BRITISH STANDARD

BS 7462:1991

Specification for

Electrical safety of domestic gas appliances

Confirmed December 2011

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Gas Standards Policy Committee (GSE/-) to Technical Committee GSE/17, upon which the following bodies were represented:

Association for Consumer Research (ACRE)
British Gas plc
Consumer Policy Committee of BSI
Department of Energy (Energy Efficiency Office)
Department of the Environment (Construction Directorate)
Department of Trade and Industry (Consumer Safety Unit, CA Division)
Gas Consumers' Council
Institution of Gas Engineers
Liquefied Petroleum Gas Industry Technical Association (UK)
National Caravan Council Limited
Royal Society for the Prevention of Accidents
Society of British Gas Industries

This British Standard, having been prepared under the direction of the Gas Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 29 November 1991

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Contents

Foreword

This British Standard has been prepared under the direction of the Gas Standards Policy Committee. Its primary purpose is to supplement standards for the safety of domestic gas appliances, e.g. BS 5258, which, while purporting to cover electrical as well as gas and mechanical safety aspects, do so only by general reference to BS 3456-101.

This British Standard is intended for appliances of gas heat input not exceeding 60 kW and in which there is no intentional additional electrical heating. It is based on, and the format closely follows that of, BS 3456-101 which itself is the implementation in a British Standard of CENELEC[1)] Harmonization Document 251 S3.

Attention is drawn to the requirements of the Low Voltage Electrical Equipment (Safety) Regulations 1989.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 46, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] European Committee for Electrotechnical Standardization.

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1 Scope

This British Standard specifies the electrical safety requirements for domestic gas appliances, hereinafter referred to as appliances, operating from a 240 V 50 Hz single phase supply without electrical heating and with a maximum electrical input of 1 kW and a maximum gas heat input of 60 kW.

In this standard, references to "hazards" denote those hazards arising from the electrical equipment and wiring.

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

2 Definitions

For the purposes of this British Standard the following definitions apply.

NOTE Unless otherwise specified, voltages and currents are expressed by their r.m.s. values.

2.1
accessible part or accessible surface

a part or surface that can be touched by means of the test finger shown in Figure 1

2.2
all-pole disconnection

disconnection of both supply conductors by a single switching action

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

2.3
appliance for building-in

a fixed appliance intended to be installed in a cabinet, in a prepared recess in a wall, or in a similar situation

NOTE Appliances for building-in may not have an enclosure on all sides, full protection against electric shock being obtained after installation.

2.4
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.

2.5
body

includes all accessible metal parts, shafts of handles, knobs, grips, etc. and metal foil in contact with all accessible surfaces of insulating material but excluding inaccessible metal parts

2.6
class 1 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 1 appliances may have parts with double insulation or reinforced insulation, or parts operating at safety extra-low voltage (see **2.29**).

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.

2.7
class II part

a part for which protection against electric shock does not rely on basic insulation only, but which has additional safety precautions, such as double insulation or reinforced insulation between live parts and accessible metal parts, there being no provision for protective earthing

2.8
class III part

a part in which protection against electric shock relies on supply at safety extra-low voltage and in which voltages higher than this, excluding spark ignition, are not generated

2.9
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.

2.10
continuous operation

operation under normal electrical load and rated heat input for an unlimited period

2.11
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

2.12
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

2.13
detachable part

a part that can be removed without the aid of a tool

NOTE See **2.36**.

2.14
double insulation

insulation comprising both basic insulation and supplementary insulation

2.15
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, the extra-low voltage circuits being separated from other circuits by basic insulation only

2.16
fixed appliance

an appliance that is fastened to a support or otherwise secured in a specific situation

2.17
hot condition

the appliance is operated in accordance with the test methods as specified in the appliance standards for the testing of component temperatures

NOTE In BS 5258, the test methods will be those referred to under the heading "Component temperatures". In BS 5386-1 they will be found under the heading "Temperature of control handles", in BS 5386-3 and BS 5386-4 under the heading "Heating" and in BS 5386-5 under the heading "Temperature of components and control knobs".

2.18
live (part)

any part deliberately connected or intended to be connected to one or other pole of the electrical supply

2.19
non-detachable part

a part that cannot be removed without the aid of a tool

NOTE See **2.36**.

2.20
non-self-resetting cut-out

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

2.21
normal load

the load to be applied to an appliance incorporating a motor so that the stress imposed corresponds to that occurring under normal conditions of use

2.22
power supply cord

a flexible cable or cord, for supply purposes fixed to, or assembled with, the appliance such that it can easily be replaced, without the aid of special purpose tools, by a similar flexible cable or cord not requiring any special preparation

2.23
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.

2.24
rated frequency

the frequency assigned to the appliance by the manufacturer

2.25
rated input

the electrical input assigned to the appliance by the manufacturer

2.26
rated voltage

the voltage assigned to the appliance by the manufacturer

2.27
rated voltage range

the voltage range assigned to the appliance by the manufacturer, expressed by its lower and upper limits

2.28
reinforced insulation

a single insulation system applied to live parts that 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 should be one homogeneous piece. It may comprise several layers that cannot be tested singly as supplementary or basic insulation.

2.29
safety extra-low voltage

a nominal voltage not exceeding 42 V between conductors and between conductors and earth, the no-load voltage not exceeding 50 V

NOTE 1 When safety extra-low voltage is obtained from the supply mains, it is essential that it be through a safety isolating transformer (see **2.30**) or a converter with separate windings.
NOTE 2 The voltage limits given are based on the assumption that the safety isolating transformer is operated at its rated supply voltage.

2.30
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, and which is designed to supply a distribution circuit, an appliance or other equipment at safety extra-low voltage

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

2.31
self-resetting thermal cut-out

a thermal cut-out that automatically restores the current after the relevant part of the appliance has cooled down sufficiently

2.32
stationary appliance

either a fixed appliance or an appliance having a mass exceeding 18 kg and not provided with a carrying handle

2.33
supplementary insulation

independent insulation applied in addition to basic insulation, in order to ensure protection against electric shock in the event of failure of the basic insulation

2.34
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

2.35
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 parts of it, between certain limits

2.36
tool

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

2.37
type X attachment

the method of attachment of a power supply cord

NOTE See **2.22**.

2.38
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.

3 General requirements

Appliances shall be so designed and constructed that, in normal use, the electrical function shall be safe so as to cause no danger to persons or surroundings, even in the event of such careless use as may occur in normal service, e.g. spillage due to a pan boiling over.

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

4 General conditions for the tests

4.1 Before testing, appliances shall be installed in accordance with both the manufacturer's instructions and the relevant gas appliance standard.

4.2 As far as practicable, the tests shall be carried out in the order of the clauses of this standard.

4.3 The test room shall be adequately ventilated but free from draught likely to affect the performance of the appliance.

If the test results are influenced by the temperature of the ambient air, the room temperature shall be maintained at 20 ± 5 °C, except where specified otherwise within this standard.

4.4 Appliances provided with a thermostat, a regulating device or a similar control shall be tested with these controls adjusted to their most unfavourable setting, with respect to the electrical system, if the setting can be altered by the user.

NOTE 1 If the adjusting means of the control is accessible without the aid of a tool, **4.4** 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, **4.4** 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.

4.5 For the purposes of **9.4**, **15.3**, **23.9** and **25.1**, parts separated from live parts by double insulation or reinforced insulation shall be regarded as not being 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.

4.6 If class 1 appliances have accessible metal parts that are not permanently and reliably 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 requirements specified for class II parts (see **9.5**, clause **13**, clause **15**, **20.19** and **23.9**).

Spark ignition electrodes shall be regarded as class II parts.

4.7 Electronic circuits shall comply with Appendix A.

4.8 Unless otherwise specified in this standard, 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.

5 Rating

Appliances covered by this standard shall be single-phase intended for direct connection to the UK mains supply and shall have a rated voltage that covers use at 240 V and a rated frequency that covers use at 50 Hz.

6 Classification

Appliances shall be classified as follows:

a) according to degree of protection against electric shock:

1) class I appliances;

2) class II appliances;

3) class III appliances.

b) according to degree of protection against moisture:

1) ordinary appliances;

2) drip-proof appliances;

3) splash-proof 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 The requirements with regard to the classification of appliances are given in **20.1** and **20.2**.

7 Marking

7.1 A data plate shall be affixed to the appliance in a position accessible and visible to the installer.

NOTE 1 The data plate may be that required in the relevant gas appliance standard.

It shall contain at least the following information:

a) the manufacturer's name and/or trade mark, complete with address for correspondence;

b) the appliance type name and/or number;

c) the rated voltage, frequency and symbol for nature of supply;

d) rated electrical input (in watts or kilowatts) if greater than 25 W;

e) rated current of the appropriate fuse-link (in amperes) for an appliance incorporating a motor where the inrush current requires a fuse of a higher current rating than the marked rating (see **10.2**);

If the rated current of the appropriate fuse-link is marked and if the fuse-link is of the time-lag type, information about the time/current characteristic rating shall be included in the relevant marking;

f) symbol for degree of protection against moisture, if applicable.

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

Motors with windings insulated with class B, class F or class H material only (see BS 2757) shall be marked with the class designation of their winding insulation.

NOTE 2 If the motor of an appliance is marked separately, the marking of the appliance and that of the motor should be such that there can be no doubt with regard to the rating and manufacturer of the appliance itself.

NOTE 3 Additional markings are allowed, provided they do not give rise to misunderstanding.

7.2 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
h	hours
min	minutes
s	seconds
∼	alternating current
	fuse-link (417-IEC-5016a, BS 6217:1981)
	rated current of the appropriate fuse-link where *X* is the numerical value of the current
	time-lag miniature fuse link where *X* is the symbol for time/current characteristic as given in BS 4265
	drip-proof construction
	splash-proof construction
⏚	earth (417-IEC 5017a, BS 6217:1981)

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

NOTE This list of symbols is not exclusive and other symbols for different purposes can be used if they do not lead to misunderstanding.

7.3 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 earth symbol shown in **7.2**.

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

7.4 Unless it is obviously unnecessary, electrical controls shall be so marked or placed that they indicate clearly which part of the appliance they control.

7.5 The different positions of switches and the different positions of electrical controls and switches which are part of a control shall be indicated by figures, letters or other visual means.

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 heating or cooling effect, speed etc. shall be indicated by a higher figure.

The figure 0 shall not be used for any other indication, unless it is so positioned and associated with other numbers that it does not give rise to confusion with the indication of the "off" position.

NOTE The figure 0 may, for example, also be used in a digital programming keyboard.

7.6 (See also **23.1**.) A wiring diagram shall be marked on the appliance in a position easily visible to the installer/service engineer.

Wiring coding shall be such that it is easily identifiable with the wiring diagram, e.g. colours, numbers.

Every fuse or circuit breaker shall have on its case or cover, or in an adjacent position, indelible indication of its rated current appropriate to the circuit(s) it protects.

Any electrical component intended for service replacement shall be marked with its electrical characteristics, e.g. capacitance, resistance.

7.7 A warning notice shall be permanently affixed in a readily visible position near to the mains supply cord entry to the appliance or, for built-in appliances, on the access panel for internal wiring. The notice shall state the following.

"The appliance must be isolated from the electrical supply before carrying out any service operation."

7.8 A label shall be attached to any flexible cord supplied with the appliance 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 that 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 that is coloured blue must be connected to the terminal that is marked with the letter N or coloured black.

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

7.9 All markings which are required by **7.1**, **7.3**, **7.5**, **7.6** and **7.7** shall be easily legible and shall comply with the durability requirements as detailed below.

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 specified in this standard, the marking shall be easily legible. It shall not be possible to remove marking plates easily and they shall show no signs of curling.

NOTE 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.

8 Instructions

8.1 General

Instruction sheets and other texts required by this standard shall be written in English.

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

8.2 Installation instructions (see also **23.1**)

8.2.1 The installation instructions shall include instructions on the method of connecting the appliance to the electrical supply.

8.2.2 If the appliance is not fitted with either:

a) a non-detachable flexible cable or cord intended to be connected to a plug; or

b) with other means for disconnection from the supply having a contact separation of at least 3 mm in both poles,

the installation instructions shall state that it is required that such means for disconnection be incorporated in the fixed wiring or, alternatively, the instructions shall state the method of fitting the cord in accordance with item 2) of **23.2**.

8.2.3 The installation instructions shall include the temperature rating or *T*-marking of the insulation of the supply cable or cord if, where it can contact any part of the appliance operating under any condition of normal use, its temperature rise exceeds that specified in Table 1.

8.2.4 The installation instructions shall include a statement that all external wiring shall be in accordance with the current IEE wiring regulations.

8.2.5 For appliances for building-in, in order to ensure that after building-in the conditions necessary to comply with this standard are achieved, the instructions for appliances for building-in shall give clear information with regard to the connection of the appliance to the supply and interconnection of separate components, if any.

Table 1 — Maximum temperature rises (but see **12.2**)

Part	Maximum temperature rise[a]
	K
Windings, if the winding insulation is:	
of class A material[b]	75 (65)
of class E material[b]	90 (80)
of class B material[b]	95 (85)
of class F material[b]	115
of class H material[b]	140
Terminals, including earthing terminals, for external conductors of stationary appliances, unless they are provided with a power supply cord	60
Ambient temperature of switches and thermostats[c]:	
without *T*-marking or temperature rating	30
with *T*-marking or temperature rating	$T - 25$
Rubber or polyvinyl chloride (PVC) insulation of internal and external wiring including power supply cords[c]:	
without *T*-marking or temperature rating	50[d]
with *T*-marking or temperature rating	$T - 25$[e]
Cord sheaths used as supplementary insulation	35
Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:	
when used as supplementary insulation or as reinforced insulation	40
in other cases	50
Lampholders E26 and E27:	
metal or ceramic type	160
insulated type, other than ceramic	120
Lampholders E14, B15 and B22[c]:	
metal or ceramic type	130
insulated type, other than ceramic	90
with *T*-marking	$T - 25$
Materials used as insulation other than that specified for wires and windings[f]:	
impregnated or varnished textile, paper or press board	70
laminates bonded with:	
melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins	85 (175)
urea-formaldehyde	65 (150)
mouldings of:	
phenol-formaldehyde with cellulose fillers	85 (175)
phenol-formaldehyde with mineral fillers	100 (200)
melamine-formaldehyde	75 (150)
urea-formaldehyde	65 (150)
polyester with glass fibre reinforcement	110

Table 1 — Maximum temperature rises (but see **12.2**)

Part	Maximum temperature rise[a]
	K
silicone rubber	145
polytetrafluorethylene	265
pure mica and tightly sintered ceramic material, when such materials are used as supplementary insulation or reinforced insulation	400
thermoplastics material[f]	—
Outer surfaces of capacitors:	
with marking of maximum operating temperature (T)	$T - 35$
without marking of maximum operating temperature:	
small ceramic capacitors for radio and television interference suppression	50
other capacitors	20
Parts in contact with oil having a flash point of t_f °C	$t_f - 50$
Any point where the insulation of supply wires can come into contact where the appliance is not already fitted with a power supply cord[c]:	
where the instructions require T-marked or temperature rated wires	$T - 25$[e]
in other cases	50[d]

[a] 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 the thermocouples are placed, the figures without parentheses apply when the resistance method (see **12.1**) 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.

[b] The classification is in accordance with BS 2757.
For totally enclosed motors, the temperature limits for class A, class E and class B materials may be increased by 5 K. A totally enclosed motor is a motor so constructed that the circulation of air between the inside and outside of the case is prevented but it is not necessarily sufficiently enclosed to be called airtight.

[c] T signifies the maximum operating temperature.

[d] This limit applies to cables, cords and wires complying with BS 6500.

[e] This limit applies to cables and flexible cords complying with BS 6141 for use in high temperature areas.

[f] There is no specific limit for thermoplastics material, which instead has to withstand the tests specified in **28.1** or **28.2** for which purpose the temperature has to be determined.

8.3 Servicing instructions

The servicing instructions shall include the following:

a) a warning in bold capital letters, on the first page, instructing the serviceman to isolate the electrical supply before carrying out any servicing procedure which might allow access to live parts. The instructions shall also state that where the appliance is connected to the supply via a plug and socket, it is essential that the plug always be withdrawn from the socket to ensure complete isolation;

b) the procedures for removing or gaining access to electrical wiring and components for servicing;

c) a wiring diagram showing essential connections and interconnections.

8.4 User instructions

The user instructions shall include the following:

a) the warning **"WARNING. THIS APPLIANCE MUST BE EARTHED."**;

b) for appliances with lamps for replacement by the user, a warning to disconnect the appliance from the electrical supply before changing the lamps. This warning shall also state that, if the appliance is connected via a plug and socket, it is essential that the plug be withdrawn completely from the socket to ensure complete electrical isolation.

9 Protection against electric shock

9.1 All positions of the appliance, when it is wired and operated as in normal use, shall have adequate protection against accidental contact with live parts and basic insulation.

Tests 1, 2 and 3 shall be carried out on the appliance such that any part which can become live during the normal operation of the appliance is tested.

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

The insulating properties of lacquer, enamel, ordinary 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. Self-hardening resins shall not be regarded as sealing compounds.

TEST 1. The test finger shown in Figure 1 shall not touch live parts or basic insulation with the exception of lamps located behind a detachable cover provided that:

a) the lampholders are designed such that lamp caps are inaccessible if they can become live during insertion; and

b) the lamps can be separated from the supply by means of a plug or a double-pole switch, the "off" position of which is clearly indicated.

Detachable covers which are marked "Remove plug before removing this cover" or "Disconnect from the mains before removing this cover", and non-detachable covers which need to be removed for user maintenance, may expose basic insulation but shall not expose live parts.

The test finger shall be applied without appreciable force in every possible position on the appliance that is accessible without the use of tools. Any user-operable lids, doors, etc. are opened and any detachable parts removed. If the manufacturer's instructions permit the removal of a part during normal operation or user maintenance, then that part is removed even if it requires the use of tools.

For appliances provided with movable devices, such as those intended for varying the heat distribution or the tension of belts, the test shall be carried out with the devices adjusted to their most unfavourable position within the range of adjustment.

NOTE 2 When applying the test finger shown in Figure 1, either or both of the jointed sections should be turned through any angle up to 90° with respect to the axis of the finger and in the same direction only.

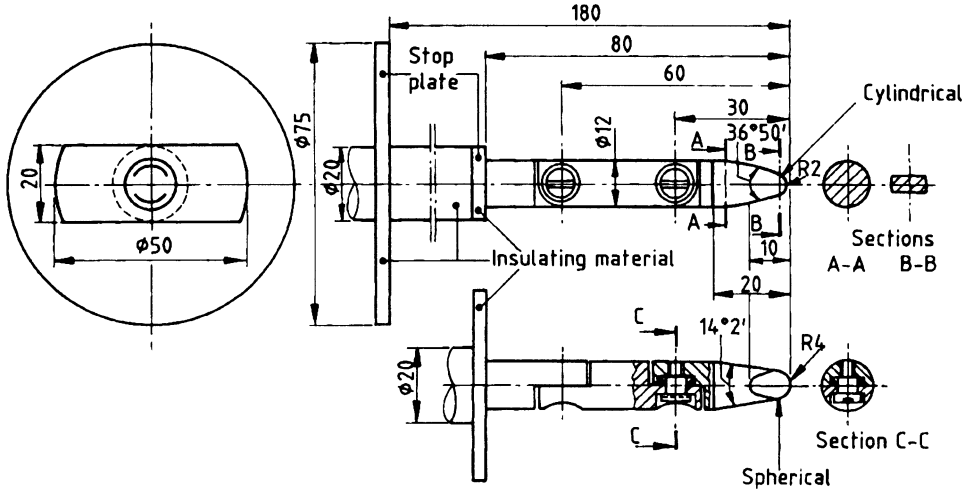
NOTE 3 It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

NOTE 4 The use of screw-type fuses and screw-type miniature circuit breakers is precluded if they are accessible without the use of tools.

TEST 2. Apertures preventing entry of the test finger shall be further tested by means of the test finger shown in Figure 2.

The test finger shall be applied with a maximum force of 30 N to any aperture where the entry of the tip of the test finger shown in Figure 1 has been prevented. If the test finger shown in Figure 2 enters the aperture and touches live parts, the appliance shall be considered not to comply with this British Standard. If it enters beyond the tip without touching live parts, the test with the test finger shown in Figure 1 shall be repeated, the test finger being pushed, if necessary, through the aperture and bent into any position.

NOTE 5 Care should be taken to avoid wedge or lever action when applying the test finger shown in Figure 2.



NOTE 1 All linear dimensions are in millimetres.

NOTE 2 Tolerances

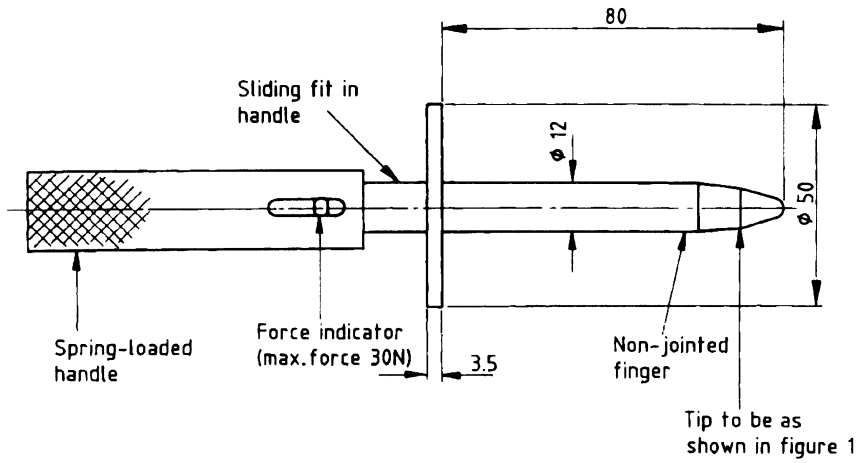
on angles: ± 5′

on linear dimensions:

less than 25 mm: +0 −0.05

over 25 mm: ± 0.2

Figure 1 — Standard test finger



NOTE 1 All dimensions are in millimetres.

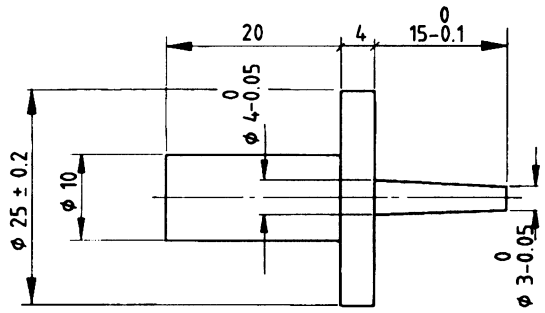
NOTE 2 Tolerances are as given in Figure 1.

NOTE 3 This drawing is not intended to govern design except as regards the dimensions shown.

Figure 2 — Special test finger

TEST 3. Apertures in parts which are not reliably connected to the appliance earth terminal, other than live parts in sockets outlets and lamp caps, are tested using the test pin shown in Figure 3.

The test pin is inserted and moved in any direction. It shall not touch live parts.



NOTE All dimensions are in millimetres.

Figure 3 — Test pin

9.2 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 voltage not exceeding 24 V.

9.3 Shafts of operating knobs, handles, levers, etc. shall not be live.

9.4 Handles, levers and knobs that are held or actuated in normal use shall not become live in the event of an insulation fault.

Except as provided for in the note, 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, either they shall be covered adequately by insulating material, or their accessible parts shall be separated from their shafts or fixings by supplementary insulation.

NOTE 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 they are separated from live parts by earthed metal.

TEST. Compliance shall be checked by inspection and, if necessary, by the tests specified for supplementary insulation (see clause **15**).

9.5 For class II parts, capacitors shall not be connected to accessible metal parts, and their casings, if of metal, shall be separated from accessible metal parts by supplementary insulation.

TEST. Compliance shall be checked by inspection and by the tests specified for supplementary insulation (see clause **15**).

9.6 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 10 times.

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

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.

The voltage between the pins of the plug is measured 1 s after disconnection with an instrument that 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.

10 Starting of motors

10.1 Motors shall start under all normal voltage conditions that may occur in use.

Centrifugal and other automatic starting switches shall operate reliably and without contact chattering.

TEST. Compliance shall be checked by starting the appliance motor three times at a voltage equal to 0.85 times rated voltage or 0.85 times the lower voltage of the rated voltage range, whichever is applicable, the appliance motor being at room temperature at the beginning of the test.

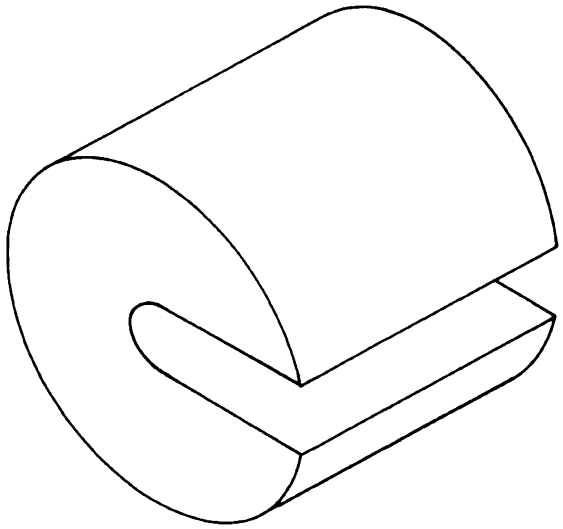
When testing a motor for a rotating spit or similar accessory, a weight as shown in Figure 4, having a mass of 4.5 kg, is attached to the rotating part.

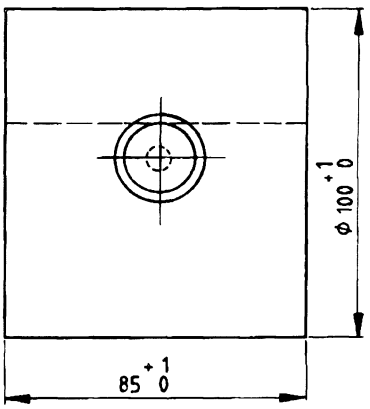
Any motor shall be started each time under the conditions occurring at the beginning of normal operation or, for automatic appliances, at the beginning of the normal cycle of operation, the motor being allowed to come to rest between successive starts.

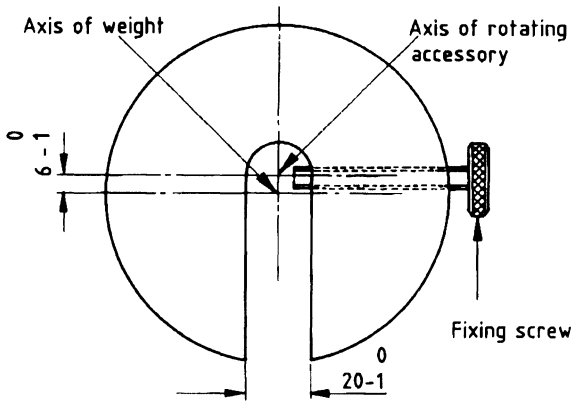
For appliances provided with motors having other than centrifugal starting switches, this test shall be repeated at a voltage equal to 1.06 times rated voltage.

In all cases, the appliance shall function in such a way that safety is not affected.

NOTE The supply source is such that, during the test, the drop in voltage does not exceed 1 %.







NOTE All dimensions are in millimetres.

Figure 4 — Load for rotating accessory

10.2 The starting current shall not blow:

a) a quick-acting fuse in the supply wiring having a value as marked on the appliance in accordance with **7.1** e); and/or

b) any fuse inside the appliance.

TEST. Compliance shall be checked by the following test.

The appliance is started 10 times at a voltage equal to 0.9 times rated voltage or at the lower limit of the rated voltage range and 10 times at a voltage equal to 1.1 times rated voltage or 1.1 times the upper limit of the rated voltage range, whichever is applicable. The interval between consecutive starts is made sufficiently long to prevent undue heating and it is not less than 5 min.

During the test, fuses shall not blow and neither shall any overload protection device operate.

NOTE The supply source is such that, during the test, the drop in voltage does not exceed 1 %.

11 Input and current

If an appliance is marked with rated current, the current taken by the appliance shall not exceed the rated current by more than 10 %.

TEST. Compliance shall be checked by measuring the current taken by the appliance operating under normal load, rated voltage and rated frequency.

12 Temperature limits

12.1 Except as given in **12.2**, the temperature rise of electrical components shall not exceed those given in Table 1 when the appliance is operated in the hot condition.

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

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 **27.1**.

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

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

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

TEST. The value of the temperature rise, Δt (in K), of a copper winding shall be calculated from the following equation:

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

where

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.

NOTE 3 It is recommended that the resistance of the 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 thereafter so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

12.2 The temperature rise limits given in Table 1 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, and carried out in accordance with clause **14** of BS 3955:1986. Other materials not listed in Table 1 may be used if they meet these conditions.

13 Leakage current and dielectric strength at operating temperature

13.1 Immediately after the tests specified in clause **12** and with the appliance operating in the hot condition and connected to a supply voltage of 254 V, the leakage current and dielectric strength shall comply with a) and b) respectively.

a) When tested in accordance with **13.2** the leakage current shall not exceed 0.25 mA for any class II parts, 3.5 mA for other parts operating at mains voltage, and 0.5 mA for parts operating at safety extra-low voltage.

b) When the electrical insulation of the appliance is tested in accordance with **13.3**, no flashover or breakdown of insulation shall occur.

13.2 TEST. The leakage current shall be measured between:

a) any pole of the supply; and

b) accessible metal parts and metal foil, connected together, the metal foil having an area not exceeding 200 mm × 100 mm and being in contact with accessible surfaces of insulating material.

The measuring circuit shall be as shown in Figure 5 for any class II parts and Figure 6 for other parts.

The resistance of the measuring circuit shall be 2 000 ± 100 Ω, and if it is suspected that high-frequency currents are being generated in an appliance incorporating a motor, the measuring instrument shall have an accuracy of at least 5 % for all frequencies within the range 20 Hz to 5 000 Hz, but it shall be insensitive to higher frequencies.

The test shall be carried out with a.c. and the leakage current shall be measured with the selector switch, shown in Figure 5 and Figure 6, in each of the positions 1 and 2.

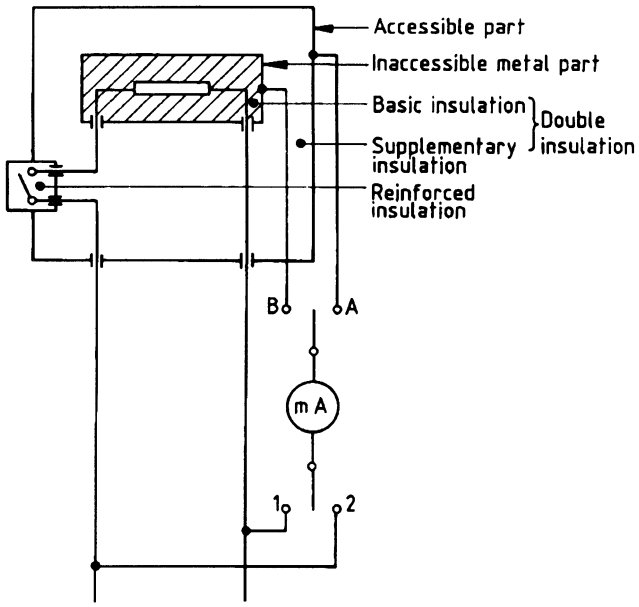


Figure 5 — Diagram for leakage current measurement at operating temperature for class II parts

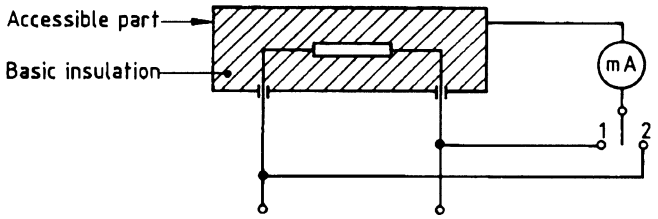


Figure 6 — Diagram for leakage current measurement at operating temperature

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 The cut-off frequency of 5 000 Hz may, for example, be obtained by connecting a capacitor of 150 ± 7.5 nF in parallel with the resistive components of the measuring circuit. The measuring circuit may be partly or completely incorporated in the measuring instrument. If an instrument of the rectifier type is used, it should rectify linearly from 0.2 mA upwards within the frequency range of 20 Hz to 10 000 Hz, and should be calibrated in r.m.s. values with a current of substantially sine-wave form. If high-frequency voltages are not present, the cut-off frequency of the measuring instrument may exceed 5 000 Hz.

NOTE 2 It is recommended that the appliance be supplied through an isolating transformer; otherwise, it should be insulated from earth.

NOTE 3 The metal foil should have 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 should be moved so as to test all parts of the surface. However, it is essential that the heat dissipation of the appliance be not affected by the metal foil.

NOTE 4 The test with the switch in the "off" position is carried out to verify that capacitors connected behind a single-pole switch do not cause excessive leakage current.

NOTE 5 If the appliance incorporates a thermal control which operates during the test of clause **12**, the leakage current is measured immediately before the control opens the circuit.

13.3 The insulation other than that of motors is subjected for 1 min to a voltage of substantially sinusoidal waveform, having a frequency of 50 Hz and the connections shall be as shown in Figure 7.

The test voltage is applied between live parts and the body. For class II parts, having intermediate metal between live parts and accessible parts, the voltage is applied across the basic insulation and the supplementary insulation.

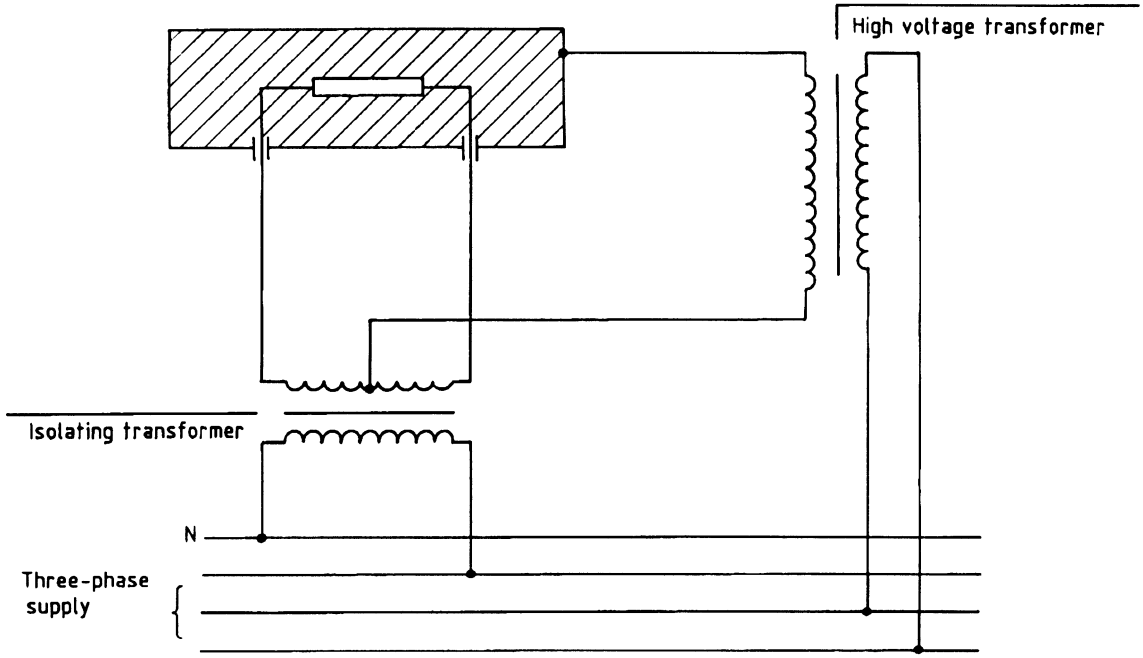


Figure 7 — Diagram for electric strength test at operating temperature

The value of the test voltage is as follows:

a) for basic insulation subjected in normal use to a safety extra-low voltage: 500 V;

b) for other basic insulation: 1 000 V;

c) for supplementary insulation: 2 750 V;

d) for reinforced insulation: 3 750 V.

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

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 2 000 Ω, connected across the output winding of the isolating transformer.

14 Moisture resistance

14.1 General

14.1.1 *General test conditions*

Before testing, 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.

14.1.2 *Ordinary appliance*

Ordinary appliances shall be subjected to the humidity test specified in **14.4** for 48 h and, at the end of this period, the appliance shall comply with clause **15**.

14.1.3 *Drip-proof appliance*

An appliance designated as drip-proof shall be subjected to the vertical rain test specified in **14.2.2** for 5 min, after which it shall comply with **15.3**. Furthermore, there shall be no trace of water on insulation for which creepage distances are specified in **27.1**.

Following this test, the appliance shall be subjected to the humidity test specified in **14.4** for 168 h, followed immediately by the tests of clause **15**.

14.1.4 *Splash-proof appliance*

An appliance designated as splash-proof shall be subjected to the vertical rain test specified in **14.2.2** for 5 min and then to the oblique rain test specified in **14.2.3** for 10 min followed by the splash test specified in **14.2.4** for 5 min. Immediately after this test it shall withstand the electric strength test specified in **15.3** and, furthermore, there shall be no trace of water on insulation for which creepage distances are specified in **27.1**.

Following this test, the appliance shall be subjected to the humidity test specified in **14.4** for 168 h, followed immediately by the tests of clause **15**.

14.1.5 *Cooker hobs*

Except as provided for in the note to **14.3**, cooker hobs shall be subjected to the spillage test specified in **14.3** followed immediately by the electric strength test specified in **15.3** and, furthermore, there shall be no trace of water on insulation for which creepage distances are specified in **27.1**.

Following this test, the appliance shall be subjected to the humidity test specified in **14.4** for 168 h, followed immediately by the tests of clause **15**.

14.2 Tests for drip-proof and splash-proof constructions

14.2.1 *Preparation*

Appliances provided with an appliance inlet shall be fitted with an appropriate connector and flexible cable or cord; 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 **24.2**; other appliances shall be tested as delivered (but see **14.1.1**).

14.2.2 *Vertical rain*

TEST. For the vertical rain test, apparatus similar to that shown in Figure 8, which delivers rain at a rate of 3 mm/min uniformly distributed over the sample, shall be used.

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

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 the normal position of use, so that the nozzles of the rain apparatus are 2 m above the uppermost point of the appliance.

14.2.3 *Oblique rain*

TEST. For the oblique rain test, the spray apparatus shown in Figure 9 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 × 120°) being about 4 s.

Appliances normally affixed 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.

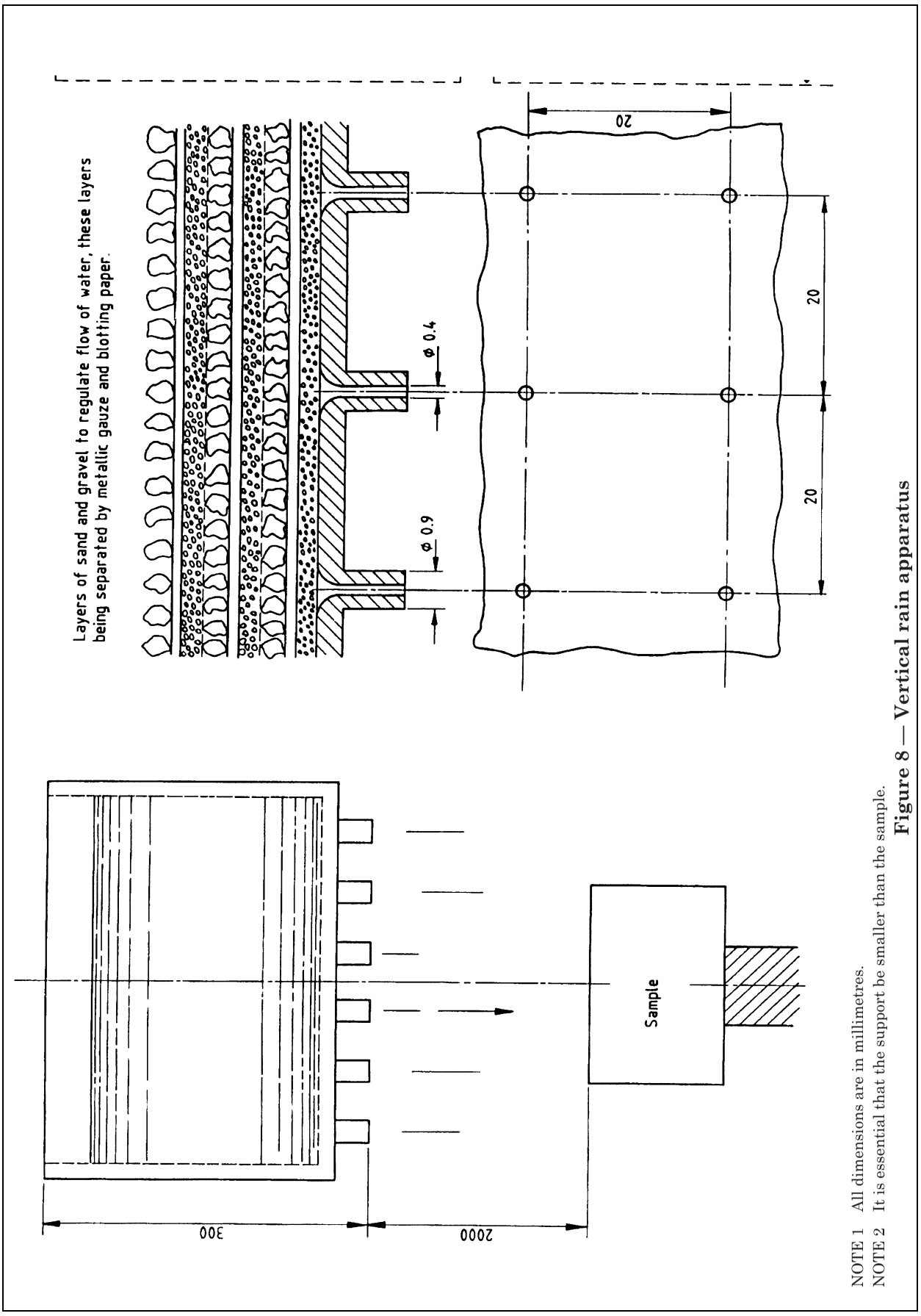
Other appliances shall be placed on a support having dimensions that are at least 50 mm in excess of those of the orthogonal projection of the appliance on the support.

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.

14.2.4 *Splash*

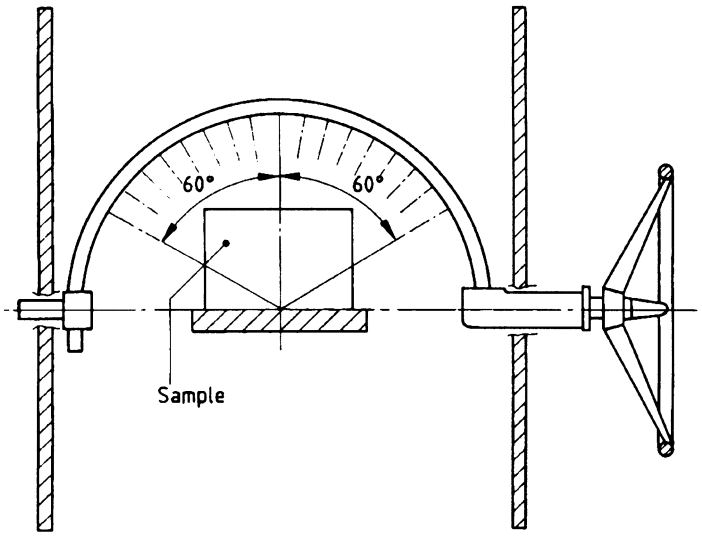
TEST. For the splash test, the apparatus shown in Figure 10 shall be used. During this test the water pressure shall be regulated so that the water splashes up to 150 mm above the bottom of the bowl. The bowl shall be placed on the floor for appliances normally used on the floor and, for all other appliances, 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 should be taken to ensure that the appliance is not hit by the direct jet.

Appliances normally used on a working surface other than the floor shall be placed on a supporting surface that has dimensions equal to the surface of the appliance in contact with the support.



NOTE 1 All dimensions are in millimetres.
NOTE 2 It is essential that the support be smaller than the sample.

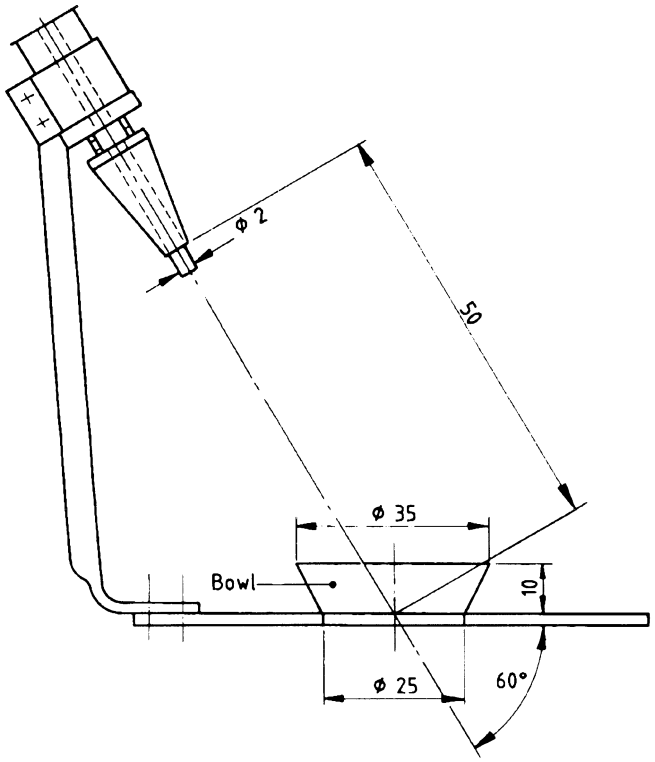
Figure 8 — Vertical rain apparatus



NOTE 1 The inside diameter of the tube is to be 15 mm.

NOTE 2 Holes 0.4 mm in diameter are to be located at 50 mm centres through the wall on the inside of the bend of the tube, over an arc subtending an angle of 60° on each side of the vertical.

Figure 9 — Spray apparatus



NOTE All linear dimensions are in millimetres.

Figure 10 — Splash apparatus

14.3 Spillage

TEST. With the appliance cold, a 220 mm diameter pan, complying with pan designation 22 given in Table 20 of BS 5386-3:1980, shall be placed centrally on the pan support above the burner under test. The pan shall be completely filled with cold water. A further quantity of 300 mL of water shall be poured in steadily over a period of 15 s.

The test is made on each burner separately, the spillage container being emptied and dried each time.

NOTE If it is evident by inspection that electrical components cannot be affected by this test, the test may be omitted.

14.4 Humidity

TEST. The appliance shall be allowed to stand in normal test-room atmosphere for 24 h after the tests of **14.2** and **14.3**, as applicable, before being subjected to the humidity test.

The humidity chamber is maintained at 93 ± 2 % r.h. and with an air temperature maintained within 1 °C (1 K) of any convenient temperature t_a between 20 °C and 30 °C.

The appliance temperature is raised to a temperature of between t_a °C and (t_a + 4) °C before being subjected to the humidity treatment.

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.

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

NOTE 2 93 ± 2 % r.h. can be obtained by placing in the humidity chamber a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water, the solution having a sufficiently large contact surface with the air.
NOTE 3 In order to achieve the specified conditions within the chamber, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

15 Insulation resistance and electric strength

15.1 General

The insulation resistance and electric strength of appliances shall be checked by the tests specified in **15.2** and **15.3**.

TEST. The tests shall be made on the cold appliance, not connected to the supply, immediately after the test specified in **14.4**, in the humidity cabinet or in the room in which the sample was brought to the temperature specified in **14.4**, after reassembly of those parts that may have been removed.

15.2 Insulation resistance

TEST. The insulation resistance shall be measured approximately 1 min after a d.c. voltage of 500 V is applied.

The insulation resistance between live parts and the body of the appliance shall be not less than 2 MΩ for basic insulation and not less than 7 MΩ for reinforced insulation.

15.3 Electric strength

TEST. Immediately after the test specified in **15.2**, no flashover or breakdown shall occur when the insulation is 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 shall be as given in Table 2 subject to the following conditions.

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

b) 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.

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

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

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 When testing insulating coatings, the metal foil may be pressed against the insulation by means of a sandbag of such size that the pressure is about 5 kN/m^2 (5 kPa). 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 3 If practicable, insulating linings should be tested separately.

Table 2 — Test voltages for electric strength test (see **15.3**)

Points of application of test voltages	Test voltage (see note)
	V
Between live parts and parts of the body that are separated from live parts by:	
basic insulation only	1 250
reinforced insulation or double insulation	3 750
Between live parts of different polarity	1 250
Between class III parts of different polarity (but see **20.9**)	500
For parts with double insulation, between metal parts separated from live parts by basic insulation only, and:	
live parts	1 250
the body	2 500
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 **27.1**	1 250 (2 500)
Between metal foil in contact with handles, knobs, grips, etc., and their shafts, if these shafts can become live in the event of an insulation fault	2 500
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, etc.	1 250 (2 500)
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	$2U + 1\,000$

NOTE The figures in parentheses apply to class II parts.

16 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 or, if applicable, at the upper or lower limit of the rated voltage range, whichever is the more unfavourable.

The temperature of insulation of the conductors of safety extra-low voltage circuits shall be determined and it shall not exceed the relevant value given in Table 1 by more than 15 K. The winding temperature of transformers shall not exceed the value given for windings in Table 3.

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

NOTE 2 A failure of basic insulation is not 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 incorporated in the transformer or located inside the appliance, if these devices are accessible only with the aid of a tool.

Table 3 — Limiting temperatures of windings

Type of protection	Insulation material				
	Class A	Class E	Class B	Class F	Class H
	Limiting temperature				
	°C	°C	°C	°C	°C
Impedance protected	150	165	175	190	210
A device that operates during the first hour	200	215	225	240	260
A device that operates after the first hour:					
maximum value	175	190	200	215	235
arithmetic average of 10 min readings	150	165	175	190	210

17 Motors

17.1 Appliances incorporating motors shall be so designed that the risk of fire and mechanical damage impairing safety or protection against electric shock as a result of normal or abnormal operation be obviated.

Compliance shall be checked by the tests specified in **17.2** and **17.3** and by the additional requirements of **17.4**.

If an appliance has more than one motor, the tests shall be carried out for each motor separately.

17.2 During the following test, the temperature rise of the motor windings, above room ambient temperature, shall not exceed the value specified in Table 1.

TEST. With the appliance operating in the hot condition and the supply voltage adjusted to 0.94 times rated voltage or 0.94 times the lower limit of the voltage range, as applicable, record the temperature rise of the motor windings using the electrical resistance method specified in clause **12**. Repeat the test at 1.06 times rated voltage or 1.06 times the upper limit of the voltage range, as applicable.

17.3 During the following test, the temperature of the motor windings shall not exceed the limits specified in Table 3.

TEST. Immediately after the test specified in **17.2**, reduce the supply voltage to 240 V and lock the rotor.

Where capacitors are fitted in the circuit of an auxiliary winding, they shall be short-circuited or open-circuited one at a time, whichever is the more unfavourable.

If the control system normally disconnects the electrical supply to the motor under locked rotor conditions, switch off the motor before taking measurements. Safety controls such as air flow proving devices are allowed to operate normally.

Record the temperature rise of the windings even 60 s for the first 10 min and thereafter every 10 min until a maximum is reached or until any thermal or overload trip operates.

17.4 During the tests specified in **17.2** and **17.3**, the motor shall not emit flames or molten metal or poisonous or ignitable gas in hazardous amounts; enclosures shall not deform to such an extent that they will impair compliance with this British Standard, and the temperature rise shall not exceed the values given in Table 4.

Table 4 — Maximum temperature rises during motor tests

Part	Maximum temperature rise
	°C
Insulation of the supply cable or cord	150
Supplementary insulation and reinforced insulation, other than those of thermoplastics materials	1.5 times the relevant value specified in **12.1**

After the tests, the insulation of appliances when cooled down to approximately room temperature, shall withstand an electric strength test as specified in **15.3**, the test voltage being as follows:

a) 1 000 V for basic insulation;

b) 2 750 V for supplementary insulation;

c) 3 750 V for reinforced insulation.

For supplementary insulation and reinforced insulation of thermoplastics material, the test specified in **28.1** shall be carried out at the maximum temperatures measured during the tests.

NOTE The humidity treatment specified in **14.4** is not applied before the electric strength test.

18 Stability and mechanical hazards

It shall not be possible to touch dangerous moving parts with a test finger similar to the test finger shown in Figure 1 but having a circular stop plate with a diameter of 50 mm instead of the non-circular plate.

Protective enclosures, guards, etc. shall have adequate mechanical strength. They shall not be removable without the aid of a tool.

For appliances provided with movable devices, such as those intended for varying the tension of belts, the test with the test finger shall be made with these devices adjusted to the most unfavourable position within their range of adjustment; if necessary, belts shall be removed.

19 Mechanical strength

19.1 When the appliance is subjected to the following test, the electrical safety shall not be impaired and, in particular, live parts shall not have become exposed so as to impair compliance with **9.1**, **14.1.3** and **14.1.4** or distorted such that the requirements of **27.1** are not met. Where supplementary insulation or reinforced insulation is suspect, it is checked using the electric strength test specified in**15.3**.

TEST. A spring-operated impact test apparatus made to the requirements of BS 7003:1988 and calibrated to deliver an energy of 0.5 ± 0.05 N · m is used to apply blows to the appliance.

The appliance is rigidly supported and three blows are applied to any accessible part that might cause impairment of the electrical safety of the appliance.

If necessary, the blows shall also be applied to handles, levers, knobs, etc., and to signal lamps and their covers but only if the lamps or covers protrude from the enclosure by more than 10 mm or if their surface area exceeds 400 mm^2. Lamps within the appliance, and their covers, shall be tested only if they are likely to be damaged in normal use.

If there is a doubt as to whether a defect has been caused by the application of preceding blows, this defect shall be ignored and the group of three blows which led to the defect shall be applied to the same place on a new sample, which shall then withstand the test.

NOTE 1 Damage to the finish, small dents that do not reduce creepage distances and clearances below the values specified in **27.1** and small chips that do not adversely affect the protection against electric shock or moisture can be ignored.

NOTE 2 Cracks not visible to the naked eye and surface cracks in fibre-reinforced mouldings, etc. can be ignored.

NOTE 3 If a decorative cover is backed by an inner cover, fracture of the decorative cover can be ignored if the inner cover withstands the test after removal of the decorative cover.

19.2 Screwed glands and shoulders in conduit entries shall be checked by test 1 for screwed glands and by test 2 for shoulders in entries for conduit sizes 16 and 19.

After the tests, glands, enclosures and conduit entries shall show no significant deformation or damage.

NOTE For shoulders in entries for conduit sizes over 19, a method of test is under consideration.

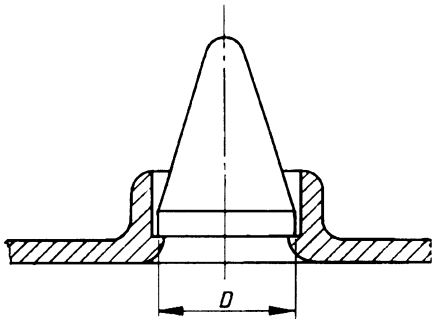
TEST 1. The screwed gland shall be fitted with a cylindrical metal rod having diameter, in millimetres, equal to the nearest whole number below the internal diameter, in millimetres, of the packing. The gland shall then be tightened by means of a suitable spanner, the force shown in Table 5 being applied to the spanner for 1 min, at a point 250 mm from the axis of the gland.

Table 5 — Test force for screwed glands

Diameter of test rod	Force	
	Metal glands	Glands of moulded material
mm	N	N
≤ 20	30	20
> 20	40	30

TEST 2. The appliance shall be rigidly supported so that the axis of the conduit entry is vertical.

The test device shown in Figure 11 shall be placed on the shoulder in the manner shown in Figure 11, and a mass of 250 g allowed to fall 10 times from a height of 150 mm onto the test device.



Size of conduit	Diameter, *D*	Tolerance
	mm	mm
16	15.7	+0.2 –0
19	18.7	+0.2 –0

Figure 11 — Device for testing shoulders in conduit entries

20 Construction

20.1 Appliances shall be class I with respect to protection against electric shock but may incorporate class II or class III parts.

20.2 Appliances shall have the appropriate degree of protection against moisture (see clause **14**).

20.3 Any normal or accidental operation of a control shall not result in a hazard.

TEST. Compliance shall be checked by a manual test.

20.4 Reset buttons of manual reset controls shall be so located or protected that their accidental resetting is unlikely to occur if resetting might result in a hazard.

20.5 It shall not be possible to remove, without the aid of a tool, parts that ensure the required degree of protection against moisture.

TEST. Compliance shall be checked by a manual test.

20.6 Components shall be located or protected in such a way that they are unaffected by condensation or possible leakage of water from joints and gaskets, etc.

20.7 The electrical integrity of the appliance shall not be affected by any of the gas safety or performance tests. In particular, insulation shall not be damaged and contacts and connections shall not have worked loose.

20.8 Overload devices shall not operate under normal running conditions.

20.9 Handles, knobs, grips, levers, etc. shall be fixed in a reliable manner so that they will not work loose in normal use, if loosening might result in an electrical hazard (see **9.4**). In particular, sealing compounds, etc., other than self-hardening resins, shall not be used as the sole means against loosening in such circumstances.

If handles, knobs, etc. are used to indicate the position of switches or similar components, it shall not be possible to fix them in a wrong position if this might result in a hazard.

TEST. Compliance shall be checked by inspection, by a manual test and by trying to remove the handle, knob, grip or lever by applying, for 1 min, an axial force. If the shape of these parts is such that an axial pull is unlikely to be applied in normal use, the force shall be as follows:

a) 15 N for actuating members of electrical components;

b) 20 N in other cases.

If the shape is such that an axial pull is likely to be applied, the force shall be as follows:

1) 30 N for actuating members of electrical components;

2) 50 N in other cases.

20.10 Unless impregnated, wood, cotton, silk, ordinary paper and similar fibrous or hygroscopic material shall not be used as insulation.

NOTE Insulating material is considered to be impregnated if the interstices between the fibres of the material are substantially filled with suitable insulant.

20.11 Appliances having parts where reliance is placed upon safety extra-low voltage to provide the necessary degree of protection against electric shock shall be so designed that the insulation between parts operating at safety extra-low voltage and other live parts complies with the requirements for double insulation or reinforced insulation (see clause **15**).

TEST. Compliance shall be checked by the tests specified for double insulation and reinforced insulation.

20.12 Reinforced insulation shall be used only when it is manifestly impractical to provide separate basic insulation and supplementary insulation.

NOTE Appliance inlets and switches are examples where reinforced insulation may be used.

20.13 Inside an appliance, the sheath of a flexible cable or cord shall be used as supplementary insulation only where:

a) it is not subject to undue mechanical or thermal stresses; and

b) its insulating properties are not less than those specified in BS 6500 or BS 6141, as appropriate, for the sheaths of flexible cables and cords.

TEST. Compliance shall be checked by inspection and, if necessary, by testing the sheaths of the flexible cables and cords as described in BS 6500 or BS 6141 as appropriate.

20.14 Supplementary insulation and reinforced insulation shall be so designed or protected that they are not likely to be impaired by deposition of dirt, or by dust resulting from wear of parts within the appliance, to such an extent that creepage distances or clearances are reduced below the values specified in **27.1**.

TEST. Compliance shall be checked by inspection, by measurement and, for rubber, by the following test.

Parts of rubber shah be aged in an atmosphere of oxygen under pressure. The samples shall be suspended freely in an oxygen bomb, the effective capacity of the bomb being at least 10 times the volume of the samples.

WARNING NOTE. The use of the oxygen bomb presents some danger unless handled with care. All precautions should be taken to avoid the risk of explosion as a result of sudden oxidation.

The bomb shall be filled with commercial oxygen not less than 97 % pure, to a pressure of 2.1 ± 0.07 MN/m^2 (2.1 ± 0.07 MPa).

The samples shall be kept in the bomb at a temperature of 70 ± 1 °C, for 96 h. Immediately afterwards, they shall be taken out of the bomb and left at room temperature, avoiding direct daylight, for at least 16 h.

After the test, the samples shall be examined and they shall show no crack visible to the naked eye.

20.15 Direct contact between bare live parts and thermal insulation shall be effectively prevented, unless such material is non-corrosive, non-hygroscopic and non-combustible.

TEST. Compliance shall be checked by inspection and by the tests specified in clauses **14** and **15** and, if necessary, by chemical tests or flammability tests.

NOTE 1 Glass-wool is an example of thermal insulation which is satisfactory for the purposes of the requirement specified in **20.15**.

NOTE 2 Non-impregnated slag-wool is an example of corrosive thermal insulation.

20.16 Current-carrying parts and other metal parts, the corrosion of which might result in a hazard, shall be resistant to corrosion under normal conditions of use.

TEST. Compliance shall be checked by verifying that, after the tests of clause **12** and, as applicable, the tests of clauses **14** and **17**, have been carried out, the relevant parts show no signs of corrosion.

NOTE 1 It is essential that attention be paid to the compatibility of the materials of terminals and terminations and to the effect of heating.

NOTE 2 Stainless steel and similar corrosion-resistant alloys and plated steel are considered to be satisfactory for the purposes of the requirement specified in **20.16**.

20.17 For appliances having compartments to which access can be gained without the aid of a tool and which are likely to be cleaned in normal use, the electrical connections shall be so arranged that they are not subject to pulling during user maintenance.

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

20.18 It shall not be possible to gain access, without the aid of a tool, to motor or slip ring brushes while they are live.

Screw-type brush-caps shall screw home against a shoulder or similar abutment and they shall engage by a minimum of three full threads.

Brush-holders that retain the brush in position by means of a locking device shall be so designed that the locking does not depend on the brush-spring tension, if loosening of the locking device might make accessible metal parts live.

Screw-type brush-caps that are accessible from the outside of the appliance shall be of insulating material or shall be covered with insulating material of adequate mechanical and electrical strength; they shall not project beyond the surrounding surface of the appliance.

TEST. Compliance shall be checked by inspection, by a manual test and, for screw-type brush-caps that are accessible from the outside of the appliance, by the test specified in **19.1**.

20.19 Class II parts shall be separated from live parts by double insulation or reinforced insulation.

20.20 Class II parts shall be designed such that parts that serve as supplementary insulation or reinforced insulation and which might be omitted during reassembly after servicing be in accordance with either of the following.

a) The parts shall be fixed in such a way that they cannot be removed without being seriously damaged. Insulation formed by lining metal enclosures with a coating of lacquer or with other material in the form of a coating that can be easily removed by scraping shall not be used for this purpose.

b) The parts shall be so designed that they cannot be replaced in an incorrect position and that, if they are omitted, the appliance be rendered inoperable or manifestly incomplete.

NOTE Sleeving may, however, be used as supplementary insulation on internal wiring if it is retained in position by positive means.

TEST. Compliance is checked by inspection and by a manual test.

20.21 Class II parts shall be so designed that creepage distances and clearances over supplementary insulation or reinforced insulation cannot, as a result of wear, be reduced below the values specified in **27.1**. They shall be so constructed that should any wire, screw, nut, washer, spring or similar part become loose or fall out of position, this part cannot, in normal use, become so disposed that creepage distances or clearances over supplementary insulation or reinforced insulation are reduced to less than 50 % of the value specified in **27.1**.

TEST. Compliance shall be checked by inspection, by measurement and by a manual test.

For the purposes of assessing compliance with the requirement specified in **20.21**, the following conditions shall apply.

a) It is not to be expected that two independent fixings will become loose at the same time.

b) Parts fixed by means of screws or nuts provided with locking washers are regarded as not being liable to become loose, provided these screws or nuts are not required to be removed during replacement of the power supply cord or other routine servicing.

c) Brush-caps complying with **20.18** are regarded as not being liable to become loose.

d) Wires connected by soldering are not considered to be adequately fixed unless they are held in place near to the termination, independently of the solder.

e) Wires connected to terminals are not considered to be adequately secured unless an additional fixing is provided near to the terminal so that, in the case of stranded conductors, this fixing clamps both the insulation and the conductor.

f) Short rigid wires are regarded as not being liable to come away from a terminal if they remain in position when the terminal screw is loosened.

20.22 Class II parts shall be so designed that metal parts conductively connected to the gas supply pipe or to the water supply mains (either through water or metal) shall be separated from live parts by double insulation or reinforced insulation.

20.23 Where aluminium foil is used, e.g. as a thermal insulator, it shall not be considered as being reliably earthed even though the tests for earthing reliability may be met. It shall, therefore, be either:

a) inaccessible using the test finger shown in Figure 1; or

b) separated from live parts by double insulation, or reinforced insulation or by earthed metal.

21 Internal wiring

21.1 Wireways shall be smooth and free from sharp edges.

Wires shall be so protected that they do not come into contact with burrs, cooling fins, etc. that may cause damage to their insulation.

Holes in metal through which insulated wires pass shall have smooth, well rounded surfaces or shall be provided with bushings.

Wiring shall be prevented effectively from coming into contact with moving parts.

NOTE In general a surface is considered to be well rounded if its curvature has a radius of at least 1.5 mm.

21.2 Internal wiring and electrical connections between different parts of the appliance shall be fitted such that it is not likely to be damaged during use.

21.3 Beads and similar ceramic insulators on live wires shall be so fixed or supported that they cannot change their position; they shall not rest on sharp edges or sharp corners. If beads are inside flexible metal conduits, they shall be contained within an insulating sleeve, unless the conduit cannot move in normal use.

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

21.4 Wiring between different parts of an appliance that can move relative to each other and their electrical connections in normal use or during user servicing, including those providing earthing continuity, shall not be exposed to undue stress. If flexible metallic tubes are used for the protection of conductors between these parts, such tubes shall not cause damage to the insulation of conductors contained therein.

Open-coil springs shall not be used to protect conductors. If a coiled spring, the turns of which touch one another, is used for this purpose, an adequate insulating lining shall be provided in addition to the insulation of the conductors.

TEST. Compliance shall be checked by inspection and by the following test.

If flexing occurs during normal use, the appliance shall be placed in the normal position of use and operated at rated voltage or at the upper limit of the rated voltage range, whichever is applicable, with the appliance operated at thermal equilibrium at rated heat input.

The movable part shall be moved backwards and forwards, so that the conductor is flexed through the largest angle permitted by the design. The number of flexings for conductors flexed in normal use shall be 10 000 and the rate of flexing shall be not greater than 30 flexings/min.

After the test, there shall be no visible damage that could affect the safety of the appliance. In addition, the wiring and its connections shall withstand an electric strength test as specified in **15.3**, the test voltage being, however, reduced to 1 000 V and applied between live parts and other metal parts only.

NOTE 1 A flexing is one movement, either backwards or forwards.

NOTE 2 The sheath of a flexible cable or cord complying with BS 6500 or BS 6141 is regarded as an adequate insulating lining.

21.5 Internal wiring shall be either so rigid and so fixed or so insulated that, in normal use, creepage distances and clearances cannot be reduced below the values specified in **27.1**.

The insulation, if any, shall be such that it cannot be damaged in normal use.

TEST. Compliance shall be checked by inspection, by measurement and by a manual test.

For the purposes of **27.1**, if the insulation of a conductor is not at least electrically equivalent to that of cables or flexible cords complying with BS 6500 or BS 6141, that conductor shall be considered to be a bare conductor. In case of doubt, internal conductors shall be considered to be bare conductors unless their insulation withstands an electric strength test carried out between the conductor and metal foil wrapped around the insulation, a test voltage of 2 000 V being applied for 15 min.

21.6 Conductors identified by the colour combination green/yellow shall not be connected to terminals other than earthing terminals.

21.7 Aluminium wires shall not be used for internal wiring.

NOTE Windings of a motor are not considered to be internal wiring.

22 Components

22.1 All components shall comply with the relevant British Standards where these exist.

NOTE 1 Whereas compliance with another British Standard does not exempt the component from the requirements of this British Standard, it will be taken into account during any assessment of the appliance.

If components are marked with their operating characteristics, the conditions under which they are used in the appliance shall be in accordance with these markings, unless a specific exception is made.

Motor capacitors and suppressors shall be marked with their rated voltage (in volts) and their rated capacitance (in microfarads).

Small lampholders similar to E10 lampholders shall comply with the requirements for E10 lampholders given in BS 6776:1986; they need not accept a lamp with an E10 cap complying with standard sheet 7004-22 of BS 5101-1:1975.

TEST. Where no British Standard specification exists for the relevant component or where the component is not marked, or is not used in accordance with its marking, the component shall be tested under the conditions occurring in the appliance, the number of samples being agreed between the manufacturer and the test authority.

For capacitors connected in series with a motor winding, it shall be verified that, when the appliance is operated at a voltage equal to 1.1 times the rated voltage or the upper limit of the rated voltage range, whichever is applicable, and under minimum load, the voltage across the capacitor does not exceed 1.1 times the rated voltage of the capacitor.

Switches not marked with individual ratings shall be tested under the conditions occurring in the appliance as follows:

a) with the appliance operating at rated heat input and maximum electrical power input, measure the currents and their corresponding power factors occurring in the switch during switching on and during operation;

b) the switch is then tested separately in accordance with BS 3955, the currents and power factors measured being used for the appropriate tests instead of the values declared by the switch manufacturer.

NOTE 2 Guidance on determining whether a control is of type 1 or type 2 as defined in BS 3955 is given in Appendix B.

22.2 Appliances shall not be fitted with any of the following:

a) switches in flexible cables or cords;

b) cut-out devices which are designed to apply deliberately a short circuit in an attempt to induce mains isolation;

NOTE The use of a shorting switch in series with a current limiting impedance to cause a fuse in the power supply circuit of the appliance to open is not interpreted as a short-circuit condition if the fuse is fitted in the appliance and its rating does not exceed 3 A.

c) thermal cut-outs designed to be reset by a soldering operation.

22.3 Plugs and socket-outlets for extra-low voltage circuits shall not be interchangeable with plugs and socket-outlets which are used for live connections on the appliance.

22.4 Plugs and socket-outlets and other connecting devices on flexible cables or cords used as an intermediate connection between different parts of an appliance shall not be interchangeable with plugs and socket-outlets complying with BS 546, BS 1363 and BS 4573 or with connectors and appliance inlets complying with the dimensional requirements of EN 60320 if direct supply of these parts from the mains could cause danger to persons or surroundings or damage to the appliance.

22.5 Lampholders shall be used only for the connection of lamps.

22.6 Capacitors shall not be connected between the terminals of a thermal cut-out.

22.7 Single pole switches and control devices shall be fitted in the line conductor with the following exceptions.

a) Where a single pole switching device is in series with a control device having an "off" position and it is technically undesirable to place them both in the line side of the circuit, the control device may be in the neutral side provided this does not prevent the control device from fulfilling the designed function under a fault condition.

b) Thermal cut-outs may be fitted in the neutral conductor provided that there is a thermostat in the line conductor.

22.8 Transformers used for safety purposes shall be short-circuit proof safety isolating transformers.

Where short-circuit protection is provided by a fuse (see clause **14** of BS 3535-1:1990), this fuse shall be fitted in either the input winding circuit or the output winding circuit either on the transformer body or as close as practicable to the transformer when fitted in the appliance. The fuse shall be connected such that all current passing to the safety extra-low voltage circuit passes through the fuse.

TEST. Compliance shall be checked by subjecting the transformer to the relevant tests specified in BS 3535.

23 Supply connection and external flexible cables and cords

23.1 Appliances shall be provided with one of the following means of connection to the supply:

a) terminals for permanent connection to fixed wiring;

b) an appliance inlet (see **23.3**);

c) a power supply cord or suitable terminals to enable the installation of a supply cord.

Appliances shall not be provided with more than one means of connection to the supply. However, where it is necessary to provide a switched line in addition to a permanent line for control purposes, both switched and permanent lines can be connected to the appliance providing that the installation instructions and appliance wiring diagram include the following:

1) a statement that a single electrical isolator shall be provided for the complete installation from which the permanent line and any switched line to the appliance is taken;

2) a schematic wiring diagram of the installation indicating how both switched and permanent lines originate from the same single electrical isolator.

NOTE Diagrams showing an input labelled "switched line" or other wording without an illustration of the source of supply do not meet this requirement.

23.2 Appliances intended to be permanently connected to fixed wiring shall allow the connection of the supply wires after the appliance has been fixed to its support, and shall be provided with the following:

a) a set of terminals allowing the connection of cables for fixed wiring of the nominal cross-sectional areas specified in **24.2**;

b) cable entries, conduit entries, knock-outs or glands that allow the connection of the appropriate types of cable or conduit.

The entries shall be suitable for cables or conduits having a maximum overall diameter as shown in Table 6.

Table 6 — Size of cable and conduit entries

Number of conductors, including the earthing conductor	Maximum overall diameter	
	Cable[a]	Conduit[b]
	mm	mm
2	12.0	16.0
3	12.5	16.0
4	13.5	20.0
5	14.5	20.0

[a] The maximum overall diameter is as given in Table 3 of BS 6004:1984 for PVC-insulated, PVC-sheathed light cable with conductors of 2.5 mm^2 cross-sectional area.

[b] These sizes are consistent with those specified in BS 4568 and BS 4607.

Conduit entries, cable entries and knock-outs shall be so designed or located that the introduction of the conduit or cable does not affect protection against electric shock or reduce creepage distances and clearances below the values specified in **27.1**.

Appliances, other than those that are drip-proof or splash-proof and which are not intended to be permanently connected to fixed wiring, shall be provided with one of the following:

1) a power supply cord; or

2) manufacturer's detailed instructions stating the type of cord and method of connecting it to the appliance such that, after the cord has been fitted according to these instructions, it meets all the requirements for power supply cords as specified in this British Standard; or

3) an appliance inlet (plug and socket).

Drip-proof and splash-proof appliances shall not be provided with an appliance inlet; instead they shall be provided with a power supply cord or manufacturer's detailed instructions complying with item 2) above.

TEST. Compliance shall be checked by inspection, by measurement and by an installation test.

23.3 Appliance inlets shall be in accordance with the following.

a) They shall be so located or enclosed that live parts are not accessible during insertion or removal of the connector.

b) They shall be so placed that the connector can be inserted without difficulty.

c) They shall be so placed that, after insertion of the connector, the appliance is not supported by the connector for any position of normal use on a flat surface.

d) Appliance inlets shall not be located where they may contact surfaces having a temperature greater than their designed maximum temperature rating.

e) The socket shall be fitted with terminals suitable for type X attachment.

TEST. For appliance inlets other than those complying with BS 4491, compliance shall be checked by inspection and, for the requirement specified in item a) of **23.3**, by means of the test finger shown in Figure 1.

NOTE Appliances provided with appliance inlets complying with BS 4491 are considered to comply with **23.3**.

23.4 Power supply cords shall be assembled to the appliance by a type X attachment.

23.5 Supply plugs shall not be fitted with more than one flexible cable or cord.

23.6 Power supply cords shall have a construction not lighter than the following:

a) *if rubber insulated*: ordinary tough rubber-sheathed flexible cord (code designation HO5RR-F as given in Table 6 of BS 6500:1990), or ordinary polychloroprene-sheathed flexible cord (code designation HO5RN-F as given in Table 6 of BS 6500:1990);

b) *if polyvinyl chloride (PVC) insulated*: light PVC-sheathed flexible cord (code designation HO3VV-F as specified in Table 15 of BS 6500:1990).

PVC-insulated and sheathed flexible cables or cords shall not be used for appliances having external metal parts, the temperature of which exceeds a 75 K rise during the test specified in clause **12**, unless the design of the appliance is such that the power supply cord is not likely to touch such metal parts in normal use or the power supply cord is appropriate for higher temperatures.

Where a higher temperature cord is required, the appropriate temperature rating for the cord shall be marked on the appliance wiring diagram.

TEST. Compliance shall be checked by inspection, by measurement and by an installation test to determine which parts are likely to be touched by the cable or cord as follows.

Install the appliance in accordance with the manufacturer's instructions and place the free (plug) end of the supply cord in all possible locations in which the mains supply socket may be located.

The power supply cord shall be provided with a green/yellow core, which is connected to the internal earthing terminal of the appliance and to the earthing contact of the plug, if any.

NOTE Attention is drawn to Statutory Instrument No. 310:1969 which requires that, for class 1 appliances offered for sale in the UK, the colour of the core connected to the live terminal is to be brown and the colour of the core to the neutral terminal is to be blue.

Power supply cords shall not be exposed to sharp points within the appliance or cutting edges on the surface of the appliance.

Power supply cords not exceeding 2 m in length shall have a nominal cross-sectional area of at least 0.5 mm^2 for rated currents up to 3 A and in all other cases the cross-sectional area shall be at least 0.75 mm^2.

23.7 Inlet openings shall be so designed and shaped, or shall be provided with an inlet bushing or lining, such that the protective covering of the power supply cord can be introduced without risk of damage.

Inlet openings in metal for power supply cords shall be provided with either a lining or a bushing, both of insulating material, complying with the requirements for supplementary insulation (see clause **15**).

23.8 Inlet bushings or linings shall be in accordance with the following.

a) They shall be so shaped as to prevent damage to the power supply cord.

b) They shall be reliably fixed.

c) They shall not be removable without the aid of a tool.

d) They shall not be integral with the power supply cord.

e) The bushing or lining shall not be of natural rubber.

23.9 All appliances, except those provided with an appliance inlet and fixed appliances provided with only a threaded conduit entry for connections to fixed wiring, shall have cord anchorages such that the conductors are relieved from strain, including twisting, where they are connected to the terminal, and that their covering is protected from abrasion, unless the inlet is situated in such a position that stress cannot be applied to the connections when the equipment is mounted as in normal use.

Cord anchorages shall be so designed or located that they comply with the following:

a) installation or replacement of any cable or cord is easily possible;

b) it is clear how the relief from strain and the prevention of twisting are to be achieved;

c) they are suitable for the different types of cable or cord that may be connected, unless the appliance is so designed that only one type of cable or cord can be fitted in which case the manufacturer's instructions shall state the size of this cable;

d) the cable or cord cannot touch the clamping screws of the cord anchorage, if these screws are accessible or electrically connected to accessible metal parts;

e) the cord is not clamped by a metal screw that bears directly on the cord;

f) at least one part of the cord anchorage is securely fixed to the appliance;

g) screws, if any, that have to be operated when replacing the cable or cord, do not serve to fix any other component unless, when omitted or incorrectly mounted, they render the appliance inoperative or clearly incomplete or unless the parts intended to be fastened by them cannot be removed without the further aid of a tool during the replacement of the cable or cord;

h) they are of insulating material or are provided with an insulating lining, if otherwise an insulation fault on the cable or cord could make accessible metal parts live;

i) for class II parts, they are of insulating material or, if metal, they are insulated from accessible metal parts by insulation complying with the requirements for supplementary insulation (see clause **15**).

TEST. Compliance shall be checked by inspection and by the following test.

The appliance shall be fitted with a suitable power supply cord. The conductors shall be introduced into the terminals, the terminal screws, if any, being tightened just sufficiently to prevent the conductors from easily changing their position. The cord anchorage shall bc used in the normal way. Its clamping screws shall be tightened with a torque equal to two-thirds of that specified in **26.1**.

The tests shall be made first with a cable or cord of 0.5 mm^2 cross-sectional area (for rated currents up to 3 A (see **23.6**) and then with one of 0.75 mm^2 cross-sectional area, unless the appliance is so designed that only one type of cable or cord can be fitted in which case a cable or cord of that type is used.

If the cord anchorage comprises one or more clamping members intended to be pressed into position by one or more nuts engaging with studs that are securely attached to the appliance, the cord anchorage shall be considered to have one part securely fixed to the appliance, even if the clamping members can be removed from the studs.

If, however, the clamping member(s) are intended to be pressed into position by means of one or more screws engaging either with separate nuts or with a thread in a part that is integral with the appliance, the cord anchorage shall not be considered to have one part securely fixed to the appliance unless one of the clamping members itself is fixed to the appliance or the surface of the appliance is of insulating material and so shaped that it is obvious that this surface is one of the clamping members (see Figure 12).

It shall not be possible to push the cable or cord into the appliance to such an extent that the cable or cord or internal parts of the appliance could be damaged.

The cable or cord shall then be subjected 25 times to a pull of 100 N. The pulls shall be applied in the most unfavourable direction, without jerks, each time for 1 s.

Immediately afterwards, the cable or cord shall be subjected for 1 min to a torque of 0.35 N · m.

During the test, the cable or cord shall not be damaged.

After the test, the conductors shall not have moved over a distance of more than 1 mm in the terminals, nor shall there be appreciable strain at the connection. Creepage distances and clearances shall not be reduced below the values specified in **27.1**.

For the measurement of the longitudinal displacement, a mark shall be made on the cable or cord while it is subjected to the pull, at a distance of approximately 20 mm from the cord anchorage or other suitable point, before starting the test.

At the end of the test, the displacement of the mark on the cable or cord in relation to the cord anchorage or other point shall be measured while the cable or cord is subjected to the pull. The cable or cord shall not have been longitudinally displaced by more than 2 mm.

23.10 The space for the supply cables or the power supply cord provided inside, or as part of, the appliance shall be in accordance with the following.

a) It shall be so designed to permit checking, before fitting the covers, if any, that the conductors are correctly connected and positioned.

b) It shall be so designed that covers, if any, can be fitted without risk of damage to the supply conductors or to their insulation.

c) It shall be adequate to allow the conductors to be easily introduced and connected.

d) It shall be so designed that covers giving access to terminals for external conductors, if any, can be removed without the need for a special tool.

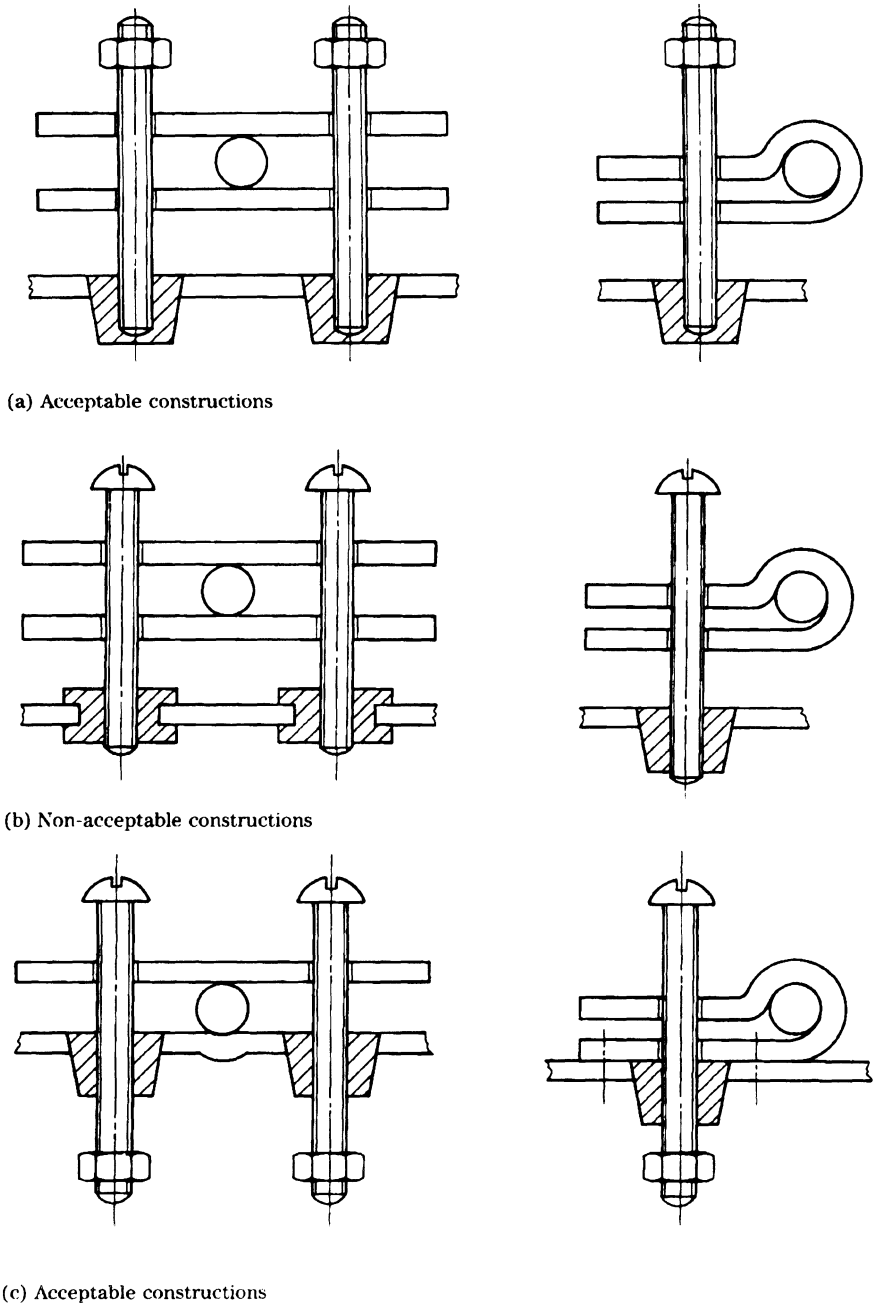
TEST. Compliance shall be checked by inspection and by an installation test with flexible cables of 0.5 mm^2 and cords of 2.5 mm^2 or, if the appliance is designed to accept some smaller maximum size, with that size of cable.

23.11 Detachable and non-detachable function and interconnection flexible cables or cords shall comply with the requirements for the supply cable or cord (see **23.10**), except for the following.

a) Appliance couplers and appliance inlet used for the function and interconnection flexible cables or cord shall not be interchangeable with the appliance couplers and appliance inlets used for the supply cable or cord, if this could cause a hazard.

b) The cross-sectional area of the conductors of the function and interconnection flexible cable or cord shall be determined on the basis of the maximum current carried by the conductor during the test specified in clause **12** and not by the rated current of the appliance.

c) The thickness of the insulation on the individual cores may be less than that specified for the supply cord, depending on the voltage of the circuit in which the particular conductor is used.



(a) Acceptable constructions

(b) Non-acceptable constructions

(c) Acceptable constructions

Figure 12 — Schematic representation of cord anchorages (see **23.9**)

TEST. Compliance shall be checked by inspection and, if necessary, by tests, such as the electric strength test specified in **15.3**.

NOTE A function and interconnection flexible cable or cord is considered to be a flexible cable or cord provided as part of a complete appliance for the purposes other than supply, i.e. for external controls or an exposed interconnection between two parts of the appliance.

23.12 Detachable flexible cables and cords used for the interconnection between different parts of the appliance shall not be provided with a means for connection such that accessible metal parts are live when the connection is removed by the disengagement of one of the connecting means.

TEST. Compliance shall be checked by inspection and, if necessary, by means of a test with the test finger shown in Figure 1.

24 Terminals for external conductors

24.1 Appliances shall be provided with terminals to which connections are made by means of screws, nuts or equally effective devices. Soldered connections shall not be used.

Screws and nuts that clamp external conductors shall have a metric thread complying with the relevant ISO or British Standard or a thread comparable in pitch and mechanical strength (see note 4). They shall not serve to fix any other component, except that they may also clamp internal conductors if these are so arranged that they are unlikely to be displaced when fitting the supply conductors.

NOTE 1 It is not to be expected that two independent fixings will become loose at the same time.

NOTE 2 Conductors connected to terminals or terminations by other means are not considered to be adequately fixed unless an additional fixing is provided near the terminal or termination; this additional fixing, in the case of stranded conductors, clamps both the insulation and the conductor.

NOTE 3 Provided that the terminals of a component, e.g. a switch, built into the appliance comply with the requirements of this clause they may be used as terminals intended for external conductors.

NOTE 4 SI, BA and Unified threads are deemed to be comparable in pitch and mechanical strength to metric ISO threads.

24.2 Terminals shall allow the connection of conductors having nominal cross-sectional areas of 0.5 mm^2 to 1.0 mm^2 for flexible cables and cords and 1 mm^2 to 2.5 mm^2 for fixing wiring or, if the appliance is designed to accept some smaller maximum size, with that size of cable or cord.

TEST for **24.1** and **24.2**. Compliance with **24.1** and **24.2** shall be checked by inspection, by measurement and by fixing cables or cords of the smallest and largest cross-sectional areas specified.

24.3 Terminals shall be so fixed that, when the conductor clamping means is tightened or loosened, the terminal does not work loose, internal wiring is not subjected to stress and creepage distances, and clearances are not reduced below the values specified in **27.1**.

NOTE Terminals may be prevented from working loose by fixing with two screws, by fixing with one screw in a recess such that there is no appreciable play, or by other suitable means.

TEST. Compliance shall be checked by inspection and by measurement, after fastening and loosening 10 times a conductor of the largest cross-sectional area specified in **24.2**, the torque applied being equal to two-thirds of the torque specified in **26.1**.

24.4 Terminals shall be so designed that they clamp the conductor between metal surfaces with sufficient contact pressure and without damage the conductor.

24.5 Terminals shall not require special preparation of the conductor in order to effect connection, and they shall be so designed or placed that the conductor cannot slip out when the clamping screws or nuts are tightened.

TEST for **24.4** and **24.5**. Compliance with **24.4** and **24.5** shall be checked by inspection of the terminals and conductors, after the test specified in **24.3** has been carried out.

NOTE The term "special preparation of the conductor" covers soldering of the strands, use of cable lugs, formation of eyelets, etc. but not the reshaping of the conductor before its introduction into the terminal or the twisting of a stranded conductor to consolidate the end.

24.6 Pillar terminals shall have the dimensions given in Table 7, except that the length of the thread in the pillar may be reduced if the mechanical strength is adequate and provided that at least two full threads are in engagement when a conductor of the smallest cross-sectional area specified in **24.2** is tightly clamped.

Table 7 — Dimensions of pillar terminals
(see **24.6**)

Minimum nominal thread diameter	Minimum diameter of hole for conductor	Minimum length of thread in pillar	Maximum difference between diameter of hole and nominal thread diameter
mm	mm	mm	mm
3.0[a]	3.0	2.0	0.6

[a] For BA threads, this value is reduced to 2.8 mm. Examples of pillar terminals are shown in Figure 13.

The length of the threaded part of the terminal screw shall be not less than the sum of the diameter of the hole for the conductor and the length of the thread in the pillar. If the thread in the pillar is recessed, the length of headed screws shall be increased accordingly.

The surface against which the conductor is clamped shall be free from sharp indentations or projections.

Such terminals shall be so designed and located that the end of a conductor introduced into the hole is visible or can pass beyond the threaded hole for a distance at least equal to half the nominal diameter of the screw, or 2.5 mm, whichever is the greater.

NOTE 1 The length of the thread in the pillar is measured to the point where the thread is first broken by the hole for the conductor.

NOTE 2 The part against which the conductor is clamped need not necessarily be in one piece with the part carrying the clamping screw.

24.7 Screw terminals shall have dimensions not less than those given in Table 8, except that the length of the thread in the screw hole or nut and the length of the thread on the screw may be reduced if the mechanical strength is adequate and provided that at least two full threads are in engagement when a conductor of the largest cross-sectional area specified in **24.2** is lightly clamped.

Table 8 — Dimensions of screw terminals
(see **24.7**)

Nominal thread diameter	Length ofthread on screw	Length of thread in screw hole or nut	Nominal difference between diameter of head and shank of screw	Height of head of screw
mm	mm	mm	mm	mm
3.5[a]	4.0	1.5	3.5	2.0

[a] For BA threads, this value is reduced to 2.8 mm. Examples of screw terminals are shown in Figure 13.

If the required length of the thread in the terminal screw hole is obtained by plunging, the edge of the extrusion shall be reasonably smooth and the length of the thread shall be at least 2.5 mm. The length of the extrusion shall not be more than 80 % of the original thickness of the metal, unless the mechanical strength is adequate with a greater length.

If an intermediate part, such as a pressure plate, is used between the head of the screw and the conductor, the length of the thread on the screw shall be increased accordingly but the diameter of the head of the screw may be reduced by 1 mm.

NOTE If the thread in the screw hole or nut is recessed, the length of headed screws has to be increased accordingly.

24.8 Stud terminals shall be provided with washers and shall have the dimensions given in Table 9.

TEST. Compliance with **24.4** to **24.8** shall be checked by inspection, by measurement and, if necessary, by the tests specified in **24.9**. A negative deviation of 0.15 mm is allowed for the nominal thread diameter and for the nominal difference between the diameters of the head and shank of the screw.

If one or more of the dimensions specified in **24.6** to **24.8** is larger than specified, the other dimensions need not be correspondingly increased; however, departures from the specified values shall not impair the function of the terminal.

Table 9 — Dimensions of stud terminals
(see **24.8**)

Minimum nominal thread diameter	Maximum difference between thread diameter and inner diameter of washers	Minimum difference between thread diameter and outer diameter of washers
mm	mm	mm
3.0[a]	0.4	0.4

[a] For BA threads, this value is reduced to 2.8 mm. Examples of stud terminals are shown in Figure 13.

24.9 If the length of thread in the pillar, screw hole or nut, or the length of thread on the screw, is smaller than that given in Table 7 or Table 8, as appropriate, or if the length of the extrusion is more than 80 % of the original thickness of the metal, the mechanical strength of the terminal shall be checked by the following tests.

Screws and nuts shall be subjected to the test of **26.1** but with the torque increased to 1.2 times the torque specified in **26.1**.

After this test, the terminal shall show no damage impairing its further use.

A conductor shall then once more be fastened as specified in **24.3** and, while clamped, it shall be subjected for 1 min to an axial pull, applied without jerks, of 40 N.

During this test, the conductor shall not move noticeably in the terminal.

24.10 The live, neutral and earth terminals shall be located in proximity to each other.

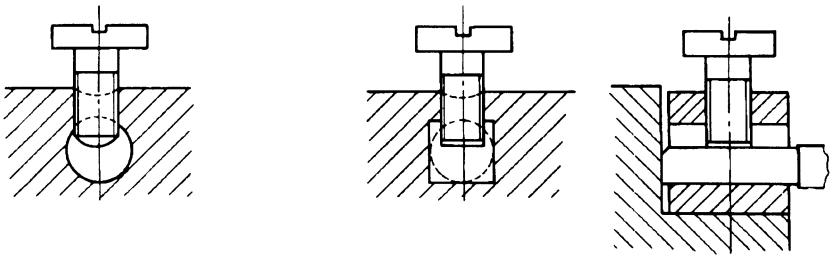
24.11 Terminal devices shall not be accessible without the aid of a tool, even if their live parts are not accessible.

24.12 Terminal devices shall be so located or shielded that, should a wire of a stranded conductor escape when the conductors are fitted, there is no risk of accidental connection between live parts and accessible metal parts.

TEST. Compliance shall bc checked by the following test.

An 8 mm length of insulation shall be removed from the end of a flexible conductor having a nominal cross-sectional area as specified in **23.6**. One wire of the stranded conductor shall be left free and the other wires shall be fully inserted into, and clamped in, the terminal.

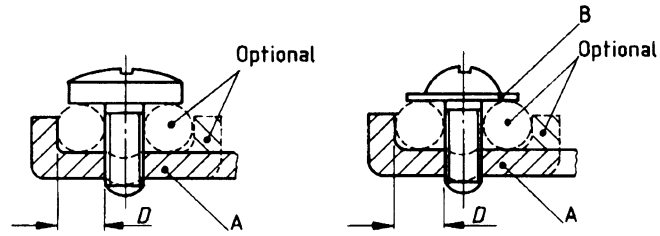
The free wire shall be bent, without tearing the insulation back, in every possible direction but without making sharp bends around barriers.



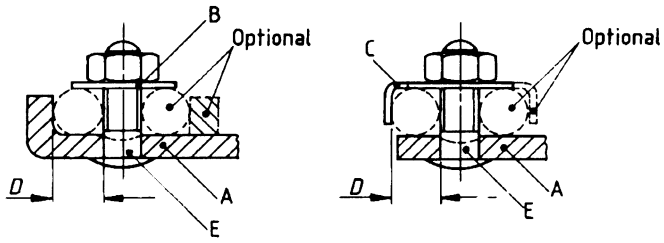
Terminal without pressure plate — Terminal with pressure plate

(a) Pillar terminals

Screw not requiring washer or clamping plate — Screw requiring washer or clamping plate



(b) Screw terminals



(c) Stud terminals

Key

Stud terminals

A Fixed part
B Washer or clamping plate
C Anti-spread device
D Conductor space
E Stud

Figure 13 — Typical examples of pillar, screw and stud terminals

The free wire of a conductor connected to a live terminal shall not touch any metal part that is accessible or connected to an accessible metal part. The free wire of a conductor connected to an earthing terminal shall not touch any live part.

25 Provision for earthing

25.1 Accessible metal parts that may become live in the event of an insulation fault shall be permanently and reliably connected to an earthing terminal or termination within the appliance or to the earthing contact of the appliance inlet.

Earthing terminals and earthing contacts shall not be connected to the neutral terminal.

Parts operating at safety extra-low voltage shall have no provision for earthing.

NOTE 1 If accessible metal parts are screened from live parts by metal parts that are connected to the earthing terminal or termination or to the earthing contact, they are not regarded as likely to become live in the event of an insulation fault.

NOTE 2 Metal parts behind a cover that does not withstand the test specified in **19.1** are considered to be accessible metal parts.

25.2 Earthing terminals shall comply with clause **24**.

Screwless terminals shall not be used for the connection of external earthing conductors.

Terminals used for earthing terminals shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of a tool.

NOTE In general, the designs commonly used for current-carrying terminals, other than some pillar terminals, provide sufficient resiliency to comply with the requirements of **25.2**; for other designs, special provisions, such as the use of an adequately resilient part that is not likely to be removed inadvertently, may be necessary.

TEST. Compliance shall be checked by inspection, by a manual test and by the tests specified in clause **24**.

25.3 If detachable parts have an earth connection, this connection shall be made before the current-carrying connections are established when placing the part in position. The current-carrying connections shall be separated before the earth connection is broken when removing the part.

For appliances with power supply cords, the arrangement of the terminals, or the length of the conductors between the cord anchorage and the terminals, shall be such that the current-carrying conductors become taut before the earthing conductor, if the cable or cord slips out of the cord anchorage.

NOTE This applies only to the length of the cores of the flexible cord and does not imply that the earth terminal should be nearer to the clamping bridge than the live terminals.

25.4 All parts of an earthing terminal shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor or any other metal that is in contact with these parts.

The body of an earthing terminal shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure, when the screw or nut shall be of brass, plated steel complying with clause **29**, or other metal no less resistant to corrosion.

If the body of an earthing terminal is a part of a frame or enclosure of aluminium or aluminium alloy, precautions shall be taken to avoid the risk of corrosion resulting from contact between copper and aluminium or its alloys.

25.5 The connection between the earthing terminal or earthing contact and parts required to be connected thereto shall have a resistance not exceeding 0.1 Ω.

TEST. Compliance shall be checked by the following test.

A current of 25 A, derived from an a.c. source and having a no-load voltage not exceeding 12 V, shall be passed between the earthing terminal or earthing contact and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal of the appliance or the earthing contact of the appliance inlet and the accessible metal part shall be measured and the resistance calculated from the current and this voltage drop.

NOTE 1 In case of doubt, the test is carried out until steady conditions have been established.

NOTE 2 The resistance of the flexible cable or cord is not included in the resistance measurement.

NOTE 3 Care should be taken to ensure that the contact resistance between the tip of the measuring probe and the metal parts under test does not influence the test results.

26 Electrical connections and screws

26.1 Screwed connections shall withstand the mechanical stresses occurring in normal use.

Screws transmitting contact pressure and screws of nominal diameter less than 3 mm shall screw into metal.

Screws shall not be of metal that is soft or liable to creep, e.g. zinc or aluminium.

Screws of insulating material shall have a nominal diameter of at least 3 mm and they shall not be used for any electrical connection.

Screws shall not be of insulating material if their replacement by a metal screw could impair supplementary insulation or reinforced insulation, neither shall screws that may be removed when replacing a power supply cord or undertaking other routine servicing be of insulating material if their replacement by a metal screw could impair basic insulation.

TEST. Compliance shall be checked by inspection and, for screws and nuts transmitting contact pressure, by the following test.

The screws or nuts shall be tightened and loosened as follows:

i) 10 times for screws in engagement with a thread of insulating material;

ii) five times for nuts and other screws.

Screws in engagement with a thread of insulating material shall be completely removed and reinserted each time.

When testing terminal screws and nuts, a conductor of the largest cross-sectional area specified in **24.2**, rigid (solid or stranded) for appliances intended to be permanently connected to fixed wiring and flexible in other cases, shall be placed in the terminal.

The test shall be carried out by means of a suitable test screwdriver, spanner or key applying a torque as shown in the appropriate column of Table 10 as follows:

a) *column 2*: for metal screws without heads if the screw, when tightened, does not protrude from the hole;

b) *column 3*: for other metal screws and for nuts;

c) *column 3*: for screws of insulating material either:

1) having a hexagonal head with a dimension across the flats exceeding the overall thread diameter; or

2) with a cylindrical head and a socket for a key, the socket having a cross-corner dimension exceeding the overall thread diameter; or

3) with a head having a slot or cross slots, the length of which exceeds 1.5 times the overall thread diameter;

d) *column 4*: for other screws of insulating material.

The conductor shall be moved each time the screw or nut is loosened. During the test, no damage impairing the further use of the screwed connections shall occur.

NOTE 1 Screws or nuts that are likely to be tightened by the user include screws intended to be operated when replacing the power supply cord.

NOTE 2 It is essential that the shape of the blade of the test screwdriver suits the head of the screw to be tested, and that the screws and nuts are not tightened in jerks.

Table 10 — Torque values for screws and nuts
(see **26.1**)

1	2	3	4
Nominal diameter of screw	**Torques for different screw and nut types**[a]		
mm	N m	N m	N m
≤ 2.8	0.2	0.4	0.4
> 2.8 ≤ 3.0	0.25	0.5	0.5
> 3.0 ≤ 3.2	0.3	0.6	0.6
> 3.2 ≤ 3.6	0.4	0.8	0.6
> 3.6 ≤ 4.1	0.7	1.2	0.6
> 4.1 ≤ 4.7	0.8	1.8	0.9
> 4.7 ≤ 5.3	0.8	2.0	1.0
> 5.3 ≤ 6.0	—	2.5	1.25

[a] See items a) to d) of **26.1**.

26.2 Screws in engagement with a thread of insulating material shall have a length of engagement sufficient to ensure a reliable connection. Correct introduction of the screw into the screw hole or nut shall be ensured.

TEST. Compliance shall be checked by inspection and by the test specified in **26.1**, the torque applied, however, being increased to 1.2 times the torque specified.

NOTE The requirement for the correct introduction of the screw can be complied with by preventing the introduction of the screw in a slanting manner, e.g. by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

26.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material that is liable to shrink or distort, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or distortion of the insulating material.

NOTE Ceramic material is not likely to shrink or distort.

26.4 Space-threaded (sheet metal) screws shall not be used for electrical connection of current-carrying parts unless they clamp these parts directly in contact with each other and are provided with a suitable means for locking.

Thread-cutting (self-tapping) screws shall not be used for the electrical connection of current-carrying parts unless they generate a full form standard machine screw thread.

Such screws shall not, however, be used if they are likely to be operated by the user or installer, unless the thread is formed by a swageing action.

Thread-cutting and thread-forming screws shall only be used to provide earthing continuity, provided that it is not necessary to disturb the connection during installation and servicing and that at least two screws are used for each connection.

26.5 Screws that make a mechanical connection between different parts of the appliance shall be secured against loosening, if the connection carries current, except that this does not apply to screws in the earthing circuit, provided there is an alternative earthing circuit.

Rivets used for current-carrying connections shall be secured against loosening if these connections are subject to torsion in normal use.

Sealing compound that softens on heating shall only be used for securing screw connections that are not subject to torsion in normal use.

NOTE 1 Spring washers, etc. may provide satisfactory security.
NOTE 2 For rivets, a non-circular shank or an appropriate notch may be sufficient.

27 Creepage distances, clearances and distances through insulation
(see Appendix C)

27.1 Creepage distances and clearances

Creepage distances and clearances shall not be less than the values given in Table 11, except for the following.

a) The values given in Table 11 do not apply to component parts for which creepage distances and clearances are specified in the British Standard with which the part complies.

b) For live parts of different polarity separated by basic insulation only, creepage distances and clearances smaller than those specified in Table 11 are permitted, provided that the electrical safety is not impaired when these creepage distances and clearances are short-circuited consecutively and the creepage distances are over insulating material complying with **28.3**.

If a resonance voltage occurs between a point where a winding and a capacitor are connected together and metal parts separated from live parts by basic insulation only, the creepage distance and clearance shall be not less than the values specified for the value of the voltage imposed by the resonance, these values being increased by 4 mm in the case of reinforced insulation.

TEST. Compliance shall be checked by measurement.

For appliances provided with an electrical inlet plug and socket, the measurements shall be made with an appropriate connector inserted; for other appliances, measurements shall be made with the supply conductors of the largest cross-sectional area specified in **24.2** and also without conductors.

Movable parts shall be placed in the most unfavourable position, nuts and screws with non-circular heads being assumed to be tightened in the most unfavourable position.

Also, the clearances between terminals and accessible metal parts shall be measured with the screws or nuts unscrewed as far as possible but the clearance shall then be not less than 50 % of the values in Table 11.

Distances through slots or openings in external parts of insulating material shall be measured to metal foil in contact with the accessible surface; the foil shall be pushed into corners and the like, by means of the test finger shown in Figure 1, but it shall not be pressed into openings.

If necessary, a force shall be applied to any point on bare conductors, on uninsulated capillary tubes of thermostats and similar devices, and to the outside of metal enclosures, in an endeavour to reduce the creepage distances and clearances while taking the measurements.

The force shall be applied by means of the test finger shown in Figure 2 and shall have the following value:

1) 2 N for bare conductors and for uninsulated capillary tubes of thermostats and similar devices;

2) 30 N for enclosures.

If a barrier is interposed and if it is in two parts that are not cemented together, the creepage distances shall also be measured through the joint.

If a barrier is interposed, clearances shall be measured over the barrier or, if the barrier is in two parts with mating surfaces that are not cemented together, through the joint.

When assessing creepage distances and clearances, the effect of insulating linings of metal enclosures or covers shall be taken into consideration.

Internal conductors shall be considered to be bare conductors, unless their insulation withstands, without flashover or breakdown, an electric strength test carried out between the conductor and metal foil wrapped round the insulation, a test voltage of 2 000 V being applied for 15 min.

27.2 Distances through insulation

Except where given in note 1, the distance through insulation, between metal parts, for working voltages up to and including 250 V, shall be not less than 1 mm if the parts are separated by supplementary insulation and not less than 2.0 mm if the parts are separated by reinforced insulation. However, supplementary insulation on wiring shall have a minimum thickness of 0.8 mm provided that, when installed, this insulation complies with **20.13**.

NOTE 1 These requirements do not apply if the insulation is applied in thin sheet form other than mica or similar scaly material, and consist of the following:

a) at least two layers for supplementary insulation, provided that at least one of the layers complies with **15.3** at a test voltage of 2 500 V;

b) at least three layers for reinforced insulation provided that, when two of the layers are placed in contact, they comply with **15.3** at a test voltage of 3 750 V.

The test voltage shall be applied between the outer surfaces of the layer or of the two layers, as applicable.

NOTE 2 This requirement does not imply that the specified distance should be through solid insulation only; it may consist. of a thickness of solid insulation plus one or more air layers.

Table 11 — Creepage distances and clearances

Points of measurement	Working voltage up to 130 V[a]		Working voltage over 130 V up to 250 V	
	Creepage distance	Clearance	Creepage distance	Clearance
	mm	mm	mm	mm
Between live parts of different polarity:				
if protected against deposition of dirt	1.0 (1.0)	1.0 (1.0)[b]	2.0	2.0[b]
if not protected against deposition of dirt	2.0 (2.0)	1.5 (1.5)[b]	3.0	2.5[b]
if lacquered or enamelled windings	1.5 (1.0)	1.5 (1.0)[b]	2.0	2.0[b]
Between live parts and other metal parts over basic insulation:				
if protected against deposition of dirt[c]:				
if of ceramic material or pure mica, etc.	1.0 (1.0)	1.0 (1.0)	2.5[d]	2.5[d]
if of other material	1.5 (1.5)	1.0 (1.0)	3.0	2.5[d]
if not protected against deposition of dirt	2.0 (2.0)	1.5 (1.5)	4.0	3.0
if the live parts are lacquered or enamelled windings	1.5 (1.0)	1.5 (1.0)	2.0	2.0
Between parts of different polarity, including the connecting wires of positive temperature coefficient (PTC) resistors, if protected against deposition of moisture and dirt[c]	1.0 (—)	1.0 (—)	1.0	1.0
Between live parts and other metal parts over reinforced insulation:				
if the live parts are lacquered or enamelled windings	6.0 (—)	6.0 (—)	6.0	6.0
for other live parts	8.0 (—)	8.0 (—)	8.0	8.0
Between metal parts separated by supplementary insulation	4.0 (—)	4.0 (—)	4.0	4.0
Between live parts in recesses in the mounting face of the appliance and the surface to which it is fitted	6.0 (2.0)	6.0 (2.0)	6.0	6.0

[a] The values given in these columns do not apply to printed wiring circuits. The values in parentheses apply to parts operating at safety extra-low voltage at up to 42 V (50 V no-load).

[b] The clearance values given do not apply to the air gaps between thermal controls, overload protection devices, switches of microgap construction, etc. or to the air gap between current-carrying members of such devices where the clearance varies with the movement of the contacts.

[c] In general, the interior of an appliance having a reasonably dust-proof enclosure is considered to be protected against deposition of dirt, provided that the appliance does not generate dust within itself. Hermetic sealing is not required.

[d] If the parts are rigid and located by mouldings or if the design is such that there is no likelihood of a distance being reduced by distortion or movement of the parts, this value may be reduced to 2.0.

28 Resistance to heat, fire and tracking

28.1 Enclosures and parts of insulating material, the deterioration of which may impair the electrical safety of the appliance, shall be sufficiently resistant to heat and to fire.

TEST. Compliance shall be checked by subjecting enclosures and other external parts of insulating material to a ball-pressure test by means of the apparatus shown in Figure 14 except that the test is not carried out on parts of ceramic material.

The surface of the part to be tested shall be placed in the horizontal position and a steel ball of 5 mm diameter shall be pressed against the surface with a force of 20 N.

The test shall be carried out in a heating cabinet at a temperature of 75 ± 2 °C or at a temperature that is 40 ± 2 °C in excess of the temperature of the relevant part determined during the test specified in clause **12**, whichever is the higher.

After 1 h, the ball shall be removed from the sample which shall than be cooled down within 10 s to approximately room temperature by immersion in cold water. The diameter of the impression caused by the ball shall be measured and it shall not exceed 2 mm.

28.2 Insulating parts retaining live parts in position shall be resistant to abnormal heat and to fire.

TEST. Compliance shall be checked by the following tests, except that the tests are not carried out on parts of ceramic material, insulating parts of commutators or brush caps, etc. or on coil formers that are not used as reinforced insulation.

A test shall be carried out as described in **28.1** but at a temperature of 125 ± 2 °C or at a temperature that is 40 ± 2 °C in excess of the temperature of the relevant part determined during the test specified in clause **12**, whichever is the higher.

In addition, the insulating parts shall be subjected to a test carried out with an electrically heated conical mandrel in an apparatus as shown in Figure 15.

The mandrel shall be inserted into a conical hole reamed into the part to be tested in such a way that portions of the conical part of the mandrel of equal length protrude from both sides. The samples shall be pressed against the mandrel with a force of 12 N. The means by which the force is applied shall then be locked to prevent any further movement. However, if the sample starts to soften or to melt during the test, a force just sufficient to keep the sample in contact with the mandrel shall be applied to the mandrel in a horizontal direction.

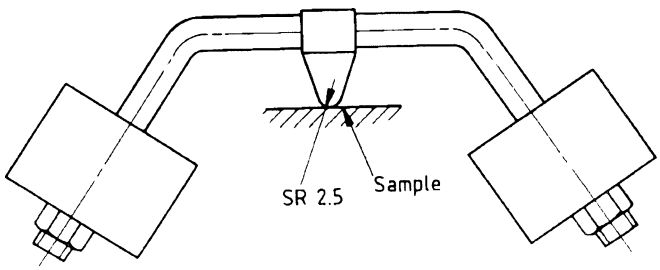
The mandrel shall be heated to a temperature of 300 °C in approximately 3 min and shall be maintained within 10 °C of this value for 2 min. The temperature shall be measured by means of a thermocouple inside the mandrel.

During the period of heating (5 min), sparks of about 6 mm in length shall be produced at the upper surface of the sample where the mandrel protrudes and the sample is in contact with the mandrel. The sparks shall be produced by means of a high-frequency generator, the electrodes of which are moved around the mandrel so as to cover the whole area of the sample near the mandrel.

Neither the sample, nor any gases produced during the heating, shall be ignited by the sparks.

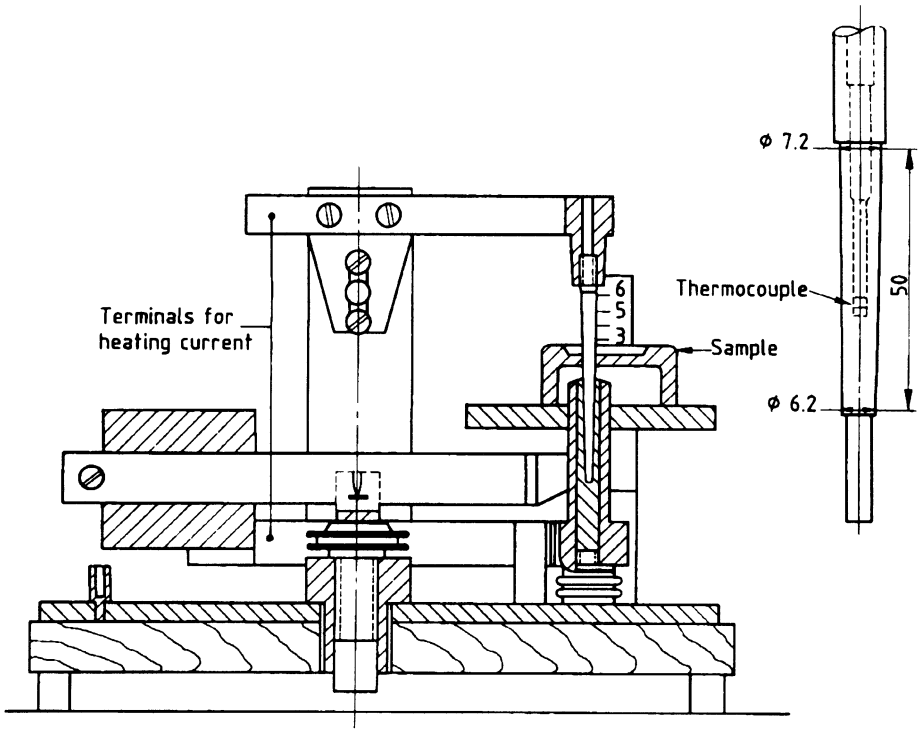
28.3 Insulating parts retaining live parts in position shall be of material resistant to tracking if they are exposed to excessive deposition of moisture or dirt in normal use, unless the creepage distances are at least equal to twice the values specified in **27.1**.

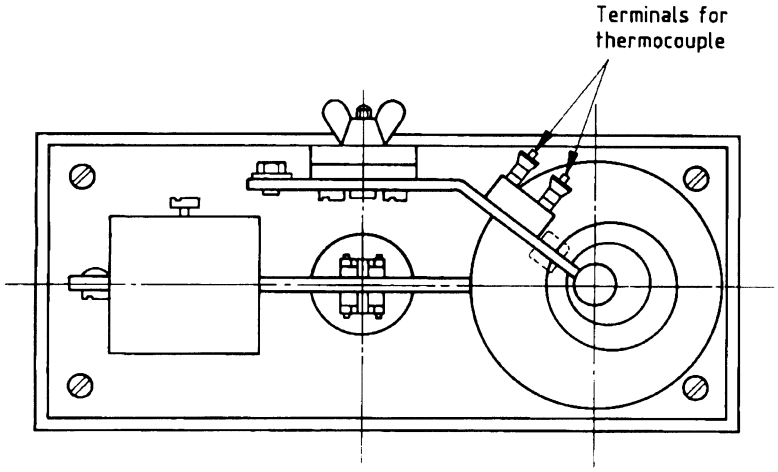
TEST. Compliance shall be checked by the following test, except that the test is not carried out on ceramic materials or on insulating parts of commutators or brush caps.



NOTE The dimension is in millimetres.

Figure 14 — Ball-pressure apparatus





NOTE All dimensions are in millimetres.

Figure 15 — Hot mandrel apparatus

A flat surface of the part, to be tested, if possible at least 15 mm × 15 mm, shall be placed in the horizontal position.

Two electrodes of platinum or other sufficiently non-corrodible material, of the dimensions shown in Figure 16, shall be placed on the surface of the sample in the manner shown in this figure, so that the rounded edges are in contact with the sample over their whole length.

The force exerted on the surface by each electrode shall be about 1 N.

The electrodes shall be connected to a 50 Hz supply such that the no-load voltage is substantially sine-wave form and has a value of 175 V, which shall not be reduced by more than 17.5 V when the electrodes are short-circuited. The total impedance of the circuit when the electrodes are short-circuited shall be adjusted by means of a variable resistor, so that the current is equal to 1.0 ± 0.1 A with a power factor of between 0.9 and 1. An overcurrent relay shall be included in the circuit, the relay being so designed that, when the current has reached a value of 0.5 A, the circuit is interrupted after a period which is as short as possible but not less than 2 s.

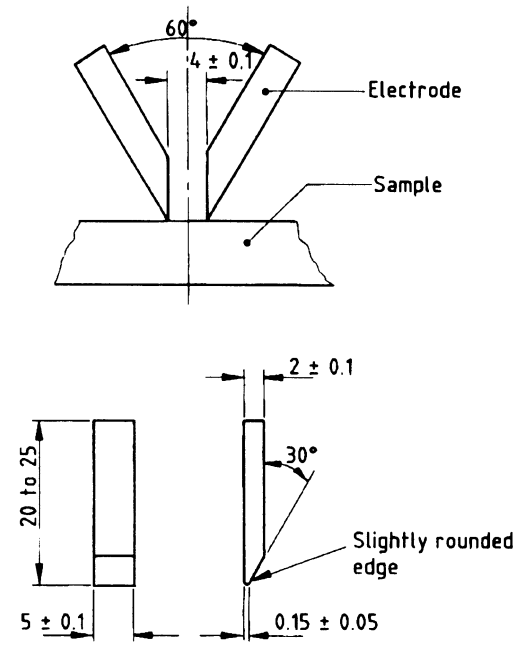
The surface of the sample shall be wetted by allowing drops of a solution of ammonium chloride in distilled water to fall centrally between the electrodes. The solution shall have a volume resistivity of 400 Ω cm at 25 °C, corresponding to a concentration of about 0.1 %. The drops shall have a volume of 20 + 5, – 0 mm^3 and shall fall from a height of 30 mm to 40 mm.

The time interval between each drop and the next shall be 30 ± 5 s.

The test shall be carried out at three places on the sample.

In case of doubt, the test shall be repeated, if necessary on a new sample.

NOTE Care should be taken to ensure that the electrodes are clean, correctly shaped and correctly positioned before each test is started.



NOTE All linear dimensions are in millimetres.

Figure 16 — Arrangement and dimensions of electrodes for tracking test

29 Resistance to rusting

Ferrous parts, the rusting of which might affect the electrical safety of the appliance, shall be adequately protected against rusting.

TEST. Compliance shall be checked by the following test (but see note 2).

All grease shall be removed from the parts to be tested by immersion in trichloroethane for 10 min (but see note 2).

The parts shall then be immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of 25 ± 5 °C.

Without drying but after shaking off any drops, the parts shall be placed for 10 min in a box containing air saturated with moisture at a temperature of 20 ± 5 °C.

After the parts have been dried for 10 min in a heating cabinet at a temperature of 100 ± 5 °C, their surfaces shall show no signs of rust.

NOTE 1 Traces of rust on sharp edges and any yellowish film removable by rubbing can be ignored.

NOTE 2 For small helical springs, etc. and for parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only there is doubt about the effectiveness of the grease film and the test is then carried out without previous removal of the grease.

WARNING NOTE. When using the liquids specified for this test, it is essential that adequate precautions be taken to prevent inhalation of their vapours.

Appendix A Electronic circuits

NOTE In this appendix, references relate to clause and subclause numbers in the main body of the text., e.g. **A.4.2** in this appendix relates to **4.2** in the main body of the text and **A.2.101** is a definition additional to those in clause **2** in the main body of the text.

A.1 Scope

This appendix applies to circuits comprising an electronic device, an electronic unit or an electronic assembly with components such as resistors, capacitors and inductors, in the appliances listed in clause **1** of this standard. All clauses of this standard apply to electronic circuits except as modified in this appendix.

A.2 Definitions

For the purposes of this appendix the following definitions apply.

A.2.101 ***electronic device***

A part in which conduction is principally by electrons moving through a vacuum, gas or semiconductor.

A.2.102 ***electronic unit***

A group of components, at least one of which is an electronic device, in which the components cannot be replaced without damage, e.g. an integrated circuit.

A.2.103 ***electronic assembly***

A group of components, at least one of which is an electronic device, but in which individual parts may be replaced without damage to the assembly, e.g. a group of components mounted on a printed circuit board.

A.4 General notes on tests

A.4.2 Cumulative stress as a result of sequential testing shall be avoided. It may be necessary to replace the affected samples or to use additional samples. The number of samples should be kept to a minimum by an evaluation of the relevant circuits.

A.4.101 Care shall be taken to ensure that, except for the test specified in **A.101**, the supply is free of such perturbations from external sources as may influence the results of the tests.

A.4.102 If an electronic unit is so enclosed that the testing of individual components is impossible, the entire electronic unit shall be considered as a whole.

NOTE It is, however, permitted to take apart electronic units that are not so vacuum sealed, completely encapsulated, moulded-in or potted that the enclosure forms one moulded part with the enclosed components, for the purpose of establishing creepage distances and clearances between live parts and other metal parts as specified in **A.27.1**.

A.4.103 If an electronic unit or assembly is tested separately, the conditions of the heat dissipation occurring when it is incorporated in the appliance shall be, if necessary, simulated during the tests.

A.4.104 All measurements shall be made with instruments that do not appreciably affect the values to be measured and which are not affected by factors such as waveform.

A.4.105 Electronic components are tested as part of the appliance during the tests specified in this British Standard.

If, during these tests, a sample ceases to function as a result of the failure of an electronic device, electronic unit or any other component that is unlikely to cause any hazardous condition in the sense of **A.4.106**, that component, electronic device or electronic unit shall be replaced and the test continued.

If, during these tests, the sample develops a fault that produces a malfunction, the test shall be continued without replacement of the component, electronic device or electronic unit, provided that no hazardous condition in the sense of **A.4.106** has been produced.

A.4.106 Circuits shall be so designed and applied that any fault condition will not render the appliance unsafe as regards electric shock, fire hazards, mechanical hazards or other dangerous malfunction.

TEST. Compliance shall be checked by simulating each of the following conditions in turn and associating with it those other fault conditions that are an inevitable consequence:

a) short-circuiting of creepage distances and clearance between live parts of different polarities (if less than those specified in **A.27.1** where a proper encapsulation has not been used) is simulated;

b) short circuit across insulating parts that do not comply with **A.15.1** is simulated;

c) short circuit across or, if applicable, open-circuiting of electronic devices, electronic units and components such as resistors, capacitors and inductors not complying with BS 415 is simulated. To check shock risk in all appliances, and fire hazard in appliances intended for unattended use, all resistors, capacitors and inductors shall be open-circuited or short-circuited whether or not they comply with BS 415.

NOTE 1 Examination of the appliance and its circuit diagrams will generally show the fault conditions that should be simulated.

NOTE 2 For mechanical hazards in all appliances, and for fire risks in attended appliances if the resistor or capacitor complies with BS 415, a short circuit is not required.

The appliance shall be operated at rated voltage or at the most unfavourable voltage of the rated voltage range and under the most unfavourable normal operating conditions as specified in clause **12**. If the operating time specified in clause **12** consists of more than one operating cycle, the duration of the test shall be equal to one operation cycle, if necessary.

During and after these tests, the appliance shall comply with **17.4**.

A.8 Instructions

A.8.1 Class I appliances, with electronic circuits where a failure of basic insulation would permit earth-leakage currents with a d.c. component exceeding *X* mA and exceeding also *Y* % of the total earth-leakage current, shall be accompanied by an instruction sheet giving the necessary information about the protection of the wiring by fuses or earth-leakage circuit-breakers.

NOTE Until international agreements have been reached, the values *X* and *Y* depend on the national usage of earth-leakage circuit-breakers.

A.9 Protection against electric shock

A.9.1 For the purposes of **A.9.1**, wiring terminals and contacts of connectors are not regarded as live parts if either of the following applies:

a) the part is connected to the output terminals of a safety isolating transformer, provided that the output voltage of the transformer does not exceed 42.4 V a.c. (peak value) or 42.4 V d.c.;

b) the current between the part and either pole of the supply through a non-inductive resistance of 2 000 ± 100 Ω does not exceed 0.7 mA (peak value) or 2 mA d.c. and, moreover:

1) for voltages between 42.4 V (peak value) and 450 V (peak value) the capacitance does not exceed 0.1 μF;

2) for voltages between 450 V (peak value) and 15 kV (peak value) the discharge does not exceed 45 μC;

3) for voltages over 15 kV (peak value), the energy of the discharge does not exceed 350 mJ.

Voltages and currents shall be measured between the relevant part and either pole of the supply source. Discharges shall be measured immediately after the interruption of the supply.

In the presence of harmonics and of frequencies higher than supply frequencies, the measurement of the a.c. leakage current shall be made with a circuit having an impedance formed by a 2 000 ± 100 Ω resistive component, including the resistance of the measuring instrument, shunted by a capacitor of 112 ± 6 nF.

For frequencies exceeding 1 kHz, the limit of 0.7 mA (peak value) is multiplied by the value of the frequency (in kHz), but it shall not exceed 70 mA (peak value).

The internal resistance of the voltmeter used for the measurements shall be at least 50 kΩ.

A.15 Insulation resistance and electric strength

A.15.1 In order to avoid overstressing the components of electronic devices, units or assemblies that are arranged across insulation that needs to be tested for dielectric strength and insulation resistance according to the main body of the standard, such tests shall not be carried out if the relevant components are not live in the sense of **A.9.1** and if they cannot be disconnected.

If integrated circuits and the like on the secondary side of an isolating transformer may be damaged or destroyed by capacitive charges or currents, they shall be disconnected or removed before the tests are carried out.

If, during this test, a flashover or breakdown occurs over an insulation, the appliance shall not be deemed to be unsatisfactory if the requirements of **A.4.106** are complied with when the relevant insulation is short-circuited.

A.27 Creepage distances, clearances and distances through insulation

A.27.1 Circuits conductively connected to the supply terminals or to supply contacts shall comply with clause **27**.

Creepage distances and clearances in circuits separated from the supply by an isolating transformer shall be not less than the values given in Table 12, for any of the following:

a) basic insulation between live parts of different polarity;

b) the insulation between live parts and non-accessible parts in class II construction;

c) the insulation between live parts and accessible parts in construction according to other classes;

d) supplementary insulation.

For reinforced insulation, creepage and clearances shall be not less than twice the values given in the Table 12.

Table 12 — Creepage distances and clearances for electronic circuits

Working voltage (r.m.s.)	Working voltage (peak)	Minimum clearance	Minimum creepage distance
V	V	mm	mm
≤ 12	≤ 17	0.19	0.40
> 12 ≤ 30	> 17 ≤ 43	0.28	0.55
> 30 ≤ 60	> 43 ≤ 85	0.38	0.72
> 60 ≤ 130	> 85 ≤ 184	0.62	1.12
> 130 ≤ 250	> 184 ≤ 354	1.15	1.95

For voltages exceeding 42.4 V (peak a.c. or d.c.) the distances through insulation shall comply with **A.15.1**.

NOTE For voltages up to 42.4 V (peak a.c. or d.c.) there are no requirements.

A.101 Operation under mains-borne perturbation

Electronic controls and electronic control systems shall not malfunction because of mains-borne perturbation in any way that results in a hazardous situation.

NOTE A test is under consideration.

Appendix B Classification of controls as type 1 or type 2 in accordance with BS 3955

B.1 BS 3955 classifies controls as type 1 or type 2 according to whether or not any operating characteristic is tested for reliability. Type 2 controls are subjected to tests for reliability; type 1 controls are not. Clause **22** of this British Standard requires that components of appliances comply with the appropriate British Standard but before a control can be said to comply with BS 3955 it is necessary to know whether it is to be classified as type 1 or type 2.

B.2 The guidelines in **B.3** to **B.7** have been established for general application.

B.3 If a change in the operating characteristics of a control does not affect safety, safety being defined by compliance with the requirements of clauses **17**, **18** and **20**, then that control may be of type 1 for any of the following reasons.

a) The inherent design of the appliance is such that a change in the operating characteristic does not affect safety.

b) An overriding safety device such as a thermal cut-out is incorporated to operate in the event of a predetermined change of operating characteristic (but see **B.4**).

c) The appliance is not intended for use unattended and therefore any effect of a change in the operating characteristic would be detected before it became dangerous (but see **B.5**).

B.4 Further consideration should be given in the case of item b) of **B.3** to abnormal conditions that are imposed during the test specified in clause **17** but during which the type 1 control, e.g. thermostat, is not short-circuited. If a type 1 control operates during the tests; no test is carried out to determine correct operation of the overriding device, e.g. thermal cut-out, under that particular abuse condition. It may of course be considered that the chance of a short-circuited thermostat and the prescribed abuse condition occurring at the same time is remote and therefore need not be evaluated.

B.5 With respect to item c) of **B.3**, there may be certain exceptions to this rule, where the rapid deterioration of the appliance in the event of failure of the thermostat can cause a hazard even when the appliance is attended. (See also **B.6**.)

B.6 Apart from the exceptions given in **B.5**, this means that all thermostats may be type 1. Thermal cut-outs, however, have to be type 2 where the cut-out is necessary for safety in the event of failure of a type 1 control or abnormal operation of the appliance.

B.7 There are certain other types of control, upon which reliance is placed for safety, that do not have an overriding safety device. These include interlock devices that prevent access to moving parts or operation of heaters without air or water flow, and some level controls.

Appendix C Measurement of creepage distances and clearances

The methods of measuring creepage distances and clearances to be used for assessing compliance with **27.1** are described in cases 1 to 10.

These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made.

a) A groove may have parallel, converging or diverging sides.

b) Any groove having diverging sides, a minimum width exceeding 0.25 mm, a depth exceeding 1.5 mm and a width at the bottom equal to, or greater than, 1 mm, is regarded as an air gap (see case 8).

c) Any corner including an angle less than 80° is assumed to be bridged with an insulating link of 1 mm width (0.25 mm for dirt-free situations) moved into the most unfavourable position (see case 3).

d) Where the distance across the top of a groove is 1 mm (0.25 mm for dirt-free situations) or more, no creepage distance exists across the air space (see case 2).

e) A creepage patch is assumed not to exist if there is an air gap [as defined in item b)] exceeding 0.25 mm.

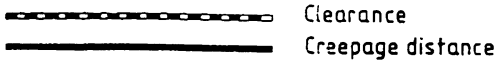
f) Creepage distances and clearances measured between parts moving relative to each other are measured when these parts are in their most unfavourable stationary positions.

g) A computed creepage distance is never less than a measured clearance.

h) Any air gap less than 1 mm wide (0.25 mm for dirt-free situations) is ignored in computing the total clearance.

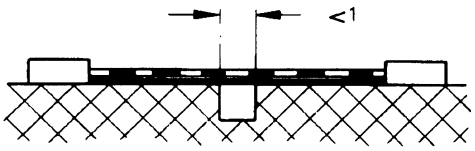
The following key applies to all 10 cases.

Key:



All dimensions illustrated in the 10 cases are in millimetres.

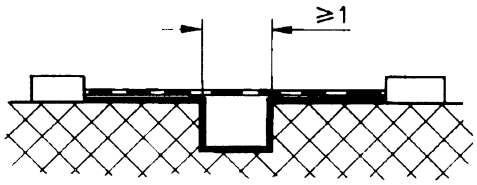
Case 1



Condition: Path under consideration includes a parallel or converging-sided groove of any depth with a width less than 1 mm.

Rule: Creepage distance and clearance are measured directly across the groove as shown.

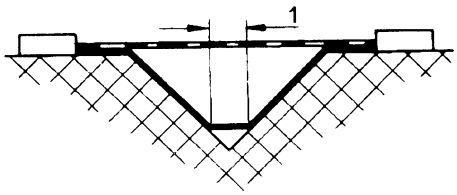
Case 2



Condition: Path under consideration includes a parallel-sided groove of any depth and equal to, or greater than, 1 mm wide.

Rule: Clearance is the line of sight distance. Creepage path follows the contour of the groove.

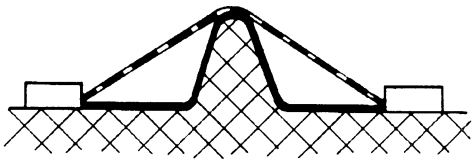
Case 3



Condition: Path under consideration includes a V-shaped groove with internal angle of less than 80° and with a width greater than 1 mm.

Rule: Clearance is the line of sight distance. Creepage path follows the contour of the groove but short-circuits the bottom of the groove by 1 mm (0.25 mm for dirt-free situations) link.

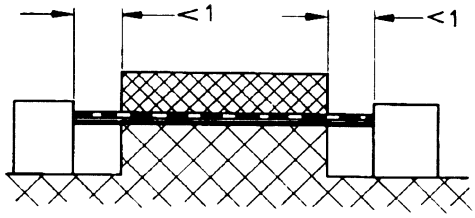
Case 4



Condition: Path under consideration includes a rib.

Rule: Clearance is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.

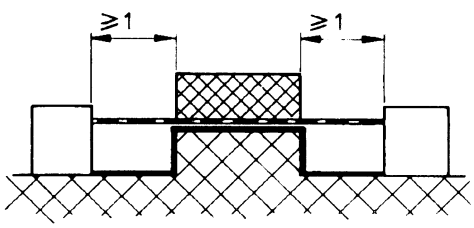
Case 5



Condition: Path under consideration includes an uncemented joint with grooves less than 1 mm (0.25 mm for dirt-free situations) wide on each side.

Rule: Creepage and clearance path is the line of sight distance shown.

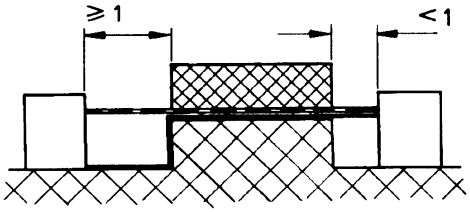
Case 6



Condition: Path under consideration includes an uncemented joint with grooves equal to, or greater than, 1 mm wide on each side.

Rule: Clearance is the line of sight distance. Creepage path follows the contour of the grooves.

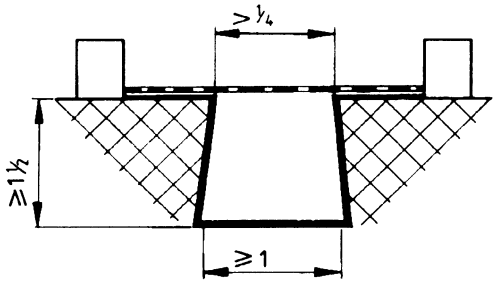
Case 7



Condition: Path under consideration includes an uncemented joint with a groove on one side less than 1 mm wide and the groove on the other side equal to, or greater than, 1 mm wide.

Rule: Clearance and creepage paths are as shown.

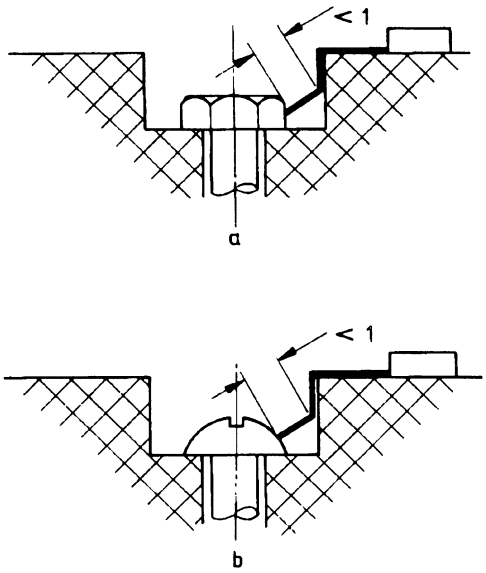
Case 8



Condition: Path under consideration includes a diverging-sided groove equal to, or greater than, 1.5 mm deep and greater than 0.25 mm wide at the narrowest part and equal to, or greater than, 1 mm at the bottom.

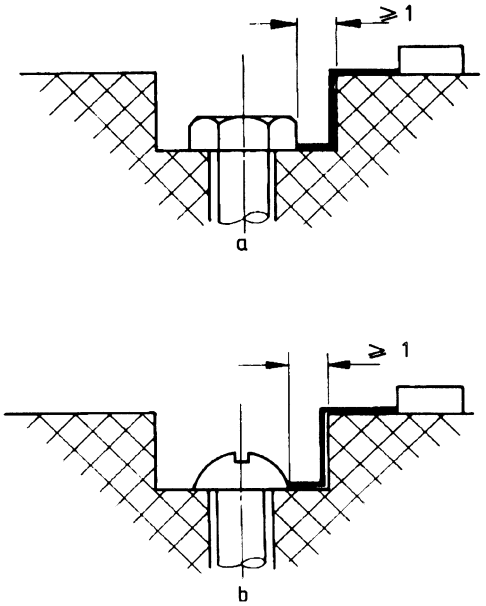
Rule: Clearance is the line of sight distance. Creepage path follows the contour of the groove. Case 3 applies as well to an internal corner if the angle is less than 80°.

Case 9



Gap between head of screw and wall of recess too narrow to be taken into account.

Case 10



Gap between head of screw and wall of recess wide enough to be taken into account.

Publication(s) referred to

BS 415, *Specification for safety requirements for mains-operated electronic and related apparatus for household and similar general use.*

BS 546, *Specification. Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors.*

BS 1363, *Specification for 13 A fused plugs and switched and unswitched socket-outlets.*

BS 2757, *Method for determining the thermal classification of electrical insulation.*

BS 3456, *Specification for safety of household and similar electrical appliances.*

BS 3456-101, *General requirements*[2)].

BS 3535, *Isolating transformers and safety isolating transformers.*

BS 3535-1, *General requirements.*

BS 3955, *Specification for electrical controls for household and similar general purposes.*

BS 4265, *Specification for cartridge fuse links for miniature fuses.*

BS 4568, *Specification for steel conduit and fittings with metric threads of ISO form for electrical installations.*

BS 4573, *Specification for 2-pin reversible plugs and shaver socket-outlets.*

BS 4607, *Non-metallic conduits and fittings for electrical installations.*

BS 5101, *Specification for lamp caps and holders together with gauges for the control of interchangeability and safety.*

BS 5101-1, *Lamp caps.*

BS 5258, *Safety of domestic gas appliances.*

BS 5386, *Gas burning appliances.*

BS 5386-1, *Gas burning appliances for instantaneous production of hot water for domestic use.*

BS 5386-3, *Domestic cooking appliances burning gas.*

BS 5386-4, *Built-in domestic cooking appliances.*

BS 5386-5, *Specification for gas burning instantaneous water heaters with automatic output variation (2nd and 3rd family gases).*

BS 6004, *Specification for PVC-insulated cables (non-armoured) for electric power and lighting.*

BS 6141, *Specification for insulated cables and flexible cords for use in high temperature zones.*

BS 6217, *Guide to graphical symbols for use on electrical equipment.*

BS 6500, *Specification for insulated flexible cords and cables.*

BS 6776, *Specification for Edison screw lampholders.*

BS 7003, *Specification for spring-operated impact-test apparatus and its calibration.*

IEC 335, *Safety of household and similar electrical appliances.*

IEC 335-1, *General requirements.*

IEC 417, *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets.*

CENELEC HD 251 S3, *General requirements*[2)].

EN 60320, *Appliance couplers for household and similar general purposes*[3)].

[2)] Referred to in the foreword only.

[3)] Published by European Committee for Standardization (CEN) and available from BSI Sales, Linford Wood, Milton Keynes MK14 6LE.

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