



Specification for

Safety of household and similar electrical appliances

Part 3. Complete particular specifications

Section 3.9 Stationary instantaneous water heaters

Spécification relative à la sécurité des appareils électrodomestiques

Partie 3. Spécifications particulières complètes

Section 3.9 Chauffe-eau instantanés stationnaires

Spezifikation bezüglich der Sicherheit von elektrischen Haushaltsgeräten

Teil 3. Volle einzelne Spezifikationen

Abschnitt 3.9 Stationäre Wasserdurchlauferhitzer

BS 3456 : Part 3 : Section 3.9 : 1979

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Foreword

This specification for stationary instantaneous water heaters has been prepared under the direction of the Light Electrical Engineering Standards Committee and is one of the first in the new series of stand-alone specifications which will replace the existing sections of Part 2 of BS 3456.

A need for revision of the whole of the BS 3456 series has arisen from the harmonization programme of the European Committee for Electrotechnical Standardization (CENELEC). The general requirements of this standard are technically identical with those of HD 250 and HD 251 except that they have been aligned with the agreed revision of HD 250 and HD 251 which will shortly be adopted as HD 251.S2. The particular requirements for stationary instantaneous water heaters are aligned with the latest IEC draft on this subject on which the corresponding CENELEC HD will be based. Any minor changes that may be required as a result of the subsequent issue of the CENELEC HD on instantaneous water heaters will be introduced by amendment action as soon as this revision has been agreed by CENELEC.

CENELEC harmonization documents recognize certain national deviations which cannot, for the moment, be removed. Such United Kingdom departures, in accordance with CENELEC regulations, are denoted in the text by a marginal marking as shown below*. Deviations for other countries may be ascertained by reference to the relevant CENELEC harmonization documents.

For ease of cross-referencing between this standard, the CENELEC HD and the IEC standards on which the HDs are based, the clause and subclause numbers have been kept in

line with those of the second edition of International Electrotechnical Commission Publication 335-1 : 1976, which is the reference document for HD 251.S2. Where a clause of the IEC standard does not apply to the appliances covered by this standard the clause number has been retained marked 'No requirement'. Additional subclauses introduced by either the CENELEC HD or by UK deviations from the HD are numbered with the main clause number, followed by I, II etc., for additional clauses for general requirements and .101, .102 etc., for additional clauses for requirements particular to instantaneous water heaters.

Appliances complying with the requirements of British Standards in the BS 3456 series of specifications are not necessarily suitable for use in premises to which the Offices, Shops and Railway Premises Act of 1963 and the Factories Act apply.

Compliance with the Electrical Equipment (Safety) Regulations: 1975 will generally be assured if appliances comply with the requirements of BS 3456. For more precise details regarding the relevance of BS 3456 to the regulations, reference should be made to the 'Administrative Guidance on the Electrical Equipment (Safety) Regulations: 1975' and the 'Electrical Equipment (Safety) (Amendment) Regulations 1976', available from HMSO (ISBN 0 11 511831 4).

Certification

The British Electrotechnical Approvals Board (BEAB) for household equipment uses the series of specifications in BS 3456 as the requirements for granting its certification mark (see the inside back cover for details).

* The marginal marking used in the text to indicate national deviations from CENELEC harmonization documents is as follows :



British Standard Specification for

Safety of household and similar electrical appliances

Part 3. Complete particular specifications

Section 3.9 Stationary instantaneous water heaters

1. Scope

1.1 BS 3456 : Part 3 : Section 3.9 specifies requirements for electric stationary instantaneous water heaters for heating water to a temperature below its boiling point for household and similar purposes. Both sheathed and bare heating element types are covered.

This standard does not take into account the special hazards that exist in nurseries and other places where there are young children or aged or infirm persons without supervision; in such cases additional requirements may be necessary.

This standard does not apply to:

- appliances designed exclusively for industrial purposes;
- appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive atmosphere (dust, vapour or gas);
- instantaneous water heaters of the electrode type;
- appliances for medical purposes.

For appliances intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary.

For appliances intended to be used in tropical countries, special requirements may be necessary.

1.2 This standard is concerned with safety and takes into account the influence on safety of components that are necessary to achieve a required degree of radio and television interference suppression.

NOTE. The titles of the standards publications referred to in this standard are listed on the inside back cover.

2. Definitions

Where the terms 'voltage' and 'current' are used, they imply the r.m.s values unless otherwise specified.

For the purposes of this British Standard the following definitions, with the exception of definitions **2.16** and **2.17**, apply. Definitions **2.16** and **2.17** have been included because, although these classes of appliance are not permitted in the United Kingdom, they are referred to in corresponding international standards.

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

2.2 rated voltage range. The voltage range assigned to the appliance by the manufacturer, expressed by its lower and upper limits.

2.3 working voltage. The maximum voltage to which the part under consideration can be subjected when the

appliance is operating at its rated voltage and under normal conditions of use.

NOTE 1. Normal conditions of use include changes of voltage within the appliance imposed by likely occurrences such as the operation of a circuit breaker or the failure of a lamp.

NOTE 2. When deducing the working voltage, the effect of possible transient voltages on the supply mains is ignored.

2.4 rated input. The input under conditions of adequate heat discharge or under normal load and at normal operating temperature assigned to the appliance by the manufacturer.

2.5 rated current. The current assigned to the appliance by the manufacturer.

NOTE. If no current is assigned to the appliance, the rated current for the purpose of this standard is determined by calculation from the rated input and the rated voltage and/or by measuring the current when the appliance is operating at rated voltage under normal load and at normal operating temperature.

2.6 rated frequency. The frequency assigned to the appliance by the manufacturer

2.7 rated frequency range. The frequency range assigned to the appliance by the manufacturer expressed by its lower and upper limits.

2.8 rated capacity. For appliances with a liquid container, the quantity of liquid for which the appliance is designed.

2.9 detachable flexible cable or cord. A flexible cable or cord, for supply or other purposes, intended to be connected to the appliance by means of a suitable appliance coupler.

2.10 power supply cord. A flexible cable or cord, for supply purposes, fixed to, or assembled with, the appliance according to one of the following methods.

type X attachment. A method of attachment such that the flexible cable or cord can easily be replaced, without the aid of special purpose tools, by a flexible cable or cord not requiring any special preparation.

type M attachment. A method of attachment such that the flexible cable or cord can easily be replaced, without the aid of special purpose tools, by a special cable or cord with, for example, a moulded-on cord guard or crimped terminations.

type Y attachment. A method of attachment such that the flexible cable or cord can be replaced only with the aid of special purpose tools normally available only to the manufacturer or his agents.

NOTE. Type M and type Y attachments may be used either with common flexible cables or cords or with special cables or cords.

2.11 No requirement.

2.12 basic insulation. Insulation applied to live parts to provide basic protection against electric shock.

NOTE. Basic insulation does not necessarily include insulation used exclusively for functional purposes.

2.13 supplementary insulation. Independent insulation applied in addition to basic insulation, in order to ensure protection against electric shock in the event of a failure of the basic insulation.

2.14 double insulation. Insulation comprising both basic insulation and supplementary insulation.

2.15 reinforced insulation. A single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this standard.

NOTE. The term 'insulation system' does not imply that the insulation must be one homogeneous piece. It may comprise several layers which cannot be tested singly as supplementary or basic insulation.

2.16 class O appliance. An appliance in which protection against electric shock relies upon basic insulation; this implies that there are no means for the connection of accessible conductive parts, if any, to the protective (earthing) conductor in the fixed wiring of the installation, reliance in the event of a failure of the basic insulation being placed upon the environment.

NOTE 1. Class O appliances have either an enclosure of insulating material which may form a part or the whole of the basic insulation, or a metal enclosure which is separated from live parts by an appropriate insulation. If an appliance with an enclosure of insulating material has provision for earthing internal parts, it is considered to be of class I or class II construction.

NOTE 2. Class O appliances may have parts with double insulation or reinforced insulation, or parts operating at safety extra-low voltage.

2.17 class OI appliance. An appliance having at least basic insulation throughout and provided with an earthing terminal, but with a power supply cord without an earthing conductor and a plug without an earthing contact and which cannot be introduced into a socket-outlet with an earthing contact.

NOTE. Class OI appliances may have parts with double insulation or reinforced insulation, or parts operating at safety extra-low voltage.

2.18 class I appliance. An appliance in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such a way that means are provided for the connection of accessible conductive parts to the protective (earthing) conductor in the fixed wiring of the installation so that accessible conductive parts cannot become live in the event of a failure of the basic insulation.

NOTE 1. Class I appliances may have parts with double insulation, or parts operating at safety extra-low voltage.

NOTE 2. For appliances intended for use with a flexible cord or cable, this provision includes a protective (earthing) conductor as part of the flexible cord or cable.

2.19 class II appliance. An appliance in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions.

Such an appliance may be of one of the following types:

- (a) an appliance having a durable and substantially continuous enclosure of insulating material that envelops all metal parts, with the exception of small parts, such as nameplates, screws and rivets, which are isolated from live parts by insulation at least equivalent to reinforced insulation; such an appliance is called an 'insulation-encased class II appliance';
- (b) an appliance having a substantially continuous metal enclosure, in which double insulation is used throughout, except for those parts where reinforced

insulation is used, because the application of double insulation is manifestly impracticable; such an appliance is called a 'metal-encased class II appliance';

(c) an appliance which is a combination of the types (a) and (b).

NOTE 1. The enclosure of an insulation encased class II appliance may form a part or the whole of the supplementary insulation or of the reinforced insulation.

NOTE 2. If an appliance with double insulation and/or reinforced insulation throughout has an earthing terminal or earthing contact, it is considered to be of class I or class OI construction. Class II appliances may be provided with means for maintaining the continuity of protective circuits, provided that such means are within the appliance and are insulated from accessible conductive parts by double insulation or reinforced insulation.

NOTE 3. Class II appliances may have parts operating at safety extra-low voltage.

2.20 class III appliance. An appliance in which protection against electric shock relies on supply at safety extra-low voltage and in which voltages higher than these are not generated.

NOTE. Appliances intended to be operated at safety extra-low voltage and having internal circuits that operate at a voltage other than safety extra-low voltage are not included in the classification and are subject to additional requirements.

2.21 extra-low voltage. A voltage supplied from a source within the appliance and, when the appliance is operated at its rated voltage, not exceeding 42 V between conductors and between conductors and earth or, for three-phase supply, not exceeding 24 V between conductors and neutral, the extra-low voltage circuit being separated from other circuits by basic insulation only.

2.22 safety extra-low voltage. A nominal voltage not exceeding 42 V between conductors and between conductors and earth or, for three-phase supply, not exceeding 24 V between conductors and neutral, the no-load voltage not exceeding 50 V and 29 V respectively.

NOTE 1. When safety extra-low voltage is obtained from the supply mains, it is essential that it be through a safety isolating transformer or a converter with separate windings.

NOTE 2. The voltage limits specified are based on the assumption that the safety isolating transformer is operated at its rated supply voltage.

2.23 safety isolating transformer. A transformer, the input winding of which is electrically separated from the output windings by an insulation at least equivalent to double insulation or reinforced insulation, and which is designed to supply a distribution circuit, an appliance or other equipment at safety extra-low voltage.

NOTE. Transformers complying with the requirements of BS 3535 without provision for earthing and with the appropriate output voltages are considered to be safety isolating transformers for the purposes of this specification.

2.24 No requirement.

2.25 No requirement.

2.26 No requirement.

2.27 fixed appliance. An appliance that is fastened to a support or otherwise secured in a specific situation.

2.28 appliance for building-in. An appliance intended to be installed in a cupboard fitment or sink unit, in a prepared recess in a wall or in a similar situation.

NOTE. In general, appliances for building-in do not have an enclosure on all sides, because for some of the sides protection against electric shock is obtained after installation.

2.29 conditions of adequate heat discharge. The conditions that apply when the appliance is installed as in normal use, and is operated with its internal parts, the water flow being adjusted so that the temperature of the

outlet water is as high as possible, but below the maximum temperature to which any cut-out included to protect the appliance under conditions of abnormal operation, and which would operate during the test specified in clause 19, may be set, so that the outlet water attains the highest possible steady state temperature.

2.30 No requirement.

2.31 No requirement.

2.32 continuous operation. Operation under normal load or in accordance with conditions of adequate heat discharge for an unlimited period.

2.33 No requirement.

2.34 intermittent operation. Operation in a series of specified identical cycles, each cycle being composed of a period of operation under normal load or in accordance with conditions of adequate heat discharge, followed by a rest period with the appliance running idle or switched off.

2.35 non-detachable part. A part that can be removed only with the aid of a tool.

2.36 detachable part. A part that can be removed without the aid of a tool.

2.37 thermostat. A temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which, during normal operation, keeps the temperature of an appliance, or of parts of it, between certain limits by automatically opening and closing a circuit.

2.38 temperature limiter. A temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which, during normal operation, operates by opening or closing a circuit when the temperature of an appliance, or of parts of it, reaches a predetermined value.

NOTE. A temperature limiter does not make the reverse operation during the normal duty cycle of the appliance. It may or may not require manual resetting.

2.39 thermal cut-out. A device which, during abnormal operation, limits the temperature of an appliance, or of parts of it, by automatically opening the circuit or by reducing the current, and which is so constructed that its setting cannot be altered by the user.

2.40 No requirement.

2.41 non-self-resetting thermal cut-out. A thermal cut-out that requires resetting by hand, or replacement of a part, in order to restore the current.

2.42 tool. A screwdriver, a coin or any other object that may be used to operate a screw or similar fixing means.

2.43 creepage distance. The shortest path between two conductive parts, or between a conductive part and the bounding surface of the appliance, measured along the surface of the insulating material.

2.44 clearance. The shortest distance between two conductive parts, or between a conductive part and the bounding surface of the appliance, measured through air.

NOTE. The bounding surface of the appliance is the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material.

2.45 all-pole disconnection. For single-phase a.c. appliances and for d.c. appliances, disconnection of both supply conductors by a single switching action or, for appliances to be connected to more than two supply conductors, disconnection of all supply conductors, except the earthed (neutral) conductor, by a single switching action.

NOTE. The protective earthing conductor is not considered to be a supply conductor.

2.46 No requirement.

2.47 accessible part or accessible surface. A part or surface that can be touched by means of test finger I specified in BS 3042 (see figure 1).

2.48 body. All accessible metal parts, shafts of handles, knobs, grips and the like and metal foil in contact with all accessible surfaces of insulating material but excluding inaccessible metal parts.

2.101 instantaneous water heater. An appliance intended for heating water mainly while it flows through the appliance (see also 6.101).

2.102 closed appliance. An appliance designed to work under the pressure of the water supply mains, the flow of water being controlled by one or more valves in the outlet system.

2.103 open-outlet appliance. An appliance in which the flow of water is controlled by one or more valves in the inlet pipe and so arranged that the heated water can leave through the outlet pipe without passing through any other control valves.

2.104 bare element appliance. An appliance in which the current passes through a heating resistor immersed directly in the water and not insulated from it. The appliance may incorporate more than one element.

2.105 sheathed element appliance. An appliance in which the current passes through a heating resistor insulated from the water by means of a refractory material contained within a metallic sheath which is immersed in the water. The appliance may incorporate more than one element.

2.106 flow switch. A switch operated by fluid flow, e.g. by the pressure difference caused by the flow. It operates only in case of effective flow, e.g. if water is let out of a tap.

2.107 pressure switch. A switch that responds automatically to the value or change in value of the pressure to which its pressure-sensing element is sensitive.

3. General requirements

3.1 Appliances shall be so designed and constructed that in normal use they function safely so as to cause no danger to persons or surroundings, even in the event of such careless use as may occur in normal service.

TEST. In general, compliance shall be checked by carrying out all the relevant tests specified.

3.1 Additionally, where the standard is used for the purposes of granting nationally recognized certification marks, designs or constructions to which the tests specified do not fully apply but which give an equivalent degree of safety and durability of safety, may be regarded as complying with the requirements of this standard, subject to the findings of a special investigation by the authority granting the certification mark and pending the issue of an amendment or extension to this standard.

4. General conditions for the tests

4.1 Tests carried out to this standard are type tests.

4.2 Unless otherwise specified, the tests shall be carried

out on a single sample as delivered, which shall withstand all the relevant tests.

NOTE 1. If it is evident from the design of the appliance that a particular test is not applicable, this test is not carried out.

NOTE 2. If the appliance is designed for different supply voltages, for both a.c. and d.c., for different speeds, etc., more than one sample may be required.

NOTE 3. If it is necessary to dismantle a class II appliance for the relevant tests, one additional sample is required.

NOTE 4. The testing of components may necessitate the submission of additional samples of these components. When the submission of such samples is necessary, they should be submitted together with the appliance.

NOTE 5. Two complete samples are normally required for the tests of 19.1 and afterwards they may be unserviceable. In the case of designs with replacement diaphragms in the pressure relief device, six additional diaphragms are required. For designs where it is required to test in accordance with test (b) of 19.1, additional samples of the complete appliance may be required.

4.3 Unless otherwise specified, the tests shall be carried out in the order of the clauses of this specification. The test specified in **18.101** shall be carried out before the tests specified in clause **15**. The tests specified in **22.28** and **22.104**, if they are not made on separate containers or heat exchangers and tests in **24.102** shall be carried out before the tests specified in clause **19**.

NOTE. Before testing is started, the appliance is operated at rated voltage in order to verify that it is in working order.

4.4 The tests shall be carried out with the appliance, or any movable part of it, placed in the most unfavourable position that may occur in normal use.

4.5 If the test results are influenced by the temperature of the ambient air, the room temperature shall be, in general, maintained at 20 ± 5 °C. If, however, the temperature attained by any part is limited by a temperature sensitive device, or is influenced by the temperature at which a change of state occurs, for example, the temperature of boiling water, the room temperature is, in case of doubt, maintained at 23 ± 2 °C.

The temperature of the water at the appliance inlet shall be 15 ± 5 °C.

4.6 Appliances for a.c. only shall be tested with a.c., at rated frequency, if marked; those for d.c. only shall be tested with d.c. and those for a.c./d.c. shall be tested at the more unfavourable supply.

Appliances for a.c. that are not marked with a rated frequency shall be tested at 50 Hz.

Appliances for a.c. that are marked with a rated frequency range of 50 Hz to 60 Hz shall be tested at 50 Hz or 60 Hz, whichever is the more unfavourable.

Appliances marked with a rated frequency range other than 50 Hz to 60 Hz shall be tested at the most unfavourable frequency within the range.

Appliances designed for more than one rated voltage shall be tested at the most unfavourable voltage.

Unless otherwise specified, appliances designed for one or more rated voltage ranges shall be tested at the most unfavourable voltage within the relevant range.

NOTE. Where reference is made to maximum or minimum rated input, the rated input related to the upper limit or lower limit respectively of the rated voltage range is meant.

When testing appliances for d.c. only, the possible influence of polarity on the operation of the appliance shall be taken into consideration.

NOTE. If the appliance is designed for one rated voltage range, the upper limit of the voltage range will be the most unfavourable voltage within the range. If the appliance is designed for more than one rated voltage or rated voltage range, it may be necessary to carry out some of the tests at the minimum, the mean and the maximum values of the rated voltage or the rated voltage range in order to establish the most unfavourable voltage.

4.7 Appliances for which alternative heating elements or accessories are available shall be tested with those

elements or accessories that give the most unfavourable results, provided that the elements or accessories used are within the appliance manufacturer's specification.

4.8 No requirement.

4.9 Appliances provided with a thermostat, a regulating device or a similar control shall be tested with these controls adjusted to their most unfavourable setting, if the setting can be altered by the user. If the conditions can be changed by regulating the water flow, the tests shall be made under the most unfavourable conditions that may occur in normal use.

NOTE 1. If the adjusting means of the control is accessible without the aid of a tool, this subclause applies whether the setting can be altered by hand or with the aid of a tool. If the adjusting means is not accessible without the aid of a tool, this subclause applies only if the setting can be altered by hand.

NOTE 2. Adequate sealing is regarded as preventing alteration of the setting by the user.

4.10 Where appropriate, appliances for building-in shall be installed in accordance with the manufacturer's instructions for installation, as far as these are in accordance with normal installation conditions.

4.11 Unless otherwise specified, appliances intended to be supplied by means of a flexible cable or cord shall be tested with the appropriate flexible cable or cord connected to the appliance.

4.12 When, it is specified that the appliance has to be supplied at a voltage such that the input is greater than rated input, this voltage shall apply only to heating elements without an appreciable positive temperature coefficient of resistance. For other heating elements, this voltage shall be determined as follows.

First, the rated voltage is supplied until the heating element reaches its operating temperature. The supply voltage is then rapidly increased to the value necessary to give the input required for the relevant test and the test is carried out as specified, the value of the supply voltage being maintained throughout the test.

NOTE. In general, the temperature coefficient is considered to be appreciable if, at rated voltage, the input of the appliance in cold condition differs by more than 25 % from the input at operating temperature.

4.13 No requirement.

4.14 Class III appliances shall be tested together with their supply transformers if these are sold with the appliances.

4.15 For the purposes of **8.6**, **8.7**, **16.4**, **25.11** and **27.1**, parts separated from live parts by double insulation or reinforced insulation shall be regarded as not likely to become live in the event of an insulation fault; connection of accessible metal parts to an earthing terminal or earthing contact does not remove the necessity for carrying out the relevant tests.

4.16 If class I appliances have accessible metal parts that are not connected to an earthing terminal or earthing contact and that are not separated from live parts by an intermediate metal part which is connected to an earthing terminal or earthing contact, such parts shall be checked for compliance with the appropriate requirements specified for class II appliances.

4.17 If class I appliances have parts operating at safety extra-low voltage, such parts shall be checked for compliance with the appropriate requirements specified for class III appliances.

4.18 For testing appliances incorporating electronic circuits, see appendix **AVA**.

5. Rating

5.1 The maximum rated voltage is:

250 V for single-phase a.c. appliances and for d.c. appliances;

440 V for all other appliances.

TEST. Compliance shall be checked by inspection of the marking.

The requirements of this standard are based on the assumption that in normal use the voltage between the supply lines and earth does not exceed 254 V.

5.1 Single-phase appliances intended for direct connection to the UK mains supply shall have a rated voltage that covers use at 240 V and a rated frequency that covers use at 50 Hz.

TEST. Compliance shall be checked by inspection of the marking.

5.101 The minimum rated pressure is 0.6 MPa for closed appliances. For open outlet appliances there is no rated pressure, but for safety reasons this type of appliance shall be subjected to the pressure test specified in **22.28**.

TEST. Compliance shall be checked by inspection of the marking.

5.102 Appliances incorporating bare element type heaters shall be designed only for a.c. operation at 50 Hz or higher.

6. Classification

The appliances covered by this standard shall be classified:

- (a) according to protection against electric shock:
 - class I appliances;
 - class III appliances.

NOTE 1. The class numbers are not intended to reflect the safety level of the appliances, but only the means by which the safety is obtained.

NOTE 2. If class III appliances are sold with a separate safety isolating transformer for their supply from the mains, their classification is not altered.

- (b) according to degree of protection against moisture:
 - splash-proof (if intended to be installed in a showering area where they could be sprayed);
 - drip-proof.

6.101 Instantaneous water heaters shall be classified:

- (a) according to operating conditions:
 - (1) closed appliances;
 - (2) open-outlet appliances;
- (b) according to heating elements:
 - (1) sheathed elements;
 - (2) bare elements;
- (c) according to controls:
 - (1) controlled by thermostat;
 - (2) controlled by flow switch.

7. Marking

7.1 Appliances shall be marked with:

- (a) rated voltage(s) or rated voltage range(s), in volts; optional for appliances with detachable heating elements only;
- (b) symbol for nature of supply, if applicable;
- (c) rated frequency or rated frequency range, in hertz, unless the appliance is designed for d.c. only or for a.c. of both 50 Hz and 60 Hz;

(d) rated input in watts or kilowatts;

(e) manufacturer's or responsible vendor's name, trade mark or identification mark;

(f) manufacturer's model or type reference;

(g) rated operating time, or rated operating time and rated resting time, in hours, minutes or seconds, if applicable;

(h) symbol for splash-proof construction;

(i) a bare element appliance shall be fitted with the following marking placed in a position to be clearly visible to the installer:

'MINIMUM COLD WATER RESISTIVITY
RATING (R) OHM CM AT 15 °C
THIS APPLIANCE MUST BE EARTHED'

This marking shall be repeated in the instruction leaflet.

The figure inserted at (R) shall be at the discretion of the manufacturer but shall not be greater than 1300.

Stationary appliances for multiple supply shall be marked with the substance of the following warning:

'BEFORE OBTAINING ACCESS TO TERMINAL
DEVICES, ALL SUPPLY CIRCUITS MUST BE
INTERRUPTED.'

This warning shall be visible when approaching any live part that might be touched during routine servicing.

NOTE 1. It is essential that appliances for star-delta connection be clearly marked with the two rated voltages (e.g. 220 Δ/380 V).

NOTE 2. The rated input or rated current is the total maximum input or current of the circuits that can be in operation simultaneously.

NOTE 3. If an appliance has alternative components that can be selected by a control device, the rated input is that corresponding to the highest loading possible.

NOTE 4. Additional markings are allowed, provided they do not give rise to misunderstanding.

7.2 No requirement.

7.3 No requirement.

7.4 If the appliance can be adjusted to suit different rated voltages or different rated inputs, the voltage or input to which the appliance is adjusted shall be easily and clearly discernible.

This requirement does not apply to appliances for star-delta connection.

NOTE. For appliances for which frequent changes in voltage setting are not required, this requirement is considered to be complied with if the rated voltage or the rated input to which the appliance is adjusted can be determined from a wiring diagram fixed to the appliance; the wiring diagram may be on the inside of a cover which has to be removed to connect the supply conductors. This diagram may be on a card which is riveted to the cover, or on a paper or similar label secured to the cover by an adhesive, but it must not be on a label loosely attached to the appliance.

7.5 For appliances marked with more than one rated voltage or rated voltage range, the rated input for each of these voltages or ranges shall be marked.

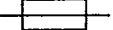
The upper and lower limits of the rated input shall be marked on the appliance so that the relation between input and voltage appears distinctly unless the difference between the limits of a rated voltage range does not exceed 10 % of the mean value of the range in which case the marking for rated input may be related to the mean value of the range.

If the input of the appliance in cold condition differs by more than 25 % from the input at operating temperature, the input in cold condition shall be marked in addition, and it

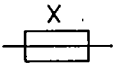
shall be placed in brackets after the marking of the input at operating temperature.

7.6 When symbols are used, they shall be as follows:

V	volts
A	amperes
Hz	hertz
W	watts
kW	kilowatts
μF	microfarads
l	litres
kg	kilograms
N/cm^2	newtons per square centimetre
*Pa	pascals
h	hours
min	minutes
s	seconds
~	alternating current
3~	three-phase alternating current
3N~	three-phase alternating current with neutral
---	direct current

 A rated current of the appropriate fuse-link

 time-lag D-type fuse-link

 time-lag miniature fuse-link where X is the symbol for time/current characteristic as given in BS 4265

 drip-proof construction (one drop)

 splash-proof construction (one drop in a triangle)

 watertight construction (two drops)

The symbol for nature of supply shall be placed next to the marking for rated voltage.

7.7 For class I appliances, the line terminal shall be indicated by the letter L.

Terminals intended exclusively for the neutral conductor shall be indicated by the letter N.

Earthing terminals shall be indicated by the symbol .

These indications shall not be placed on screws, removable washers or other parts that might be removed when conductors are being connected.

7.8 Appliances to be connected to more than two supply conductors and appliances for multiple supply shall be provided with a connection diagram, fixed to the appliance, unless the correct mode of connection is obvious.

The correct mode of connection is considered to be obvious if, for three-phase appliances, the terminals for the supply conductors are indicated by arrows pointing towards the terminals. The earthing conductor is not a supply conductor. For appliances for star-delta connection, the connection diagram shall show how the elements are to be connected.

Marking in words is an acceptable means of indicating the correct mode of connection.

The connection diagram may be the wiring diagram referred to in 7.4.

7.9 Unless it is obviously unnecessary, switches, the operation of which might cause a hazard, shall be so marked or placed as to indicate clearly which part of the appliance they control.

Indications used for this purpose shall, wherever practicable, be comprehensible without a knowledge of languages, national standards, etc.

7.10 The different positions of regulating devices, and the different positions of switches on stationary appliances shall be indicated by figures, letters or other visual means. The 'off' position shall not be indicated by words only.

If figures are used for indicating the different positions, the 'off' position shall be indicated by the figure 0 and the position for a greater output, input, cooling effect, etc., shall be indicated by a higher figure.

The figure 0 shall not be used for any other indication.

7.11 Thermostats, regulating devices and the like, intended to be adjusted during installation or in normal use, shall be provided with an indication for the direction of adjustment to increase or to decrease the value of the characteristic being adjusted.

NOTE. An indication of + and - is considered to be sufficient.

7.12 If it is necessary to take special precautions when installing or using the appliance, details of these shall be given in an instruction sheet that accompanies the appliance. If the appliance is not provided with a non-detachable flexible cable or cord intended to be connected to a plug, or with other means for disconnection from the supply having a contact separation of at least 3 mm in all poles, the instruction sheet shall state that such means for disconnection must be incorporated in the fixed wiring.

If the supply wires of an appliance can come into contact with parts of a terminal block or compartment for fixed wiring and these parts have, under conditions of normal use, a temperature such that the insulation of the wire is subjected to a temperature rise exceeding that specified in table 3, the instruction sheet shall also state that the appliance must be connected by means of wires having appropriate T-marking or T-rating.

NOTE. Special precautions may be necessary, for example, for appliances, for building-in.

In order to ensure that, after building-in, the conditions necessary to comply with the requirements of this standard are achieved, the instruction sheet for appliances for building-in should give clear information with regard to the following:

- dimensions of the space to be provided for the appliance;
- dimensions and position of the means for supporting and fixing the appliance within this space;
- minimum clearances between the various parts of the appliance and the surrounding parts of the fitment;
- minimum dimensions of ventilating openings and their correct arrangement;
- connection of the appliance to the supply and the interconnection of separate components, if any.

Open-outlet appliances shall be provided with an instruction stating in substance that the outlet acts as a vent and must not be connected to any form of tap or fitting not recommended by the manufacturer.

For closed appliances, other than those with flow switches and having a rated capacity up to 3 litres, a precautionary reminder shall appear in the instructions that accompany the appliance to the effect that a suitable relief device should be connected to the appliance at the time it is installed unless the device is incorporated in the appliance.

The user instructions shall include in bold type an instruction covering the need for regular cleaning of the spray head and advising against switching on if it is thought that the water in the heater may have been frozen and what action should be taken in this case.

*The recommended unit of pressure is the bar and preference should be given to its use. 1 bar = 10^5 N/m^2 = 100 kPa.

7.13 Instruction sheets and other texts required by this standard shall be written in the official language(s) of the country in which the appliance is to be sold. For appliances for sale in the United Kingdom instructions shall be in English.

Where symbols are used, they shall be those indicated in this standard, although additional symbols are permitted if they do not give rise to misunderstanding.

TEST. Compliance with the requirements of **7.1** to **7.13** shall be checked by inspection.

7.14 Marking required by this standard shall be easily legible and durable.

Marking specified in **7.1** to **7.5** shall be on a main part of the appliance.

The marking of fixed appliances shall be clearly discernible from the outside after the appliance has been fixed as in normal use but, if necessary, after removal of a cover.

The marking of other appliances shall be clearly discernible from the outside, if necessary after removal of a cover.

For stationary appliances, the marking shall be beneath a cover only if it is near to the terminals for external conductors.

Marking on, and indications for, switches, thermostats, thermal cut-outs and other control devices shall be placed in the vicinity of these components; they shall not be placed on removable parts if these parts can be replaced in such a way that the marking is misleading.

TEST. Compliance shall be checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

After all the tests of this standard, the marking shall be easily legible, it shall not be easily possible to remove marking plates and they shall show no curling.

NOTE 1. A revision of the test for checking the durability of the marking is under consideration.

NOTE 2. In considering the durability of the marking, the effect of normal use is taken into account. Thus, for example, marking by means of paint or enamel other than vitreous enamel on containers that are likely to be cleaned frequently is not considered to be durable.

7.1 A label shall be attached to the flexible cord of all class I appliances fitted with a flexible cable or cord having cores coloured green-and-yellow, blue and brown. This label shall state the following.

'IMPORTANT

The wires in this mains lead are coloured in accordance with the following code.

Green-and-yellow: Earth

Blue: Neutral

Brown: Live'

In addition the user instructions and label shall include the substance of the following.

'As the colours of the wires in the mains lead of this appliance may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows.

The wire which is coloured green-and-yellow must be connected to the terminal in the plug which is marked with the letter E or by the earth symbol  or coloured green or green-and-yellow.

The wire which is coloured blue must be connected to the terminal which is marked with the letter N or coloured black.

The wire which is coloured brown must be connected to the terminal which is marked with the letter L or coloured red.'

TEST. Compliance shall be checked by inspection.

7.II For class I appliances the following warning notice shall be given on a label attached to the end of the flexible cord.

'WARNING – THIS APPLIANCE MUST BE EARTHED'

For all class I appliances the warning shall be included in the user instructions.

NOTE. The label specified in **7.1** may be used for this purpose a separate label is not required.

TEST. Compliance shall be checked by inspection.

7.III For appliances fitted with a flexible cord and with a rated input exceeding 3 kW a label shall be attached to the flexible cord stating that the appliance must be connected to an outlet having a rated current greater than 13 A and that a 13 A (BS 1363) plug is therefore not suitable.

TEST. Compliance shall be checked by inspection.

NOTE. For appliances intended for export, labelling other than that specified in **7.I** to **7.III** may be required.

7.101 The water inlet and water outlet shall be clearly indicated. These indications shall not be placed on detachable parts.

If colours are used for this purpose, the colour blue shall be used to indicate the cold water inlet and the colour red to indicate the hot water outlet.

The water inlet and water outlet may, for example, be indicated by means of arrows showing the direction of the water flow.

7.102 The marking of the operating temperature of thermal cut-outs incorporating replaceable parts shall be visible after the cut-out has been installed, if necessary after removal of the cover giving access to the electrical parts, but without removing any separate thermal insulation.

TEST. Compliance with the requirements of **7.101** and **7.102** shall be checked by inspection.

8. Protection against electric shock

8.1 Appliances shall be so constructed and enclosed that there is adequate protection against accidental contact with live parts. This requirement applies for all positions of the appliance when it is wired and operated as in normal use, even after opening of lids and doors and removal of detachable parts, except for lamps located behind a detachable cover, provided that the appliance can be isolated from the supply by means of a plug or an all-pole switch, the 'off' position of which is clearly indicated. During the insertion or removal of lamps, protection against accidental contact with live parts of the lamp cap shall also be ensured.

There shall be, in addition, adequate protection against the risk of contact with basic insulation. Such insulation may, however, be accessible after removing a cover that requires the use of tools for removal and has to be removed for user maintenance, or after removing a cover that can be removed without tools if marked 'Remove plug before removing this cover' or 'Disconnect from the mains before removing this cover'.

The insulating properties of lacquer, enamel, paper, cotton, oxide film on metal parts, beads and sealing

compound shall not be relied upon to give the required protection against accidental contact with live parts.

The enclosure of the appliance shall have no openings, other than those necessary for the use and working of the appliance, giving access to live parts and, for class II appliances, to parts separated from live parts by basic insulation only.

NOTE 1. Unless otherwise specified, parts operating at safety extra-low voltage not exceeding 24 V are not considered to be live parts.

NOTE 2. If a manufacturer instructs the user to remove a part during normal operation or user maintenance, that part is regarded as a detachable part even if a tool has to be used for its removal.

NOTE 3. This requirement excludes the use of screw-type fuses and screw-type miniature circuit-breakers if they are accessible without the aid of a tool.

NOTE 4. Self-hardening resins are not regarded as sealing compound.

TEST. Compliance shall be checked by inspection and, except as specified hereinafter, by a test with test finger I specified in BS 3042 (see figure 1).

In addition, apertures in class I and class II appliances, other than those in metal parts connected to an earthing terminal or earthing contact, and those giving access to live parts in socket outlets and lamp caps, shall be tested with test pin I specified in BS 3042 (see figure 2). The test finger and the test pin are applied, without appreciable force, in every possible position, except that appliances normally used on the floor and having a mass exceeding 40 kg are not tilted.

Appliances for wall-mounting and appliances for building-in shall be tested as delivered, except that reliance may be placed on the enclosure to provide protection against contact with basic insulation.

An appliance designed as a single appliance but delivered as a number of units shall be tested after assembly.

Apertures preventing the entry of the finger shall be further tested by means of a straight unjointed test finger of the same dimensions, which is applied with a force of 20 N; if this finger enters, the test with test finger I is repeated, the finger being introduced through the aperture. If the unjointed test finger does not enter, the force applied is increased to 30 N. If then the guard is so displaced or the aperture so distorted that test finger I can be inserted without force, the test with test finger I is repeated. An electrical contact indicator shall be used to show contact.

It shall not be possible to touch bare live parts or live parts protected by lacquer, enamel, ordinary paper, cotton, oxide film, beads or sealing compound only, with test finger I specified in BS 3042.

It shall not be possible to touch basic insulation with test finger I unless it is under a detachable cover which either requires the use of a tool for removal or is marked, 'Remove plug before removing this cover' or 'Disconnect from the mains before removing this cover'.

NOTE 1. When applying test finger I, either or both of the jointed sections should be turned through any angle up to 90° with respect to the axis of the finger in the same direction only.

NOTE 2. It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

NOTE 3. The fact that appliances for wall-mounting and appliances for building-in are tested as delivered does not imply that such appliances must be completely enclosed; the basic insulation of wiring in appliances other than those of class II may give the required protection against electric shock, provided it is adequately protected or enclosed after installation of the appliance.

8.2 No requirement.

8.3 No requirement.

8.4 Conducting liquids that are or may become accessible

in normal use shall not be in direct contact with live parts other than those operating at safety extra-low voltages not exceeding 24 V.

This subclause is not applicable to bare element appliances.

8.5 Shafts of operating knobs, handles, levers and the like shall not be live.

TEST. Compliance with the requirements of **8.4** and **8.15** shall be checked by inspection.

8.6 For appliances other than those of class III, handles, levers and knobs that are held or actuated in normal use shall not become live in the event of an insulation fault. If these handles, levers or knobs are of metal, and if their shafts or fixings are likely to become live in the event of an insulation fault, they shall either be adequately covered by insulating material or their accessible parts shall be separated from their shafts or fixings by supplementary insulation.

For stationary appliances, this requirement does not apply to handles, levers and knobs, other than those of electrical components, provided they are either reliably connected to an earthing terminal or earthing contact, or separated from live parts by earthed metal.

TEST. Compliance shall be checked by inspection and, if necessary, by the tests specified for supplementary insulation.

8.7 For appliances other than those of class III, handles which, in normal use, are continuously held in the hand, shall be so constructed that, when gripped as in normal use, contact between the operator's hand and metal parts that may become live in the event of an insulation fault is unlikely.

This requirement does not apply to the metal parts on the flexible outlet hose or hand set of appliances connected to fixed wiring.

TEST. Compliance shall be checked by inspection and by manual test.

8.8 No requirement.

8.9 Appliances intended to be connected to the supply by means of a plug shall be so designed that, in normal use, there is no risk of electric shock from charged capacitors when touching the pins of the plug.

TEST. Compliance shall be checked by the following test, which is carried out ten times.

The appliance is operated at rated voltage or at the upper limit of the rated voltage range.

The appliance switch, if any, is then moved to the 'off' position and the appliance is disconnected from the supply by means of the plug.

One second after disconnection, the voltage between the pins of the plug is measured with an instrument which does not appreciably affect the value to be measured.

This voltage shall not exceed 34 V.

NOTE. Capacitors having a rated capacitance not exceeding 0.1 µF are not considered to entail a risk of electric shock.

9. No requirement.

Table 1. No requirement.

10. Input and current

10.1 The input of the appliance at rated voltage and at normal operating temperature shall not deviate from the rated input by more than +5 % or -10 % or 10 W, whichever is the greater.

Table 2. No requirement.

TEST. Compliance shall be checked by measuring the input of the appliance operated at rated voltage and in accordance with conditions of adequate heat discharge and/or under normal load, when the input has stabilized.

10.2 No requirement.

10.3 If a heating appliance has a marking for the input in cold condition, this shall not differ by more than 20 % from the marked value.

TEST. Compliance shall be checked by inspection and by measurement.

NOTE. For appliances and detachable heating elements marked with one or more rated voltage ranges, the tests specified in **10.1** and **10.3** are carried out at both the upper and lower limits of the ranges, unless the marking of the rated input is related to the mean value of the relevant voltage range, in which case the tests are carried out at a voltage equal to the mean value of that range.

11. Heating

11.1 Appliances and their surroundings shall not attain excessive temperatures in normal use.

TEST. Compliance shall be checked by determining the temperature rise of the various parts under the conditions specified in **11.2** to **11.7**.

11.2 Appliances for building-in shall be built in, dull black-painted plywood walls, about 20 mm thick, being used.

Other heating appliances shall be placed in a test corner. The test corner consists of two walls at right angles, a floor and, if necessary, a ceiling, all of dull black-painted plywood having a thickness of 20 mm. Appliances normally fixed to a wall shall be mounted on one of the walls away from the other wall and away from the floor or ceiling, or installed according to the manufacturer's instructions.

11.3 Temperature rises other than those of windings shall be determined by means of fine-wire thermocouples so chosen and positioned that they have the minimum effect on the temperature of the part under test.

Thermocouples used for determining the temperature rise of the surface of walls, ceiling and floor shall be attached to the back of small blackened discs of copper or brass, 15 mm in diameter and 1 mm thick, which are flush with the surface.

As far as possible, the appliance shall be so positioned that parts likely to attain the highest temperatures touch the discs.

In determining the temperature rises of handles, knobs, grips and the like, consideration shall be given to all parts that are gripped in normal use and, if of insulating material, to parts in contact with hot metal.

The temperature rise of electrical insulation, other than that of windings, shall be determined on the surface of the insulation at places where failure could cause a short circuit, contact between live parts and accessible metal parts, bridging of insulation or reduction of creepage distances or clearances below the values specified in **29.1**.

Temperature rises of windings shall be determined by the resistance method unless the windings are non-uniform or unless it involves severe complications to make the necessary connections, in which case the temperature rise shall be determined by means of thermocouples.

NOTE 1. If it is necessary to dismantle the appliance to position thermocouples, the input is measured again to check that the appliance has been correctly reassembled.

NOTE 2. The point of separation of the cores of a multicore cable or cord and where insulated wires enter lampholders are examples of places where thermocouples are positioned.

11.4 The appliance shall be operated in accordance with conditions of adequate heat discharge, with all heating elements in circuit, the supply voltage being such that the input is 1.15 times the maximum rated input.

11.5 No requirement.

11.6 No requirement.

11.7 The appliance shall be operated:

(a) on consecutive cycles of operation, until steady conditions are established, for appliances for intermittent operation, the 'on' and 'off' periods being the rated 'on' and 'off' periods;

(b) until steady conditions are established for appliances for continuous operation.

11.8 During the test the temperature rises shall be monitored continuously and they shall not exceed the values shown in table 3; and sealing compound, if any, shall not flow out.

Table 3. Permissible temperature rises

Part	Temperature rise	Part	Temperature rise
	°C or K		°C or K
Windings ¹ , if the winding insulation is:		phenol-formaldehyde with mineral fillers	100 (200)
of class A material ²	75 (65)	melamine-formaldehyde	75 (150)
of class E material ²	90 (80)	urea-formaldehyde	65 (150)
of class B material ²	95 (85)	polyester with glass-fibre reinforcement	110
of class F material ²	115	silicone rubber	145
of class H material ²	140	polytetrafluoroethylene	265
Terminals, including earthing terminals, for external conductors of stationary appliances, unless they are provided with a power supply cord	60	pure mica and tightly sintered ceramic material, when such materials are used as supplementary insulation or reinforced insulation	400
Ambient of switches and thermostats ³ :	30	thermoplastic material ⁷	—
without <i>T</i> -marking or temperature rating	7-25	Wood, in general ⁸	65
with <i>T</i> -marking or temperature rating		wooden supports, walls, ceiling and floor of the test corner and wood cabinets:	65
Rubber or polyvinyl chloride insulation of internal and external wiring including power supply cords:		Outer surface of capacitors:	
without <i>T</i> -marking or temperature rating	50 ⁴	with marking of maximum operating temperature (<i>T</i>)	7-35
with <i>T</i> -marking or temperature rating	7-25 ⁵	without marking of maximum operating temperature:	
Cord sheaths used as supplementary insulation	35	small ceramic capacitors for radio and television interference suppression	50
Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:		other capacitors	20
when used as supplementary insulation or as reinforced insulation	40	Handles, knobs, grips and the like which, in normal use, are continuously held (e.g. of soldering irons):	
in other cases	50	of metal	30
Lampholders E26 and E27:		of porcelain or vitreous material	40
metal or ceramic type	160	of moulded material, rubber or wood	50
insulated type, other than ceramic	120	Handles, knobs, grips and the like which, in normal use, are held for short periods only (e.g. of switches):	
Lampholders, E14, B15 and B22:		of metal	35
metal or ceramic type	130	of porcelain or vitreous material	45
insulated type, other than ceramic	90	of moulded material, rubber or wood	60
with <i>T</i> -marking	7-25	Parts in contact with oil having a flash-point of <i>t</i> °C	<i>t</i> -50
Material used as insulation other than that specified for wires and windings ⁶ :		Any point where the insulation of wires can come into contact with parts of a terminal block or compartment for fixed wiring of a stationary appliance not provided with a power supply cord:	
impregnated or varnished textile, paper or press board	70	where the instructions require <i>T</i> -marked or temperature rated wires	7-25 ⁵
laminates bonded with:		in other cases	50 ⁴
melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins	85 (175)		
urea-formaldehyde resin	65 (150)		
mouldings of:			
phenol-formaldehyde with cellulose fillers	85 (175)		

NOTES TO TABLE 3

¹ To allow for the fact that the temperature of windings of universal motors, relays, solenoids, etc. is usually below the average at the points where thermocouples are placed, the figures without parentheses apply when the resistance method is used and those within parentheses apply when thermocouples are used. For windings of vibrator coils and a.c. motors, the figures without parentheses apply in both cases.

² The classification is in accordance with the requirements of BS 2757.

Examples of class A material are:

impregnated cotton, silk, artificial silk and paper; enamels based on oleo- or polyamide resins.

Examples of class B material are:

asbestos, glass fibre, melamine-formaldehyde and phenol-formaldehyde resins.

Examples of class E material are:

mouldings with cellulose fillers, cotton fabric laminates and paper laminates bonded with melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins; cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;

varnished polyethylene terephthalate textile bonded with oil-modified alkyd resin varnish;

enamels based on polyvinylformal, polyurethane or epoxy resins.

³ *T* signifies the maximum operating temperature.

For the purpose of this test, switches and thermostats marked with individual ratings may be considered as having no marking for the maximum operating temperature, if requested by the appliance manufacturer.

⁴ This limit applies to cables, cords and wires complying with the requirements of BS 6500.

⁵ This limit will become applicable as soon as there are British Standards for high temperature cables, cords and wires.

⁶ The values in parentheses apply, if the material is used for handles, knobs, grips and the like and it is in contact with hot metal.

⁷ There is no specific limit for thermoplastic material which has to withstand the tests specified in 30.1 or 30.2, for which purpose the temperature rise must be determined.

⁸ The limit specified concerns the deterioration of wood and it does not take into account deterioration of surface finishes.

The temperature rise limits in the table may be exceeded if it can be shown that the temperatures are not in excess of the thermal capabilities of the materials as determined by ageing tests made on the materials themselves. Other materials not listed in the table may be used under the same conditions.

The values in the table are based on an ambient temperature not normally exceeding 25 °C but occasionally reaching 35 °C. However, the temperature rise values specified are based on 25 °C.

The value of the temperature rise of a copper winding shall be calculated from the formula:

$$\Delta t = \frac{R_2 - R_1}{R_1} (234.5 + t_1) - (t_2 - t_1)$$

where

Δt is the temperature rise (in °C or K)

R_1 is the resistance at the beginning of the test (in Ω)

R_2 is the resistance at the end of the test (in Ω)

t_1 is the room temperature at the beginning of the test (in °C)

t_2 is the room temperature at the end of the test (in °C)

At the beginning of the test, the windings shall be at room temperature.

It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

NOTE. The classification of handles, knobs, grips and the like according to their materials is derived from the constant:

$$b = \sqrt{\lambda \cdot c \cdot \gamma}$$

where

λ is the thermal conductivity of the material (in $W/(m \cdot K)$)

c is the specific heat of the material (in $J/(kg \cdot K)$)

γ is the specific mass of the material (in kg/m^3)

The materials are classified as follows:

value of b greater than 3500 metal;

value of b between 1000 and 3500 porcelain or vitreous material;

value of b less than 1000 moulded material, rubber or wood.

An alternative method of determining the constant, b , is as follows.

Samples of materials with known values of the constant, b , and a sample of the material to be classified, all samples having the same dimensions, are fixed to a heated metal plate.

The temperatures of the upper surfaces of the various samples are measured and the temperatures of the reference samples are plotted as a function of the constant, b .

The constant, b , of the material to be classified is derived from this curve by reading off the value, b , corresponding to the temperature attained by the sample under investigation.

11.9 No requirement.

12. Operation under overload conditions

12.1 Appliances shall be so designed and constructed that they withstand overloads that are liable to occur in normal use.

TEST. Compliance shall be checked by the test specified in **12.2** and, if applicable, by the test specified in **12.3**.

After the tests, the appliance shall show no damage within the meaning of this standard.

In particular, heating wires, internal wiring and the general assembly shall not show such deformation that creepage distances and clearances are reduced below the values specified in **29.1**. Contacts and connections shall not have worked loose.

12.2 TEST. Appliances normally fixed to a wall shall be fixed to a wall, as near as possible to the floor or to a ceiling, as is likely to occur in normal use, unless specific instructions are given by the manufacturer.

The appliance shall be subjected to 15 cycles, each cycle comprising an operating period as specified in **11.7**, in accordance with conditions of adequate heat discharge, and a cooling period sufficient to allow the appliance to cool down to approximately room temperature.

Throughout the operating period, all heating elements that can be operated at the same time shall be in circuit, the supply voltage being such that the input is 1.27 times rated input or 1.21 times rated input plus 12 W, whichever is the greater.

If a self-resetting thermal cut-out or a non-self-resetting thermal cut-out that is accessible and can be reset without the aid of a tool, operates, the operating period is considered to be ended. The appliance is then allowed to cool down and the cut-out is reset for the next cycle.

During the test, non-self-resetting thermal cut-outs that are accessible only with the aid of a tool or which require the replacement of a part shall not operate and no vapour or ignitable gas shall accumulate in the appliance.

NOTE. Forced cooling may be used for the purpose of shortening the cooling period.

12.3 TEST. Appliances provided with a pressure switch shall be subjected to an additional test under the conditions specified in **12.2**, but the operating and cooling periods shall be each approximately 5 min and the current shall be interrupted by controlling the working pressure.

13. Electrical insulation and leakage current at operating temperature

13.1 The electric insulation of the appliance at operating temperature shall be adequate and the leakage current in normal use shall not be excessive.

TEST. Compliance shall be checked by the tests specified in **13.2** and **13.3**, the appliance being operated in accordance with conditions of adequate heat discharge and/or under normal load for the time specified in **11.7**.

The appliance shall be operated with all heating elements in circuit, the supply voltage being such that the input is 1.15 times the maximum rated input.

Three-phase appliances which are also suitable for single-phase supply shall be tested as single-phase appliances with the three sections connected in parallel.

The tests shall be carried out while the appliance is connected to the supply, except that, for three-phase appliances not suitable for single-phase supply, the test specified in **13.3** shall be carried out immediately after the appliance has been disconnected from the supply.

13.2 The leakage current shall be measured between any pole of the supply and accessible metal parts and metal foil with an area not exceeding 200 mm x 100 mm in contact with accessible surfaces of insulating material, connected together.

For appliances with bare heating elements the tests shall be carried out with test water at 15 °C having the minimum permissive resistivity according to the marking. The test water may be prepared by the addition of ammonium phosphate.

The measuring circuit shall be as shown in figure 5 for single-phase appliances having a rated voltage not exceeding 250 V and for three-phase appliances to be tested as single-phase appliances. For three-phase appliances not suitable for single-phase supply, the measuring circuit shall be as shown



in figure 7, the measurement being taken with each of the switches a, b and c closed and then repeated with each switch open in turn, the other two switches being closed.

The resistance of the measuring circuit shall be $2000 \pm 100 \Omega$.

The test shall be carried out with a.c., unless the appliance is for d.c. only, in which case the test shall be carried out with d.c.

For single-phase appliances having a rated voltage not exceeding 250 V and for three-phase appliances to be tested as single-phase appliances, the leakage current shall be measured with the selector switch shown in figure 5 in each of the positions 1 and 2.

After an operating time as specified in 11.7, the leakage current shall not exceed the following values to accessible metal parts and metal foil:

- | | |
|---|--|
| (1) for stationary class I heating appliances | 0.75 mA or 0.75 mA per kW rated input of the appliance, whichever is the greater, with a maximum of 5 mA |
| (2) for class III appliances | 0.5 mA |

For bare element appliances a test shall also be made with the measuring apparatus connected between a metal sieve in the outflowing water and the earthing terminal of the appliance. The earthing terminal is connected through a changeover switch first to one pole and then to the other pole of the supply as shown in figure 5A. The current flowing shall not exceed 0.25 mA.

If the appliance incorporates one or more capacitors and is provided with a single-pole switch, the measurements shall be repeated with the switch in the 'off' position.

NOTE 1. In view of the difficulty and danger of insulating the appliance and water supply from earth the appliance should be supplied through an isolating transformer.

NOTE 2. The metal foil has the largest area possible on the surface under test, without exceeding the dimensions specified. If its area is smaller than the surface under test, it is moved so as to test all parts of the surface; the heat dissipation of the appliance should not, however, be affected by the metal foil.

NOTE 3. The test with the switch in the 'off' position is made to verify that capacitors connected behind a single-pole switch do not cause an excessive leakage current.

13.3 The insulation shall be subjected for 1 min to a voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz. For single-phase appliances and three-phase appliances to be tested as single-phase appliances, the connections shall be as shown in figure 8.

The test voltage shall be applied between live parts and the body.

The value of the test voltage shall be:

- 500 V for basic insulation subjected in normal use to a safety extra-low voltage;
- 1000 V for other basic insulation;
- 2750 V for supplementary insulation;
- 3750 V for reinforced insulation.

Initially, not more than half the prescribed voltage shall be applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

NOTE 1. Glow discharges without drop in voltage are neglected.

NOTE 2. The high voltage transformer used for the test should have a rating of at least 500 V A.

NOTE 3. If the secondary winding of the isolating transformer is not provided with a tap at the midpoint, the output winding of the high voltage transformer can be connected to the midpoint of a potentiometer having a total resistance not exceeding 2000 Ω and connected across the output winding of the isolating transformer.

14. Radio and television interference suppression

The incorporation of components necessary to achieve an adequate degree of radio and television interference suppression shall not adversely affect the safety of the appliance.

TEST. Compliance shall be checked by the tests specified in this standard.

NOTE. Attention is drawn to the fact that compliance with the requirements concerning the limits for interference effects generated by the appliance, as specified in BS 800, and when measured in accordance with that standard, will in most cases ensure that the appliance has the required degree of radio and television interference suppression.

15. Moisture resistance

15.1 The enclosure of drip-proof and splash-proof appliances shall provide the degree of protection against moisture in accordance with the classification of the appliance.

TEST. Compliance shall be checked by the appropriate treatment specified in 15.2.

Immediately after the treatment for splash-proof and drip-proof appliances, the appliance shall withstand the electric strength test specified in 16.4, and inspection shall show that water which may have entered the appliance does not impair compliance with the requirements of this standard; in particular, there shall be no trace of water on insulation for which creepage distances are specified in 29.1.

The appliance shall be allowed to stand in normal test-room atmosphere for 24 h before being subjected to the test specified in 15.4.

15.2 Appliances with type X attachments shall be fitted with the lightest permissible type of flexible cable or cord of the smallest cross-sectional area specified in 26.2, and other appliances shall be tested as delivered.

Electrical components, covers and other parts that can be removed without the aid of a tool shall be removed and subjected, if necessary, to the relevant treatment with the main part.

Sealing rings of glands and other sealing means, if any, shall be aged in an atmosphere having the composition and pressure of the ambient air by suspending them freely in a heating cabinet ventilated by natural circulation.

They shall be kept in the cabinet at a temperature of $70 \pm 2^\circ\text{C}$, for 10 days (240 h).

Immediately afterwards, the samples shall be taken out of the cabinet and left at room temperature, avoiding direct daylight, for at least 16 h before being reassembled. The glands and other sealing means shall then be tightened with a torque equal to two-thirds of that applied during the test specified in 21.3.

NOTE. The use of an electrically-heated cabinet is recommended. Natural circulation may be provided by holes in the walls of the cabinet.

Drip-proof appliances shall then be subjected for 5 min to the vertical rain test.

Splash-proof appliances shall then be subjected for 10 min to the oblique rain test, followed by 5 min subjection to the splash test.

For the vertical rain test, an apparatus similar to that shown in figure 9 which delivers 3 mm of rain per minute, uniformly distributed over the sample, shall be used.

Appliances normally fixed to a wall shall be fixed in the normal position of use, to a wooden board, if necessary, this board having dimensions that are equal to those of the surface of the appliance in contact with the wall. They

shall be fixed 3 mm off the surface using spacers.

The wooden board itself shall be supported so that the nozzles of the rain apparatus are 2 m above the uppermost point of the appliance.

Other appliances shall be placed in normal position of use so that the nozzles of the rain apparatus are 2 m above the uppermost point of the appliance.

For the oblique rain test, the spray apparatus shown in figure 11 shall be used, the apparatus comprising a tube formed into a semicircle. The radius of the circle is 200 mm or a multiple of 200 mm and is as small as is compatible with the size and position of the sample. The tube is perforated so that jets of water are directed towards the centre of the circle, and the water pressure at the inlet to the apparatus is equivalent to a head of about 10 m.

The tube is caused to oscillate through an angle of 120° , 60° on each side of the vertical, the time for one complete oscillation ($2 \times 120^\circ$) being about 4 s.

Appliances normally fixed to a wall shall be mounted as in normal use on a wooden board having dimensions that are 150 ± 50 mm in excess of those of the orthogonal projection of the appliance on the board. Wall mounted appliances shall be fixed 3 mm off the surface using spacers.

Other appliances shall be placed on a support having dimensions that are at least 50 mm in excess of those of the orthogonal projection of the appliance on the support.

The sample shall be mounted or placed at the centre of the semicircle formed by the tube so that its lowest part is level with the axis of oscillation. The sample shall be turned about its vertical axis during the test.

For the splash test, the apparatus shown in figure 10 shall be used. During the test, the water pressure shall be regulated so that the water splashes up 150 mm above the bottom of the bowl. The bowl shall be placed on the floor for appliances normally used on the floor and, for all other appliances, on a horizontal support 50 mm below the lowest edge of the appliance; the bowl shall be moved around so as to splash the appliance from all directions. Care shall be taken to ensure that the appliance is not hit by the direct jet.

NOTE. A revision of the splash test is under consideration.

15.3 No requirement.

15.4 Appliances shall be proof against humid conditions that may occur in normal use.

TEST. Compliance shall be checked by the humidity treatment described in this subclause, followed immediately by the tests specified in clause 16.

Cable entries, if any, shall be left open; if knock-outs are provided, one of them shall be opened.

Electrical components, covers and other parts that can be removed without the aid of a tool, shall be removed and subjected, if necessary, to the humidity treatment with the main part.

The humidity treatment shall be carried out in a humidity cabinet containing air with a relative humidity of $93 \pm 2\%$. The temperature of the air, at all places where samples can be located, is maintained within 1°C (1 K) of any convenient value t between 20°C and 30°C .

Before being placed in the humidity cabinet, the sample shall be brought to a temperature of between t and $t + 4^\circ\text{C}$.

The sample shall be kept in the cabinet for 7 days (168 h).

NOTE 1. In most cases, the sample may be brought to the specified temperature by keeping it at this temperature for at least 4 h before the humidity treatment.

NOTE 2. A relative humidity of $93 \pm 2\%$ can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water, having a sufficiently large contact surface with the air.

NOTE 3. In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

After this treatment, the appliance shall show no damage within the meaning of this standard.

16. Insulation resistance and electric strength

16.1 The insulation and electric strength of appliances shall be adequate.

TEST. Compliance shall be checked, for heating appliances, by the tests specified in 16.2 and 16.4 and, which are made on the cold appliance, not connected to the supply, immediately after the test specified in 15.4, in the humidity cabinet or in the room in which the sample was brought to the prescribed temperature, after reassembly of those parts that may have been removed.

16.2 A test voltage, d.c. for appliances for d.c. only and a.c. for all other appliances, shall be applied as specified in items 1 and 4 of table 5, the metal foil having a size not exceeding 200 mm x 100 mm and being moved, if necessary, so as to test all parts of the surface. For bare element appliances the test shall be made with test water according to 13.2.

The test voltage shall be:

(a) 1.06 times rated voltage, or 1.06 times the upper limit of the rated voltage range, for appliances for d.c. only, for single-phase appliances and for three-phase appliances which are also suitable or single-phase supply, if the rated voltage or the upper limit of the rated voltage range does not exceed 250 V;

(b) 1.06 times rated voltage, or 1.06 times the upper limit of rated voltage range, divided by $\sqrt{3}$, for other appliances.

The leakage current shall be measured within 5 s after the application of the test voltage.

In no case shall the leakage current exceed the following values between the parts specified in items 1 and 4 of table 5:

(a) class III appliances	0.5 mA
(b) other stationary class I appliances	0.75 mA or 0.75 mA per kW rated input of the appliance, whichever is the greater, with a maximum of 5 mA

16.3 No requirement.

Table 4. No requirement

16.4 Immediately after the test specified in 16.2, for heating appliances, the insulation shall be subjected for 1 min to a voltage of substantially sine-wave form, having a frequency of 50 Hz. The value of the test voltage and the points of application are shown in table 5.

Table 5. Test voltages

Points of application of test voltage	Test voltage		
	Class III appliances	Class II appliances	Class I appliances
1. Between live parts and parts of the body that are separated from live parts by: basic insulation only reinforced insulation	V 500 —	V — 3750	V 1250 3750
2. Between live parts of different polarity	500	1250	1250
3. For parts with double insulation, between metal parts separated from live parts by basic insulation only, and: live parts the body	— —	1250 2500	1250 2500
4. Between metal enclosures or covers lined with insulating material and metal foil in contact with the inner surface of the lining, if the distance between live parts and these metal enclosures or covers, measured through the lining, is less than the appropriate clearance as specified in 29.1	—	2500	1250
5. Between metal foil in contact with handles, knobs, grips and the like and their shafts, if these shafts can become live in the event of an insulation fault	—	2500	2500
6. Between the body and either the power supply cord wrapped with metal foil or a metal rod of the same diameter as the power supply cord, inserted in its place, fitted in inlet bushings of insulating material, cord guards, cord anchorages and the like	—	2500	1250
7. Between the point where a winding and a capacitor are connected together, if a resonance voltage, U , occurs between this point and any terminal for external conductors, and: the body metal parts separated from live parts by basic insulation only	— —	— 2U+1000	2U+1000 —

The test between the live parts of different polarity is carried out only where the necessary disconnections can be made without damaging the appliance.

The test between the point where a winding and a capacitor are connected together, and the body or metal parts, is carried out only where the insulation is subjected to the resonance voltage under normal running conditions. Other parts are disconnected and the capacitor is short-circuited.

The test is not carried out between the contacts of switches of micro-gap construction, relays, thermostats, thermal cut-outs and the like, or on the insulation of capacitors connected between live parts of different polarity.

Initially, not more than half the prescribed voltage shall be applied; then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

NOTE 1. Care is necessary to ensure that the metal foil is so placed that no flashover occurs at the edges of the insulation.

NOTE 2. For appliances incorporating parts with both reinforced insulation and double insulation, care is necessary to ensure that the voltage applied to the reinforced insulation does not overstress the basic insulation or the supplementary insulation.

NOTE 3. When testing insulating coatings, the metal foil may be pressed against the insulation by means of a sandbag of such a size that the pressure is about 0.05 bar. The test may be limited to places where the insulation is likely to be weak, for example where there are sharp metal edges under the insulation.

NOTE 4. If practicable, insulating linings are tested separately.

17. Overload protection

Appliances incorporating circuits supplied from a transformer shall be so constructed that, in the event of short circuits that are likely to occur in normal use, excessive temperatures do not occur in the transformer or in the associated circuits.

TEST. Compliance shall be checked by applying the most unfavourable short circuit or overload that is likely to occur in normal use, the appliance being operated at a voltage equal to 1.06 or 0.94 times rated voltage, whichever is the more unfavourable.

The temperature rise of the insulation of the conductors of safety extra-low voltage circuits shall be determined and shall not exceed the relevant value specified in table 3 by more than 15 °C (15 K). The winding temperature of transformers shall not exceed the value specified for

windings as below:

Class A 200 °C

Class E 215 °C

Class B 225 °C.



NOTE 1. Examples of short circuits that are likely to occur in normal use are the short-circuiting of bare or inadequately insulated conductors of safety extra-low voltage circuits which are accessible, and the internal short-circuiting of lamp filaments.

NOTE 2. A failure of insulation complying with the requirements specified for basic insulation of class I or class II construction is not, for the purposes of this requirement, considered to be likely to occur in normal use.

NOTE 3. Protection of transformer windings may be obtained by the inherent impedance of the windings, or by means of fuses, automatic switches, thermal cut-outs or similar devices located inside the transformer or located inside the appliance, provided that these devices are accessible only with the aid of a tool.