation, each water heater shall be capable of meeting the following test requirement.

Raise the internal pressure to 1.3 times the operating pressure specified by the manufacturer. Any leakage, or cracking shall be deemed a failure and require remedial action or rejection.

Pneumatic testing with air or an inert gas (e.g. helium) is possible. In this case the minimum pressure is 3.5 bar, with a maximum of 1.1 times maximum working pressure. Every 250th water heater from production shall be tested with water 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.

An FPC system conforming to the requirements of ISO 9001, 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:

- maximum operating pressure (rated pressure) of the primary and the secondary system in Pa or bar;
- maximum operating temperature of the heating fluid in °C;
- type of corrosion protection and maintenance;
- nominal capacity of the water heater;
- location and nominal diameter of all connections;
- accommodation of expansion water;
- pressure drop through the primary heater;
- primary flow rate information;
- diagram showing position of devices, drain tap, etc.

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.

Annex A
(normative)

Hot water safety and performance testing

A.1 Scope

This annex specifies the test requirements for hot water delivery and primary heater performance. A test is included for use when local regulations require the temperature of the stored water to be kept at below 100 °C by means of a temperature or pressure temperature relief valve.

A.2 Tests required

The following table shows the performance testing requirements.

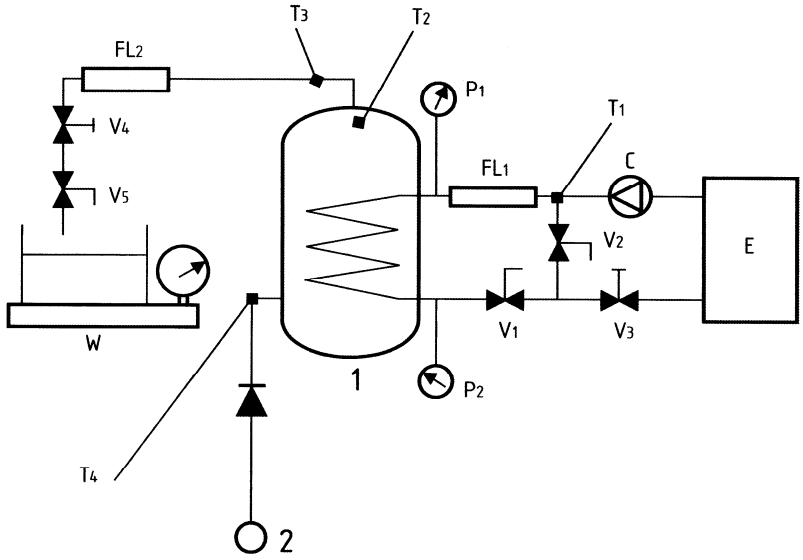
Table A.1 — Performance testing requirements

Test clause	Test description
A.4.1	Hot Water Performance
A.5.1	Hot Water Capacity
A.5.2	Reheat Performance (primary heating power)
A.4.2	Primary Heater Pressure Drop
A.6	Temperature Control

A.3 Test apparatus

The apparatus shall be constructed in accordance with the schematic diagram shown in Figure A.1. The water heater, complete with factory applied insulation and/or casing 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. Where local regulations require the water heater to have a temperature relief valve, the test should be carried out with this fitted.



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

Description of components

Heat Source — A thermostatically controlled heat source (E) capable of providing a primary water flow temperature of (80 ± 2) °C

Where test A.6 is required in order to satisfy local regulations, a flow temperature of ($110^{\ 0}_{-2}$) °C will also be required (for test A.6 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 °C and 20 °C.

In order to provide a basis for comparison, the default flow rate used in these tests is 0.25 l/s but this can be changed to suit the recommendations of the manufacturer and/or intended conditions of use but has to remain constant throughout the test procedure. The actual flow-rate used for the testing should be indicated in 5 g) and 7.2.

Circulator — A circulator (C) capable of maintaining a primary flow of 0.25 l/s unless otherwise specified by the manufacturer. All flow rates shall be measured to (0.25 ± 0.01) l/s.

Flow Meter — A flowmeter (FL_1) calibrated for water at 80 °C and accurate to ± 0.01 l/s at the specified flow rate. The second flow meter (FL_2) is optional and is used to speed up calibration of the test rig.

By-Pass Arrangement — A primary by-pass arrangement (V_1 and V_2) employing two full flow lever operated, quarter turn spherical valves.

Outlet Valve — A full flow lever operated, quarter turn spherical valve (V_5).

Flow Control Valves — Two needle valves (V_3 and V_4) or similar devices for regulating the primary and secondary flows respectively.

Pressure Gauges — Two pressure gauges (P_1 and P_2) or similar device/s such as a differential manometer capable of measuring the pressure drop across the primary heat exchanger to an accuracy of ± 2 %.

Temperature Sensors — Four thermometers or thermocouple type devices capable of measuring temperature to an accuracy of ± 1 °C. The devices shall be positioned as follows:

(T1) 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.

(T2) Positioned inside or on the cylinder to sense the stored water temperature at a point 25 mm below the hot water outlet.

(T3) Positioned in the outlet pipe to sense the temperature of hot water leaving the cylinder, this shall be sited no more than 150 mm from the cylinder outlet.

(T4) Positioned in the cold water inlet to sense the temperature of cold water entering the cylinder, this shall be sited no more than 150 mm from the cylinder inlet.

A.4 Performance tests

A.4.1 Hot water performance

The cylinder shall be set up for testing as shown in Figure A.1 and the following procedure followed:

1. 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 should now be allowed to heat up to a flow temperature of 80 °C with valves V_1, V_2 and V_3 open and any excess air allowed to escape.

2. Valve V_2 shall be closed, valves V_1 and V_3 shall be opened and valve V3 adjusted to give the required ΔT. Once this is achieved then valve V_2 shall be opened and V_1 closed.

3. The water heater shall be connected to a 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.

4. 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 flowrate 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 flowrate

Volume (l)	Flowrate (l/s)
Up to 100	0.15
101 — 250	0.25
251 — 500	0.50
501 — 750	0.75
751 — 1000	1.00

5. The test cycle shall start with the temperature of water measured at $T_2 \geq 13$ °C and ≤ 15 °C. This may either require fresh water to be drawn off via valve V5 or (in exceptionally cold conditions) the cylinder to receive a "pulse" of heat from the primary circuit.

6. With valve V_5 and V_1 closed and V_2 open, the primary circuit shall be run up to temperature (80 °C). Once stable primary conditions are established valve V_1 shall be opened and valve V_2 closed immediately afterwards. Once the temperature T_2 at the top of the cylinder reaches 15 °C a timer shall be started. During this reheat phase it may be necessary to make slight adjustments to the flowrate measured at FL_1 by means of valve V_3. 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.

7. When the temperature at T_2 reaches 60 °C, 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. The system shall then be allowed to stabilize for one minute.

8. One minute after closing valve V_1, the draw off shall commence by opening valve V_5, the timer shall be started as V_5 is opened and the flow rate adjusted, if required, during the draw off by means of valve V_4 in order to maintain the domestic flow rate according to Table A.2. The temperature of draw off shall be noted in 5 litre increments at T_3. When the temperature at T_3 drops to below 40 °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. Any alternative measuring equipment shall be capable of indicating the mass of draw off water to an accuracy of 1 %.

A.4.2 Primary heater pressure drop

The pressure drop across the primary heater when measured in accordance with Step 6 shall be noted.

A.5 Interpretation of hot water performance results

A.5.1 Hot water capacity

This is derived from the hot water draw off profile as determined by Step 8 of A.4.1. 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 was used, a continuous plot can be substituted for the 5 l incremental manual plot. For the cylinder to be deemed as satisfying the requirements of this standard, then at least 75 % of the cylinders actual capacity shall be drawn off as hot water at 40 °C or above. The volume drawn off at 40 °C or above shall be determined by reference to the graph of the draw off profile.

A.5.2 Reheat performance

The heat exchanger output in kW shall be calculated from the draw off profile. The average temperature of the water drawn off at 40 °C or above can be established from the curve and is noted as temperature T_{av}. The volume of water drawn off at 40 °C or above is noted as *V*. The time in minutes taken to reheat the cylinder from 15 °C to 60 °C (as established by A.4.1 Step 7) is noted as *t*. The heat exchanger performance in kW is expressed as *P* and is calculated as follows.

Where;

$$P = \frac{(T_{av} - 15) \times V}{14.3 \times t}$$

P = the heat exchanger performance in kW,

T_{av} = the average temperature of the water drawn off at 40 °C,

V = the volume of water drawn off at 40 °C or above,

t = the time in minutes taken to reheat the cylinder from 15 °C to 60 °C

14.3 = conversion factor to kilowatts (860/60 min)

A.6 Temperature or temperature pressure relief valve function

This test is only required where local regulations require a t & p valve to be fitted.

The waterheater shall be set up as shown in diagram 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 electrical test meter) provided to measure the temperature at which the contacts open.

1. The flow temperature from the primary heat source shall be set to a temperature of (110 $^{0}_{-2}$)°C with a flow rate of 0.25 l/s and the cylinder heated as before by means of the primary heater.

2. The temperature at which the cylinder's control thermostat (typically at 60 °C to 65 °C) operates shall be noted.

3. The control thermostat shall then be set to maximum and the new operation temperature noted. At this point the non self-resetting cut out shall not have operated.

4. The heating shall continue until the non self-resetting cut out operates. This temperature shall be noted. At this point the temperature relief valve shall not have operated.

5. Heating shall then continue until the temperature relief valve operates. At this point the temperature in the cylinder as measured at T_2 shall not exceed 100 °C. With the heat source still connected, the test shall continue such that the temperature relief valve eventually closes and the test repeated for a second time.

6. 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 cut-outs to be tested are those which control the electrical input to the element.

Annex B
(normative)

Standing heat loss measurement

B.1 General

This annex specifies the requirements for measuring the heat loss of indirectly hot water cylinders. The test is carried out under conditions that closely match those of domestic electric storage water heaters (IEC 60379). Cylinders with an internal airspace shall be tested under normal operating conditions such that the pressure prior to commencing heating is the operating pressure.

B.2 Test apparatus

This test shall be performed on a cylinder fitted with a horizontally mounted immersion heater or fixed electrical element of 3 kW output mounted so as to heat at least the same amount of water as determined during the hot water draw off test A.5.1. For cylinders of up to 250 l capacity a 3 kW element shall be used. For larger cylinders a greater output can be used as specified by the manufacturer.

This condition shall be checked by heating the cylinder by means of the immersion heater or element until the 0 temperature measured at the top (T_2 on Figure A.1) reaches 65 °C, then carrying out the draw off test as specified by A.5.1.

Apart from the introduction of the immersion heater or element, all other aspects of the cylinders design shall be as identical as possible, particularly with regard to the insulation characteristics. In circumstances where it is impossible to fit an immersion heater then an external electrical flow heater and circulator pump can be substituted as indicated in Figure B.1. The electric flow heater shall be controlled such that it energizes in response to the temperature T_W.

The circulator shall operate whilst the flow heater is energized but only the electrical input to the flow heater shall be measured.

All connecting pipes, the flow heater and the circulator shall be well insulated.

The unit to be tested shall either be mounted on a base of 20 mm thick medium density fibreboard at a height of (400 ±100) mm above floor level or wall mounted using the manufacturers instructions. It should be provided with a temporary means of filling and a well-insulated vent/overflow pipe of 22 mm diameter as shown by Figure B.1. After filling the inlet valve used for filling can be covered with temporary insulation if desired.

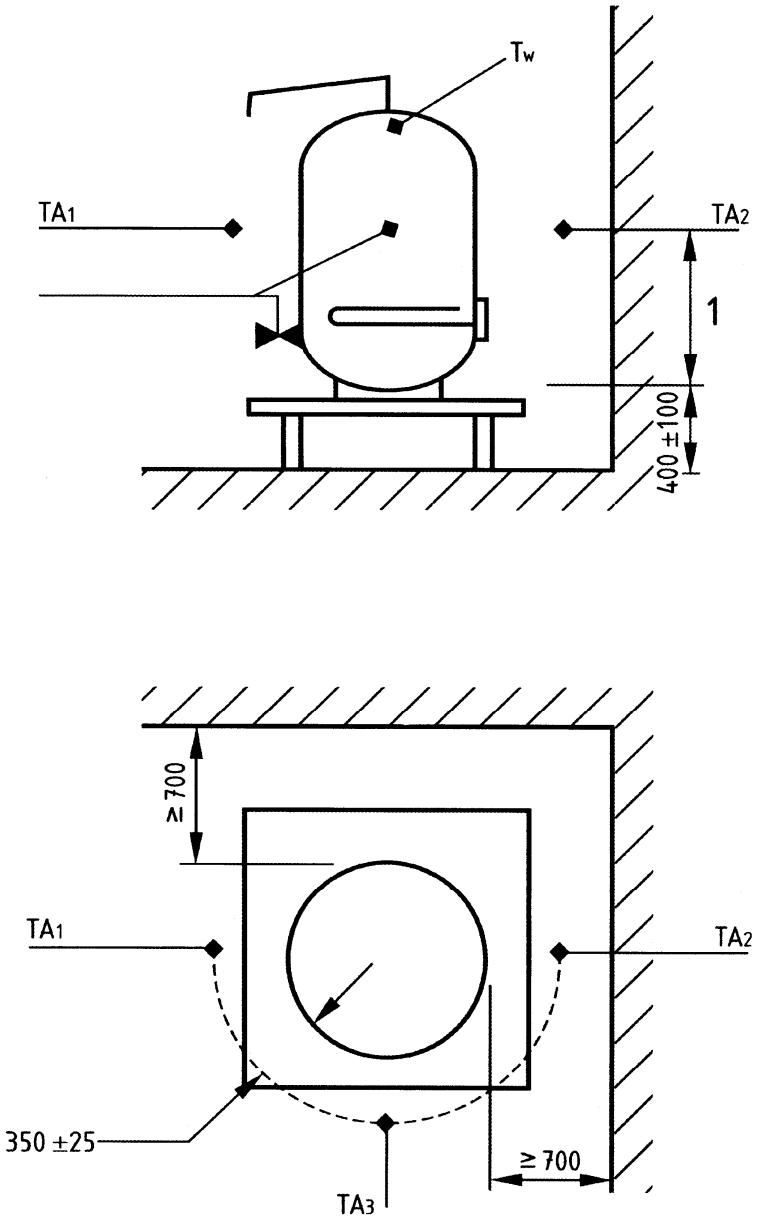
The test apparatus shall be in draught free environment where it is shielded from direct radiation and has a controlled ambient temperature of (20 ± 2) °C during the test period.
Unless wall mounted to manufacturers instructions, the water heater shall be positioned at least 700 mm from any wall or other vertical surface.

Three thermocouples (TA_1, TA_2 and TA_3) or similar temperature measuring devices capable of measuring temperature to an accuracy of ± 1 °C shall be positioned around the cylinder at a height equating to half way up the cylinder (± 25 mm) at a distance of (350 ± 25) mm from the outside of the cylinder insulation/casing. These devices shall be positioned away from any wall or vertical surface as shown in Figure B.1.

A thermocouple (T_w) or similar temperature measuring device capable of measuring temperature to an accuracy of ± 1 °C should be positioned on or inside the vessel at a point approximately 25 mm below the hot draw off as indicated in Figure B.1.

NOTE In order to facilitate stable temperature control it may be advisable to either control the operation of the immersion heater via a suitable control mechanism sensing the temperature of T_w or to fit a second control sensor close to T_w.

The electricity supply to the immersion heater shall be connected via a kilowatt hour meter with an accuracy of ± 0.01 kWh.



Key
1 Half the cylinder height

NOTE Water Connection positions are schematic and in some instances may be at the base of the cylinder. Where a wall mounted unit is used then TA_2 may be positioned midway between the water heater casing and the wall.

Figure B.1 — Schematic of test apparatus

B.3 Test procedure

Fill the test apparatus with cold water via a temporary connection to a valve connected to the cold feed or 1 other suitable connection.

When the cylinder is full, water will flow from the vent/overflow and the water supply can be disconnected.

The immersion heater shall be switched on and the temperature control adjusted to give a temperature at T_w of (65 ± 2) °C.

NOTE During the initial stages of the test, water will drip out of the overflow whilst heating occurs and a suitable temporary receptacle or drain arrangement may be required.

Determine the standing heat losses over successive 24 h test periods as follows. After a stabilization period of at least 24 h, confirmed by consistent temperature readings, record an initial kilowatt hour meter reading to the nearest 0.01 kWh.

Record subsequent meter readings at 24 h intervals and determine the energy consumption (E_1, E_2, E_3, etc) for each 24 h test period by subtraction.

For each 24 h period calculate and record the mean ambient temperature TA (which is the mean of TA_1, TA_2 and TA_3) and record T_w.

Continue the test regime until the standing loss as calculated in B.4 is within 2 % for at least two successive 24 h periods. The standing loss shall be taken as the mean of these results. If it is not possible to achieve a variation of less than 2 % between the results continue the test for at least 168 h and record the results for the last three 24 h periods.

B.4 Calculation of results

Calculate the heat loss for each test period, corrected for a 45 °C differential between hot water and ambient temperature as follows:

$$\text{Heat Loss } Qst = \left(\frac{45}{Tw - TA} \right)$$

where

E is the energy consumed in 24 h test period in kWh

T_w is the mean water temperature over a 24 h test period in °C

TA is the mean ambient temperature over a 24 h test period in °C

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 capacity 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	—	—	1200	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 x 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 x 400 mm. Of at least 400 mm or oval at least 300 mm x 400 mm.
500	—	1200	—	One cleaning opening with a diameter of at least 400 mm or oval at least 300 mm x 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 capacity 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	—	—	1200	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 x 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. Of at least 400 mm or oval at least 300 mm × 400 mm.
500	—	1200	—	One cleaning opening with a diameter of at least 400 mm or oval at least 300 mm × 400 mm.

Bibliography

[1] Guidance paper F "Durability and the Construction Products Directive".

[2] Guidance paper D "CE marking under the Construction Products Directive".

[3] Guidance paper H "A harmonized approach to dangerous substances under the Construction Products Directive".

[4] 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).

[5] ISO 9001, *Quality management systems — Requirements*.

[6] EN 806, *all parts, Specifications for installations inside buildings conveying water for human consumption*

[7] prEN 13203, all parts, *Gas-fired domestic appliances producing hot water — Appliances not exceeding 70 kW heat input and 300 litres water storage capacity*