BRITISH STANDARD

BS 5486-13: 1989

Incorporating Amendment No. 1

Low-voltage switchgear and controlgear assemblies —

Part 13: Specification for particular requirements of consumer units

UDC 621.316.3:621.3.021:621.3.016.31:[621.3—77.002.72]:[.001.2:001.4]:620.1

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Power Electrical Engineering Standards Policy Committee (PEL/-) to Technical Committee PEL/12, upon which the following bodies were represented:

ASTA Certification Services
Association of British Mining Equipment Companies
Association of Supervisory and Executive Engineers
British Gas plc
Building Employers' Confederation
Department of Trade and Industry (Consumer Safety Unit, C A Division)
ERA Technology Ltd.
Electrical Contractors' Association
Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
GAMBICA (BEAMA Ltd.)
Health and Safety Executive
National Inspection Council for Electrical Installation Contracting
Transmission and Distribution Association (BEAMA Ltd.)

This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 30 June 1989

First published April 1979
First revision June 1989

The following BSI references relate to the work on this standard:
Committee reference PEL/12
Draft for comment 87/20531 DC

ISBN 0 580 17226 0

Amendments issued since publication

Amd. No.	Date of issue	Comments
6554	April 1991	Indicated by a sideline in the margin

Contents

Foreword

This Part of BS 5486 has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee. It supersedes BS 5486-13:1979, which is withdrawn.

This Part has been revised to align it with BS 5486-1:1986. The opportunity has been taken to modify the requirements for short-circuit testing.

The clause and subclause numbering from clause **2** onwards of this Part of BS 5486 follows that of BS 5486-1:1986. Many subclauses refer to the equivalent subclause in BS 5486-1 as either applicable or not applicable; where no reference is made to Part 1, the subclause replaces the equivalent subclause in that Part.

Reference should be made to the note contained in the foreword to BS 5486-1, regarding requirements described as "under consideration".

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 16, 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.

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1 Scope and general requirements

1.1 Scope

This Part of BS 5486 specifies particular requirements for consumer units such as are installed in consumers' premises, for the control and distribution of electrical energy from a single phase earthed neutral system having a declared voltage not exceeding 250 V a.c. at a nominal frequency of 50 Hz and supplied through a type II fuse complying with BS 1361:1971 rated at not more than 100 A and with outgoing ways not exceeding 50 A rating.

NOTE 1 All references to Part 1 relate to BS 5486-1:1986; see foreword.
NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

1.2 General requirements

ASSEMBLIES known as consumer units shall comply with all the requirements of Part 1 of this standard unless otherwise indicated hereinafter and shall also comply with the supplementary requirements contained in this Part.

Individual components, such as circuit-breakers, fuses, switches and wiring accessories, shall comply with the relevant British Standards and in this respect are not covered by this standard.

2 Definitions

2.1 General definitions

The definitions given in this subclause in Part 1 apply, together with the following.

2.2.101
consumer unit

an ASSEMBLY for the control and distribution of electrical energy, principally in domestic consumers' premises, incorporating manual means of double pole isolation on the incoming circuit(s) and an assembly of one or more of the following on the outgoing circuits:

a) fuses;

b) miniature circuit-breakers;

c) protective devices (residual current or fault voltage operated).

NOTE Consumer units are also known as consumer control units and consumers' electricity control units.

2.2 Definitions concerning constructional units of ASSEMBLIES

The definitions given in this subclause in Part 1 apply.

2.3 Definitions concerning the external design of ASSEMBLIES

The definitions given in this subclause in Part 1 apply as appropriate.

2.4 Definitions concerning the structural parts of ASSEMBLIES

The definitions given in this subclause in Part 1 apply as appropriate.

2.5 Definitions concerning the conditions of installation of ASSEMBLIES

The definitions given in this subclause in Part 1 apply as appropriate.

2.6 Definitions concerning protective measures with regard to electric shock

The definitions given in this subclause in Part 1 apply.

2.7 Gangways within ASSEMBLIES

The definitions given in this subclause in Part 1 do not apply to consumer units.

2.8 Definitions relating to electronic functions

The definitions given in this subclause in Part 1 apply.

3 Classification of ASSEMBLIES

The provisions of this clause in Part 1 shall apply.

4 Electrical characteristics of ASSEMBLIES

4.1 Rated voltages

The provisions of this subclause in Part 1 shall apply.

4.2 Rated current

The rated current of a circuit of a consumer unit is stated by the manufacturer, taking into consideration the ratings of the components of the electrical equipment in the circuit within the assembly, their disposition and application. This current shall be carried without the temperature rise of its several parts exceeding the limits specified in **7.3** of Part 1 when tested according to **8.2.1**.

NOTE Due to the complex factors determining the rated currents, no standard values can be given.

If the consumer unit has only one incoming circuit, the rated current of this incoming circuit determines the rated current of the consumer unit. The rated current of the incoming circuit(s) shall not exceed 100 A.

4.3 Rated short-time withstand current (of a circuit of an ASSEMBLY)

The provisions of this subclause in Part 1 are not applicable.

4.4 Rated peak withstand current (of a circuit of an ASSEMBLY)

The provisions of this subclause in Part 1 are not applicable.

4.5 Rated prospective short-circuit withstand current (of a circuit of an ASSEMBLY)

The provisions of this subclause in Part 1 are not applicable.

4.6 Rated conditional short-circuit current (of a circuit of an ASSEMBLY)

The provisions of this subclause in Part 1 are not applicable.

4.7 Rated fused short-circuit current (of a circuit of an ASSEMBLY)

The provisions of this subclause in Part 1 are not applicable.

4.8 Rated diversity factor

A rated diversity factor as defined in Part 1 and expressed in Table I of Part 1 does not apply to consumer units, owing to the flexibility of selection of outgoing protective devices (see **8.2.1.3**). Consumer units are rated and tested at the rated current of the isolating means for the incoming circuit (see **4.2**).

4.9 Rated frequency

The rated frequency of the ASSEMBLY is the value of frequency which designates it and to which the operating conditions are referred. For ASSEMBLIES in this Part the rated frequency shall be 50 Hz.

5 Information to be given regarding the ASSEMBLY

The following information shall be given by the manufacturer either on the nameplate or in some other way.

5.1 Nameplates

Each ASSEMBLY shall be provided with one or more plates, marked in a durable manner and located in a place such that they are visible and legible when the ASSEMBLY is installed.

Information specified under a), b) and c) shall be given on the nameplate. The rated current, r), shall be given either on the nameplate or on the means of isolation; in either case it shall be clearly visible after installation. A warning notice shall be provided and be clearly visible after installation stating that the rated current must not be exceeded.

Information from d) to q) may, where applicable, be given on the nameplates, in the relevant documents, the circuit diagrams or in the manufacturer's list or catalogues:

a) the manufacturer's name or trademark;

NOTE The final assembler of the ASSEMBLY is deemed to be its manufacturer (see note 2 to **2.1.1.1** of Part 1).

b) type designation or identification number making it possible to get relevant information from the manufacturer;

c) the number and date of this Part of BS 5486, i.e. BS 5486-13:1989[1)];

d) rated frequency, i.e. 50 Hz;

e) rated operational voltages (see **4.1.1** of Part 1);

f) rated insulation voltage (see **4.1.2** of Part 1);

g) rated voltages of auxiliary circuits (if applicable);

h) limits of operation (see clause **4**);

i) rated current of each circuit (if applicable; see **4.2**);

k) short-circuit withstand strength (see **7.5.2**);

l) degree of protection (see **7.2.1** of Part 1);

m) measures for the protection of persons (see **7.4**);

n) service conditions for indoor use, outdoor use or special use, if different from the usual service conditions as given in **6.1** of Part 1;

o) type of system earthing for which the ASSEMBLY is designed;

p) dimensions (see Figure C3 of Part 1), given preferably in the order of height, width (or length), depth;

q) mass;

r) rated current of consumer unit (see **4.2**).

5.2 Markings

Means shall be provided for the identification of the circuit connected to each outgoing fuseway, outgoing circuit-breaker way or outgoing protective device way.

Where the means of identification is detachable, the relationship between the identification and the appropriate outgoing way shall be readily ascertainable.

Where items of equipment in the consumer unit are designated, the designations used shall be identical with those in the wiring diagrams, which may be supplied with the consumer unit.

[1)] Marking BS 5486-13:1984 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of such a claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

5.3 Instructions for installation, operation and maintenance

The provisions of this subclause in Part 1 shall apply.

6 Service conditions

6.1 Normal service conditions

The provisions of this subclause in Part 1 shall apply.

6.2 Special service conditions

The requirements of Part 1 apply except that recessing of Flush type units into walls is not considered a special condition (see **6.2.9** of Part 1).

6.3 Conditions during transport, storage and erection

The provisions of this subclause in Part 1 shall apply.

7 Design and construction

7.1 Mechanical design

7.1.1 *General.* The ASSEMBLY shall incorporate manual means of double pole isolation on the incoming circuit(s) and an assembly of one or more of the following on the outgoing circuits:

fuses;

miniature circuit-breakers;

protective devices/residual current or fault voltage operated connected to common busbar(s) with associated multi-terminal neutral bar(s) and multi-terminal protective conductor bar(s).

The ASSEMBLIES shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity which are likely to be encountered in normal service. For parts of consumer units which are made of plastics materials the resistance to thermal stresses shall be verified according to **8.2.10**.

NOTE Parts which only serve aesthetic purposes, which are not intended for protection against electric shock, and which are not in contact with live parts need not be tested.

Protection against corrosion shall be ensured by the use of suitable materials or by the application of equivalent protective coatings to the exposed surface, taking account of the intended conditions of use and maintenance. Ferrous structural parts of consumer units, including enclosures, shall have an adequate resistance to rusting when tested in accordance with **8.2.9**.

All enclosures or partitions shall be of a mechanical strength sufficient to withstand the stresses to which they may be subjected in normal service. Enclosures of consumer units shall in addition withstand an impact strength test in accordance with **8.2.8**.

The apparatus and circuits in the ASSEMBLIES shall be so arranged as to facilitate their operation and maintenance and at the same time ensure the necessary degree of safety.

The covers of enclosures, other than those provided solely for aesthetic purposes, that are intended to be opened without tools, shall be provided with a means of attaching and fastening which shall guard against omission, loss or fracture of any part of the fastening device.

Doors and similar parts provided with hinges shall open to at least 90°.

7.1.2 *Clearances, creepage distances and isolating distances*

7.1.2.1 *Clearances and creepage distances.* The provisions of this subclause in Part 1 shall apply.

7.1.2.2 *Isolating distances.* Not applicable.

7.1.2.3 *Isolation.* Means of isolation from the incoming phase and neutral supply conductors shall be provided by means of one of the following:

a) a double pole switch;

b) a double pole miniature circuit-breaker;

c) a double pole earth fault protective device (residual current or fault voltage operated).

7.1.3 *Terminals for external conductors*

7.1.3.1 The provisions of this subclause in Part 1 shall apply.

7.1.3.2 Unless otherwise agreed between the manufacturer and the user, terminals shall be so designed that conductors and cables of the indicated material, from the smallest to the largest cross-sectional areas corresponding to the appropriate rated currents, can be connected (see Appendix A).

NOTE For the purpose of this standard, the user is the person or authority responsible for selecting the equipment for the intended use.

7.1.3.3 The provisions of this subclause in Part 1 shall apply.

7.1.3.4 A multi-terminal bar shall be provided for the neutral conductors. The terminals shall correspond in number to the number of outgoing circuits; their identification or location shall ensure that the final circuit neutral conductors can be readily connected in the same sequence as that of their respective phase conductors in relation to the associated outgoing circuits.

Terminals for outgoing neutral conductors shall be capable of clamping a single conductor from 1 mm^2 up to and including 6 mm^2. The terminals shall also be capable of clamping two or three 2.5 mm^2 conductors or two 4 mm^2 conductors.

Where there is provision for a fuse or miniature circuit-breaker rated in excess of 35 A, at least one terminal shall be capable of clamping one 16 mm^2 conductor.

Connections between the neutral pole of the means of isolation and the neutral bar shall be made by means of an incorporated connection or by a conductor of appropriate rating connected to terminals.

7.1.3.5 A multi-terminal bar shall be provided for the protective conductors. The terminals shall correspond in number to the number of outgoing circuits and their identification or location shall ensure that the final circuit protective conductors can be readily connected in the same sequence as that of their respective phase conductors in relation to the associated outgoing circuits. In addition, terminals shall be provided for the earthing lead and two bonding conductors to be connected to the bar.

All terminals for outgoing conductors shall be capable of clamping a single conductor of between 1 mm^2 and 6 mm^2. The terminals shall also be capable of clamping two 2.5 mm^2 conductors or three 1.5 mm^2 conductors.

7.1.3.6 Openings in cable entries, cover plates, etc., shall be so designed that when the cables are properly installed, the stated protective measures against contact and degree of protection shall be obtained. This implies the selection of means of entry suitable for the application as stated by the manufacturer.

In metal enclosures provision shall be made for at least one conduit entry of appropriate size for the incoming cables and for one conduit entry for each outgoing way. It is permissible to provide an opening or openings at the rear of the enclosure for back-entry wiring.

In non-metallic enclosures suitable provision for cable entry for the incoming cables and for all outgoing cables shall be made. Both reduced sections in the sides and one or more openings in the back are suitable for this purpose. Entries shall be of sufficient size to accommodate sheathed cables of the appropriate rating. The timber of any wooden frames shall be of a suitable quality to facilitate the making of cable entries.

7.1.3.7 Terminals for outgoing phase conductors having a current rating of less than 30 A shall be capable of clamping conductors from 1 mm^2 to 4 mm^2 inclusive.

Terminals for outgoing phase conductors having a current rating of 30 A or 32 A shall be capable of clamping either one 6 mm^2 conductor, or two 4 mm^2 conductors, or two or three 2.5 mm^2 conductors.

Terminals for outgoing phase conductors having a current rating of between 35 A and 50 A shall be capable of clamping one 16 mm^2 conductor.

7.2 Enclosure and degree of protection

The provisions of this subclause in Part 1 shall apply.

7.3 Temperature rise

The provisions of this subclause in Part 1 including Table III shall apply.

7.4 Protection against electric shock

7.4.1 *Protection against both direct and indirect contact.* Not applicable.

7.4.2 *Protection against direct contact (see **2.6.8** of Part 1).* Protection against electric shock in normal service can be obtained either by appropriate constructional measures on the ASSEMBLY itself or by additional measures to be taken during installation; this may require information to be given by the manufacturer.

One or more of the protective measures defined hereinafter may be selected, taking into account the requirements laid down in the following subclauses. The choice of the protective measure shall be subject to an agreement between the manufacturer and the user.

NOTE Information given in the manufacturer's current catalogues may take the place of such an agreement.

7.4.2.1 *Protection by insulation of live parts.* The provisions of this subclause in Part 1 shall apply.

7.4.2.2 *Protection by barriers or enclosures.* The provisions of this subclause in Part 1 shall apply.

7.4.2.3 *Protection by obstacles.* Not applicable.

7.4.3 *Protection against indirect contact (see **2.6.9** of Part 1).* The user shall indicate the protective measure which is applied to the installation for which the ASSEMBLY is intended. In particular, attention is drawn to "Regulations for Electrical Installations" published by the Institution of Electrical Engineers, where requirements for protection against shock in case of a fault are specified for the complete installation, e.g. the use of protective conductors.

7.4.3.1 *Protection by using protective circuits.* A protective circuit in an ASSEMBLY consists of either a separate protective conductor or the conductive structural parts or both. It provides the following:

a) protection against the consequences of faults within the ASSEMBLY;

b) protection against the consequences of faults in external circuits supplied through the ASSEMBLY.

The requirements to be complied with are given in the following subclauses.

7.4.3.1.1 Constructional precautions shall be taken to ensure electrical continuity between the exposed conductive parts of the ASSEMBLY (see **7.4.3.1.5**) and between these parts and the protective circuits of the installation (see **7.4.3.1.6**).

7.4.3.1.2 The provisions of this subclause in Part 1 shall apply.

7.4.3.1.3 The provisions of this subclause in Part 1 shall apply.

7.4.3.1.4 The provisions of this subclause in Part 1 shall apply.

7.4.3.1.5 Continuity of protective circuits shall be ensured by effective interconnections either directly or by means of protective conductors, and in accordance with the provisions of items a), c), d), e), f) and g) of this subclause in Part 1. Special precautions may be necessary with metal parts of the assembly where abrasion resistant finishes, e.g. powder coatings, are used.

7.4.3.1.6 The provisions of this subclause in Part 1 shall apply. (See also **7.1.3.5**.)

7.4.3.1.7 The provisions of this subclause in Part 1 shall apply.

7.4.3.1.8 The provisions of this subclause in Part 1 shall apply.

7.4.3.1.9 The provisions of this subclause in Part 1 shall apply.

7.4.3.2 *Protection by measures other than using protective circuits.* The provisions of this subclause in Part 1 shall apply.

7.4.4 *Discharging of electrical charges.* The provisions of this subclause in Part 1 shall apply.

7.4.5 *Operating and maintenance gangways within ASSEMBLIES.* Not applicable.

7.4.6 *Requirements related to accessibility in service by authorized personnel.* Not applicable.

7.5 Short-circuit protection and short-circuit withstand strength

7.5.1 *General.* ASSEMBLIES shall be so constructed as to be capable of withstanding the thermal and dynamic stresses resulting from short-circuit currents up to the rated values.

NOTE The short-circuit stresses may be reduced by the use of current-limiting devices (inductances, current-limiting fuses or other current-limiting switching devices).

7.5.2 *Information concerning the short-circuit withstand strength*

7.5.2.1 For an ASSEMBLY having only one incoming unit, the manufacturer shall state the short-circuit withstand strength of any short-circuit protective device incorporated in the incoming unit in accordance with **7.5.2.1** of Part 1.

7.5.2.2 For an ASSEMBLY having several incoming units incorporating short-circuit devices which are unlikely to be in operation simultaneously, the short-circuit withstand strength may be indicated for each of the incoming units in accordance with **7.5.2.1**.

7.5.2.3 Not applicable.

7.5.3 *Relationship between peak and r.m.s. values of short-circuit current.* The provisions of this subclause in Part 1 including Table V shall apply for tests other than those detailed in **8.2.3.2**.

7.5.4 *Co-ordination of short-circuit protective devices.* The provisions of this subclause in Part 1 shall apply.

7.5.5 *Circuits within an ASSEMBLY.* The provisions of this subclause in Part 1 shall apply.

7.6 Components installed in ASSEMBLIES

7.6.1 *Selection of components.* The components shall be suitable for the particular application with respect to their rated voltages, rated currents, service life, making and breaking capacities, short-circuit withstand strength, etc.

Components incorporated in the ASSEMBLIES shall comply with the relevant British Standards.

Fuses shall comply with either BS 1361 or BS 3036; miniature circuit-breakers shall comply with BS 3871-1.

Incoming switches shall comply with BS 5419 and have utilization category at least AC-21 at the rated current of the ASSEMBLY.

Residual current operated protective devices shall comply with BS 4293, or other specifications having safety and performance requirements no less suitable.

Fault voltage operated protective devices shall comply with BS 842.

Means of isolation shall have provision to prevent unintentional reclosure.

When fuses are incorporated the design shall be such that it is not possible to interchange fuse carriers so as to put into circuit a carrier of greater current rating than that which is intended without the use of tools. This requirement does not apply to 15 A, to 16 A, or to 20 A carriers; carriers of these ratings may have identical fixing arrangements and are distinguished only by marking.

When miniature circuit-breakers are incorporated the design shall be such that it is not possible to interchange miniature circuit-breakers so as to put into circuit a breaker of greater current rating than that which is intended without the use of tools. This requirement does not apply to 15 A, to 16 A, or to 20 A breakers; breakers of these ratings are dimensionally identical and are distinguished only by marking.

NOTE It is assumed that for normal applications there would be no requirements for more than one fuse or miniature circuit-breaker rated in excess of 35 A.

7.6.2 *Installation of components.* The provisions of this subclause in Part 1 shall apply.

7.6.3 *Fixed parts.* The provisions of this subclause in Part 1 shall apply.

7.6.4 *Removable parts and withdrawable parts.* Not applicable.

NOTE For the purposes of this Part a fuse-link is not considered to be a removable part (i.e. a part having a removed position).

7.6.5 *Identification.* The provisions of this subclause in Part 1 shall apply.

7.7 Internal separation of ASSEMBLIES by barriers or partitions

One or more of the following conditions can be attained by dividing ASSEMBLIES by means of partitions or barriers into separate compartments or barriered subsections:

a) protection against contact with live parts belonging to the adjacent functional units;

b) limitation of the probability of accidentally initiating arcs;

NOTE The effects of an accidental arc can be reduced considerably by the use of means limiting the magnitude and duration of the short-circuit current.

c) protection against the passage of solid foreign bodies from one unit of an ASSEMBLY to an adjacent unit.

Typical forms of separation are as follows:

a) separation of the busbars from the functional units;

b) in certain cases, separation of functional units from each other as well as from the busbars.

The purpose and extent of internal separation shall be the subject of an agreement between the manufacturer and the user.

Internal reliable separation of circuits with different voltages shall be provided where necessary.

7.8 Electrical connections inside an ASSEMBLY: Bars and insulated conductors

7.8.1 *General.* The provisions of this subclause in Part 1 shall apply.

7.8.2 *Dimensions and rating of busbars and insulated conductors.* The provisions of this subclause in Part 1 shall apply.

7.8.3 *Wiring (see also **7.8.2** of Part 1).* The provisions of this subclause in Part 1 shall apply (see also **7.1.3**).

7.9 Requirements for electronic equipment supply circuits

The provisions of this subclause in Part 1 shall apply.

8 Test specifications

8.1 Classification of tests

The tests to verify the characteristics of an ASSEMBLY include the following:

a) type tests (see **8.1.1** and **8.2**);

b) routine tests (see **8.1.2** and **8.3**).

8.1.1 *Type tests (see 8.2).* Type tests are intended to verify compliance with the requirements laid down in this standard for a given type or range of ASSEMBLY.

Type tests shall be carried out on a sample of an ASSEMBLY having the least number of ways, or on such parts of ASSEMBLIES manufactured to the same design.

They shall be carried out on the initiative of the manufacturer.

The type tests shall be made by the manufacturer, who shall arrange for a recognized authority to make type tests for which he is not equipped.

The manufacturer shall hold available certificates of such type tests as evidence of compliance with the requirements of this standard together with detailed drawings and a record of any alterations that have been made subsequent to the type tests.

Type tests include:

a) verification of temperature-rise limits (**8.2.1**);

b) verification of the dielectric properties (**8.2.2** of Part 1);

c) verification of the short-circuit withstand strength (**8.2.3**);

d) verification of the continuity of the protective circuit (**8.2.4**);

e) verification of clearances and creepage distances (**8.2.5** of Part 1);

f) verification of mechanical operation (**8.2.6** of Part 1);

g) verification of the degree of protection (**8.2.7** of Part 1);

l) verification of impact strength (**8.2.8**);

m) verification of resistance to rusting (**8.2.9**);

n) verification of resistance of plastics materials to heat (**8.2.10**).

These tests may be carried out in any order and/or on different samples of the same type.

If modifications are made to the components of the ASSEMBLY new type tests have to be carried out only in so far as such modifications are likely to adversely affect the results of these tests.

8.1.2 *Routine tests (see 8.3).* Routine tests are intended to detect faults in materials and workmanship. They are carried out on every new ASSEMBLY after its assembly or on each transport unit. Another routine test at the place of installation is not required.

ASSEMBLIES which are assembled from standardized components outside the works of the manufacturer of these components, by the exclusive use of parts and accessories specified or supplied by the manufacturer for this purpose, shall be routine-tested by the firm which has assembled the ASSEMBLY.

Routine tests are as follows:

a) inspection of the ASSEMBLY including inspection of wiring and, if necessary, electrical operation test (see **8.3.1**);

b) dielectric test (applies only for consumer units containing internal wiring, as distinct from busbars) (see **8.3.2**);

c) checking of protective measures and of the electrical continuity of the protective circuit (see **8.3.3**).

These tests may be carried out in any order.

8.1.3 *Testing of devices of self-contained components incorporated in the ASSEMBLY.* The provision of this subclause in Part 1 shall apply.

The test shall normally be carried out at the values of rated current in accordance with **8.2.1.3** with the apparatus of the ASSEMBLY installed.

The test shall be carried out in accordance with the type of duty for which the sample is designed.

The temperature-rise test on the individual circuits shall be made with the type of current for which they are intended, and at the design frequency. The test voltages used shall be such that a current equal to the current determined according to **8.2.1.3** flows through the circuits. Coils of relays, contactors, releases, etc., shall be supplied with rated voltages.

8.2.1.2 *Arrangement of the ASSEMBLY.* The ASSEMBLY shall be arranged as in normal use, with all covers etc. in place.

8.2.1.3 *Temperature-rise test using current on all apparatus.* The test shall be made on one or more representative combinations of circuits so chosen as to cover with reasonable accuracy the worst conditions for which the consumer unit is designed.

If the consumer unit includes fuses, these shall be fitted with fuse-links as specified by the manufacturer. If fuse-links complying with BS 1361 are fitted for the test the power losses of the fuse-links shall be stated in the test report.

The size and the disposition of external conductors used for the test shall be stated in the test report.

The test shall be made for a time sufficient for the temperature rise to reach a constant value (but not exceeding 8 h). In practice, this condition is reached when the variation does not exceed 1 K/h.

When a control electromagnet is energized during the test, the temperature shall be measured when thermal equilibrium is reached in both the main circuit and the control electromagnet.

NOTE To shorten the test, if the devices allow it, the current may be increased during the first part of the test, it being reduced to the specified test current afterwards.

Table VIII — Standard cross sections of copper conductors corresponding to the test current

Range of actual rated current[a], A	0 7.9	7.9 14.9	14.9 22	22 29.9	29.9 39	39 43	43 72	72 93	93 117
Cross section, mm^2	1	1.5	2.5	4	6	10	16	25	35
Values of the rated thermal current[b], A	⩽ 6	10	15 (16)[c] 20		30 (32)[c]	40	45 50 60 (63)[c]	80	100

[a] The value of current shall be greater than the value in the first line and less than or equal to the value in the second line.
[b] These are standard recommended currents and are given for reference purposes only.
[c] The rated thermal current values in parentheses are alternatives to the previous values.

In the absence of detailed information on service conditions, the external conductors shall be single-core, PVC insulated, copper cables with cross-sectional areas as given in Table VIII.

The supply shall be alternating current at any convenient voltage at a frequency of approximately 50 Hz. The ambient temperature shall be between 20 °C and 25 °C.

As far as practicable the cables shall be in free air. The minimum length of each temporary cable from terminal to terminal shall be:

a) 1 m for cross sections up to and including 10 mm^2;

b) 2 m for cross sections larger than 10 mm^2.

Type tests for temperature rise shall be made on consumer units at their current ratings. The units shall be in a clean new condition; they shall be tested in surroundings free from external draughts and shall be mounted and wired as in service.

Each pair of outgoing conductors shall be bunched together for the first metre as measured from the unit and each cable entry shall be plugged to prevent the unrestricted entry of air.

For the purposes of the test, a current equal to the current rating of the consumer unit shall be distributed among the least possible number of outgoing ways, taking into account the provisions of the note in **7.6.1** in such a manner that each fuse or miniature circuit-breaker is loaded, preferably to between 60 % and 70 % of its current rating. The test shall be so arranged that the means of isolation and the loaded fuses or miniature circuit-breakers are, as far as practicable, adjacent to one another. If alternative mounting positions are possible, the unit shall be mounted for test with the fuses or miniature circuit-breakers one above the other. Where a unit consists of one outgoing way in combination with a switch, the test current shall be equal to the highest current rating of the fuse or miniature circuit-breaker which it will accommodate. When cartridge fuse-links are used for the test they shall comply with BS 1361.

The power loss of the fuse-link used for the test shall be recorded in the test report.

8.2.1.4 *Temperature-rise test using heating resistors with an equivalent power loss.* Not applicable.

8.2.1.5 *Measurement of temperatures.* The provisions of this subclause in Part 1 shall apply.

8.2.1.6 *Ambient air temperature.* The provisions of this subclause in Part 1 shall apply.

8.2.1.7 *Results to be obtained.* The provisions of this subclause in Part 1 shall apply.

8.2.2 *Verification of dielectric properties.* The provisions of this subclause in Part 1 including Table X shall apply.

8.2.3 ***Verification of the short-circuit withstand strength***

8.2.3.1 *Test arrangements.* The ASSEMBLY shall be set up as in normal use. It will be sufficient to test a single functional unit if the remaining functional units are constructed in the same way and cannot affect the test result.

8.2.3.2 *Short-circuit test procedure.* The following test procedure is intended to verify the performance of the incoming device and its connections, and any other item in the ASSEMBLY not separately rated in excess of 16 kA, when the complete ASSEMBLY is protected by a fuse-link complying with type II of BS 1361:1971. This type test shall be deemed to cover the use of any other short-circuit protective device having a Joule integral ($I^2 t$) and cut-off current not exceeding the values given in item b) below, at the rated voltage, prospective current and power factor.

a) It shall be verified that the representative samples of the final circuit protective devices used for the test comply with Table 101 and Table 102 where applicable.

Table 101 — Requirements for final circuit protective devices: Miniature circuit-breakers complying with BS 3871-1

Circuit-breaker type	Time	Test current / Rated current	Result
	h		
1,2,3,4	2	1.0	No trip
	1	1.5 (rating < 10 A)	Trip
		1.35 (rating > 10 A)	Trip
B.C.D.	1	1.13	No trip
	1[a]	1.45	Trip

NOTE Test to be conducted at specified reference ambient temperature.
[a] This test to commence within five seconds of the end of the test at 1.13.

Table 102 — Requirements for final circuit protective devices: Semi-enclosed fuses complying with BS 3036 and cartridge fuses complying with BS 1361, Type 1

Fuse rating	Time	Test current / Rated current	Result
A	h		
5(6)	0.75	1.0	Fuse intact
15(16)	1.0		
20	1.0		
30(32)	1.25		
45	1.5		
5(6)	0.75	2.0	Fuse melted
15(16)	1.0		
20	1.0		
30(32)	1.25		
45	1.5		

b) The reference fuse shall be a 100 A fuse-link complying with type II of BS 1361:1971. Details of the fuse-links used for the test, i.e. manufacturer's name, reference, rated current, rated voltage and pre-arcing $I^2 t$, shall be given in the test report.

c) The final circuit protective device shall be mounted as in service in the manufacturer's smallest recommended enclosure complying with this Part of BS 5486 (metal if offered in the catalogue). The connection on the load side of the protective device under test shall be in accordance with Table 103 and 0.6 ± 0.05 m in length.

d) The test circuit shall be connected as shown in Figure 101. The relative positions of the closing switch, inductive reactor and resistor are not obligatory, but the resistor and reactor shall be in series with the master circuit-breaker.

e) The impedance used for limiting the prospective short-circuit fault current to the required value shall be inserted on the supply side of the circuit.

Resistors shall be connected between line and neutral, after the impedances for adjusting the prospective current, so as to draw current of 10 A per phase at rated voltage from the supply, if an air-cored inductor is used, a resistor taking approximately 1 % of the current through the inductor shall be connected in parallel with it.

A lower value of shunt current may be used with the consent of the manufacturer.

8.2.3.3 *Circuit conditions.* The applied voltage shall be not less than 100 % and not more than 110 % of the rated single phase voltage of the final circuit protective device. The recovery voltage measured two cycles after operation shall be not less than 95 % nor more than 105 % of the rated single phase voltage of the final circuit protective device, and shall be maintained for at least 30 s after the interruption of the short-circuit current. The higher limit of 105 % may be exceeded with the consent of the manufacturer.

Table 103 — Cross sections of copper conductors on load side of protective device under test

Device rating		Conductor
A		mm^2
	≤ 6	1.0
> 6	≤ 10	1.5
> 10	≤ 20	2.5
> 20	≤ 32	6.0
> 32	≤ 40	10.0

The value of the prospective short-circuit current shall be 16 kA – 0 % at a power factor of 0.6 ± 0.05 determined from a calibration oscillogram taken with a link of negligible impedance positioned as shown in Figure 101. All parts of the equipment normally earthed in service, including its enclosure, shall be insulated from earth, but shall be connected to the neutral of the supply or to a substantially inductive artificial neutral, permitting a prospective fault current of at least 100 A. This connection shall include a reliable device, such as a fuse consisting of a copper wire of 0.1 mm diameter and not less than 50 mm in length, for the detection of the fault current and, if necessary, a resistor to limit the value of the prospective fault current to approximately 100 A.

8.2.3.4 *Test sequence.* The ASSEMBLY shall be subject to the following two tests A and B with the outgoing way fitted with a final circuit protective device of the maximum thermal current rating.

If the final circuit protective devices have a short-circuit rating less than 16 kA, two further tests A and B shall be carried out with a device of the minimum thermal rating fitted.

In addition, if the ASSEMBLY is designed to accept different types or ranges of outgoing devices, each type or range shall be further tested separately.

The two tests are as follows.

a) *Test A.* With the circuit connected as described above, with all fuses in place and all circuit-breakers closed, the test voltage is applied with the point-on-wave controlled to provide initiation of the fault at between 0° and 20° (electrical) on the rising voltage.

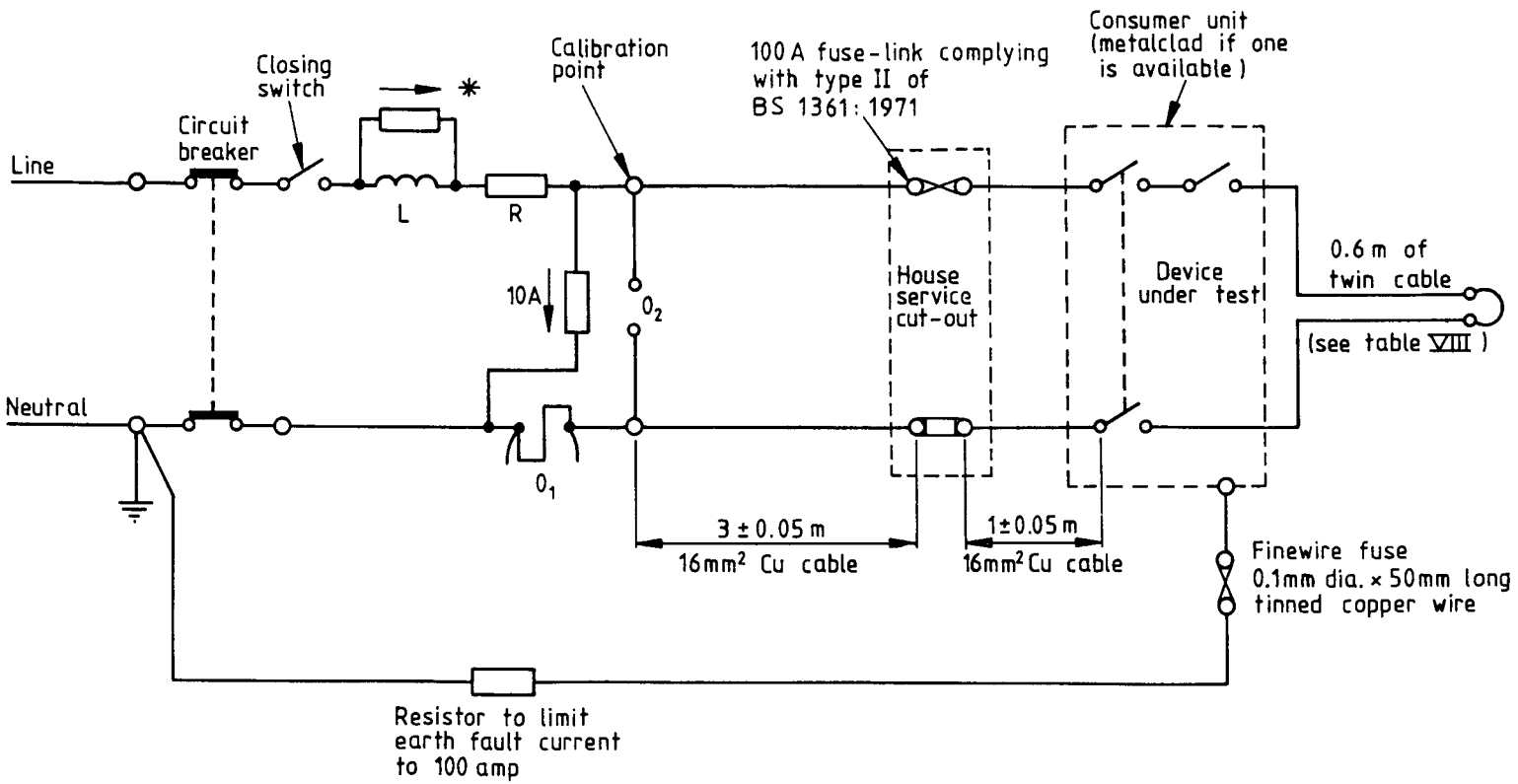
b) *Test B.* A further short-circuit operation shall be applied after suitable preparation as indicated in Table 104 dependent on which of the alternative results of test A is achieved. If circuit-breakers are included in the ASSEMBLY, the test shall be applied by reclosing a circuit-breaker with the test circuit energized. If fuses are used, the test shall be as in test A.

During the tests cheesecloth shall be placed on the outside of the enclosure at all openings, e.g. arc vents and handles. There shall be no ignition of the cheesecloth.

The cheesecloth shall be clean and dry bleached plain cotton of approximately 30 g to 40 g per square metre. When placed into position the cheesecloth shall be folded loosely in such a manner that cut and torn edges will not be exposed directly to the arc or flash. Ignition of the cheesecloth is considered to have occurred when a flame is visible. Smouldering is not considered to be evidence of ignition. The cheesecloth may be changed following each test B. Details of the I^2 t let through by the combination of devices during the test shall be given in the test report. A new ASSEMBLY of the same design may be used for each of the two test sequences.

Table 104 — Preparation for test B

		Result of test A		
Reference fuse complying with BS 1361		**Intact**	**Blown**	
Protective device		**Operated**		**Not operated**
Final circuit preparation for test B	MCB complying with BS 3871 or RCCB complying with BS 4293	Nil	Replace reference fuse	Replace reference fuse, open circuit-breaker
	Fuse complying with BS 3036	Rewire test fuse	Replace reference fuse. Rewire test fuse	Replace reference fuse
	Fuse complying with BS 1361	Replace test fuse	—	—



* Regulator to take approximately 1 % of the current through the inductor.

NOTE O_1 and O_2 are oscillograph connections.

Figure 101 — Test circuit to prove coordination of characteristics

8.2.3.5 *Conditions after test.* Where the incoming switch is a protective device, e.g. miniature circuit-breaker (mcb) or residual current-operated circuit-breaker (rccb), the test report shall state which of the protective devices operated during the test, i.e. the incoming and/or outgoing devices.

The earth fault indicating device shall be intact and the degree of protection of the enclosure shall not be impaired.

The insulation resistance a) shall be measured within 3 min of the conclusion of the series of tests. The insulation resistance for b) and c) shall be measured as soon as practical after measurement of a), the times of measurement of b) and c) being recorded in the test report. The values shall be measured at 500 V d.c. and shall not be less than the following.

a) 0.10 MΩ between the final circuit protective device incoming terminal and the corresponding outgoing terminal, with the incoming isolating device open and with the blown fuse in position or the mcb opened, whichever is applicable.

b) 0.25 MΩ between the final circuit protective device terminals and earth, with the final circuit fuse rewired, the final circuit cartridge fuse replaced, or the mcb reclosed, whichever is applicable, and with the incoming isolating device open.

c) 0.25 MΩ between the final circuit protective device incoming terminals and any other metal parts which are unearthed and exposed in service.

The condition of the incoming isolating device shall comply with its product specification with regard to isolating properties. The conductors shall not be deformed such that the clearance and creepage distances specified in **7.1.2** are impaired. There shall be no loosening of parts used for the connection of the conductors.

Where an rccb is included in the ASSEMBLY its operation shall be checked. With the rccb fully closed and connected to a supply at 0.85 times rated voltage ± 5 % the test device shall be operated. The rccb shall open.

8.2.4 *Verification of the effectiveness of the protective circuit*

8.2.4.1 *Verification of effective connection between the exposed conductive parts of the ASSEMBLY and the protective circuit.* It shall be verified that the different exposed conductive parts of the ASSEMBLY are effectively connected to the protective circuit in accordance with the requirements of **7.4.3.1**.

In case of doubt, where constructional methods other than those quoted in **7.4.3.1.1** of Part 1 are used to ensure continuity, a measurement may be carried out to verify that the resistance between the terminal for the incoming protective conductor and the relevant exposed conductive part of the ASSEMBLY does not exceed 0.1 Ω when measured by a current of 25 A.

8.2.4.2 *Verification of the short-circuit strength of the protective circuit by test.* Not applicable.

8.2.4.3 *Results to be obtained.* Not applicable.

8.2.5 *Verification of clearances and creepage distances.* The provisions of this subclause in Part 1 shall apply.

8.2.6 *Verification of mechanical operation.* The provisions of this subclause in Part 1 shall apply.

8.2.7 *Verification of degree of protection.* The provisions of this subclause in Part 1 shall apply.

8.2.8 *Verification of impact strength.* Under consideration.

8.2.9 *Verification of resistance to rusting.* The test is carried out either on the whole consumer unit, or on separate parts of it. It is permissible to test pieces of large parts, provided that the protection against rust on the piece taken for testing is the same as that in the final construction.

All grease shall be removed from the parts, or representative samples of the consumer unit to be tested, by immersion in a suitable cleaning agent for 10 min. The parts shall then be immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of 20 ± 5 °C.

Without drying but after shaking off any drops of ammonium chloride solution, the parts shall be placed for 10 min in a box containing air saturated with moisture and 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.

Traces of rust on edges and any yellowish film removable by rubbing shall be ignored.

For small helical springs and similar components, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film; the test shall be made without removal of the grease.

8.2.10 ***Verification of resistance of plastics materials to heat***

8.2.10.1 Compliance shall be checked by the tests described in **8.2.10.2**, **8.2.10.3** and **8.2.10.4**. These tests shall be applied to consumer units after removal of their built-in components, e.g. switching devices, indicating lights.

8.2.10.2 The consumer unit shall be kept for 1 h in a heating cabinet at a temperature of 80 ± 3 °C.

The structural parts of the consumer unit, e.g. enclosure and covers, shall not undergo any change impairing further use of the consumer unit.

Marking shall remain easily legible.

It is permissible to test individual parts, e.g. panels, boxes and enclosures, of the consumer unit, provided proper precautions are taken to make the test representative.

Where installed components are likely to affect the result of the test, these components shall be incorporated for the test.

8.2.10.3 Parts of plastics material necessary to retain current-carrying parts shall be subjected to a ball pressure test by means of the apparatus shown in Figure 102.

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

The test shall be made in a heating cabinet at a temperature of 125 ± 2 °C. After 1 h the ball shall be removed from the sample which shall then be cooled down within 10 s to approximately room temperature by immersion in cold water. The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

8.2.10.4 Other parts constructed of plastics material that do not retain current-carrying parts in position even where they are in contact with them, shall be subjected to a ball pressure test as described in **8.2.10.2** but the test shall be made at a temperature of 70 ± 2 °C.

NOTE to **8.2.10.2** and **8.2.10.3**. For the purposes of **8.2.10.2** and **8.2.10.3** parts of an earthing circuit are considered to be current carrying parts.

8.3 Routine tests

8.3.1 *Inspection of the ASSEMBLY including inspection of wiring and, if necessary, electrical operation test.* The provisions of this subclause in Part 1 shall apply.

8.3.2 ***Dielectric test***

8.3.2.1 *General.* This test is only for ASSEMBLIES containing internal wiring, as distinct from busbars.

A dielectric test is not required on ASSEMBLIES containing busbars and/or prefabricated main circuit wiring only, nor on simple constructions where an inspection under **8.1.2** a) is sufficient. The test voltage according to **8.2.2.4** of Part 1 shall be applied for 1 s. The a.c. source shall have sufficient power so as to maintain the test voltage irrespective of all leakage currents. The test voltage shall have a practically sinusoidal wave form and a frequency between 45 Hz and 62 Hz.

All electrical equipment of the ASSEMBLY shall be connected for the test, except that apparatus which, according to the relevant specifications, is designed for a lower test voltage, and current consuming apparatus, e.g. windings and measuring instruments, in which the application of the test voltage would cause the flow of a current, shall be disconnected at its terminals.

Anti-interference capacitors installed between live and exposed conductive parts shall not be disconnected and shall be capable of withstanding the test voltage.

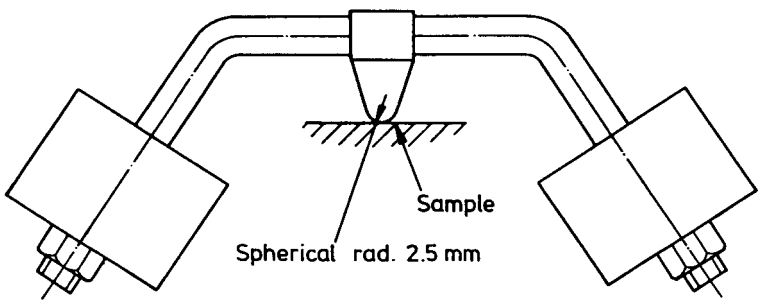


Figure 102 — Ball-pressure apparatus

For the test, either:

a) all switching devices shall be closed; or

b) the test voltage shall be applied successively to all parts of the circuit.

The test voltage shall be applied between the live parts and the frame of the ASSEMBLY.

8.3.2.2 *Value of test voltage.* The provisions of this subclause in Part 1 shall apply.

8.3.2.3 *Results to be obtained.* The provisions of this subclause in Part 1 shall apply.

8.3.3 *Checking of protective measures and of the electrical continuity of the prospective circuits.* The provisions of this subclause in Part 1 shall apply.

8.3.4 *Verification of insulation resistance.* Not applicable.

Appendix A Minimum and maximum cross sections of copper conductors suitable for connection

(See **7.1.3.2**)

Provision shall be made for the connection of one incoming copper cable per terminal, at least over the range of sizes specified in Table 105. Apart from the removal of the insulation no special preparation of the end of the conductor is permitted, other than the reshaping of the conductor before its introduction into the terminal.

Table 105 — Cross sections of copper conductors suitable for connection

Rated current of incoming conductor	Cross sections of rigid (solid or stranded) conductors
A	mm^2
5 (6)[a]	1 to 10
10	1 to 10
15 (16)[a]	1 to 10
20	1 to 10
30 (32)[a]	1 to 10
40	1 to 16
45	1 to 16
50	1 to 16
60 (63)[a]	6 to 25
80	10 to 35
100	16 to 35[b]

[a] The rated current values in parentheses are alternatives to the previous values.

[b] Provision for accommodation of conductors up to 50 mm^2 may be required. In this event such provision should be specified additionally by the user.

Appendix B Method of calculating the cross-sectional area of protective conductors with regard to thermal stresses due to currents of short duration

The provisions of this appendix in Part 1 shall apply.

Appendix C Typical examples

For the purposes of this Part Figure C1 to Figure C10 of this appendix in Part 1 are illustrative of the definitions but do not necessarily apply to consumer units.

Appendix D Typical arrangements of forms of separation by barriers or partitions

This appendix in Part 1 is not applicable.

Appendix E Items subject to agreement between manufacturer and user

6.1.1.2[a]	(Note) Use of ASSEMBLIES in arctic climate.
6.1.3[a]	(Note) Use of electronic equipment at altitudes above 1 000 m.
6.2.9[a]	Special service conditions.
6.3[a]	Conditions during transport, storage and erection.
7.1.3.2[b]	Cross-sectional area of cables to be connected.
7.2.1.1[a]	Degree of protection required for the intended installation. For floor-mounted ASSEMBLIES also the degree of protection of the bottom to be indicated.
7.4.2[b]	Choice of protective measure against direct contact.
7.4.3[b]	Choice of protective measure against indirect contact.
7.5.4[a]	Co-ordination of short-circuit protective devices.
7.7[b]	Form of separation.
7.9.1[a]	Input voltage variations for electronic equipment supply.
8.2.1.6[a]	Ambient air temperatures for temperature-rise test.
8.2.3.2[b]	Value of shunt current.
8.2.3.3[b]	Recovery voltage exceeding 105 %.
8.3.1[a]	Repetition of electrical operation test on site.

[a] Subclause of BS 5486-1:1986.

[b] Subclause of this Part of BS 5486.

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Publications referred to

BS 842, *Specification for a.c. voltage-operated earth-leakage circuit-breakers.*

BS 1361, *Specification for cartridge fuses for a.c. circuits in domestic and similar premises.*

BS 3036, *Specification. Semi-enclosed electric fuses (ratings up to 100 amperes and 240 volts to earth).*

BS 3871, *Specification for miniature and moulded case circuit-breakers.*

BS 3871-1, *Miniature air-break circuit-breakers for a.c. circuits.*

BS 4293, *Specification for residual current-operated circuit-breakers.*

BS 5419, *Specification for air-break switches, air-break disconnectors, air-break switch disconnectors and fuse-combination units for voltages up to and including 1 000 V a.c. and 1 200 V d.c.*

BS 5486, *Low-voltage switchgear and controlgear assemblies.*

BS 5486-1, *Specification for type-tested and partially type-tested assemblies (general requirements).*

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