BS 7657:2010

BSI Standards Publication

Specification for cut-out assemblies up to 100 A rating, for power supply to buildings

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Contents

Summary of pages
This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 30, an inside back cover and a back cover.

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 28 February 2010. It was prepared by Technical Committee PEL/17, *Switchgear, Controlgear, and HV-LV co-ordination*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 7657:1993, which is withdrawn.

Relationship with other publications

This British Standard is to be read in conjunction with BS EN 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*. The provisions of the general rules dealt with in BS EN 60947-1:2007 are only applicable when specifically cited and they may be supplemented or modified as detailed in the standard.

The clause numbering of this British Standard follows that of BS EN 60947-1:2007 as closely as possible. Where a subclause of BS EN 60947-1:2007 is not relevant to this British Standard, it is marked as "Vacant" or omitted.

Information about this document

This is a full revision of the standard and introduces the following principal changes:

- the standard has been aligned as closely as possible with the principal reference standard, BS EN 60947-1:2007;
- all other references have been updated;
- the standard is more performance based and less prescriptive, particularly in respect to insulating materials;
- more stringent heat and fire performance requirements for insulating materials have been introduced;
- the temperature-rise testing has been extended to include typical installation conditions (in a meter box) and three-phase applications.

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope and references

1.1 Scope

This standard specifies the requirements for cut-out assemblies up to 100 A rating, for power supply to buildings. Each cut-out assembly provides a means of terminating service cables, fuse protection, a neutral facility and/or a means of earthing the supply, and anti-tamper protection. Cut-out assemblies are suitable for use on single-phase or three-phase low-voltage public electricity supply systems with a maximum voltage up to 440 V a.c. and at a frequency of 50 Hz, the neutral being effectively earthed.

The provisions of the general rules dealt with in BS EN 60947-1:2007 are applicable to this standard when specifically called for.

NOTE Clauses and subclauses, tables, figures and annexes of the general rules thus applicable are identified by reference to BS EN 60947-1:2007, for example, BS EN 60947-1:2007, ***1.2.3****; BS EN 60947-1:2007, Table 1; BS EN 60947-1:2007, Annex A.*

1.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 88-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) – Examples of standardized systems of fuses A to F*

BS 923-1, *Guide on high-voltage testing techniques – Part 1: General*

BS 5372, *Specification for dimensions of cable terminations for multi-core extruded solid dielectric insulated distribution cables of rated voltages 600/1000 V and 1900/3300 V having copper or aluminium conductors*

BS 5467, *Electric cables – Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V*

BS 6004, *Electric cables – PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring*

BS 7870-3.10, *LV and MV polymeric insulated cables for use by distribution and generation utilities – Part 3: Specification for distribution cables of rated voltage 0.6/1 kV – Section 3.10: PVC insulated combined neutral and earth copper wire concentric cables with copper or aluminium conductors*

BS 7870-3.11, *LV and MV polymeric insulated cables for use by distribution and generation utilities – Part 3: Specification for distribution cables of rated voltage 0.6/1 kV – Section 11: XLPE insulated combined neutral and earth copper wire concentric cables with copper or aluminium conductors*

BS EN 60085, *Electrical insulation – Thermal evaluation and designation*

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BS EN 60216-1, *Guide for the determination of thermal endurance properties of electrical insulating materials – Part 1: Ageing procedures and evaluation of test results*

BS EN 60269-1:2007+A1:2009, *Low voltage fuses – Part 1: General requirements*

BS EN 60335-1:2002+A2:2006, *Household and similar electrical appliances – Safety – Part 1: General requirements.*

BS EN 60695-2-10:2001, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

BS EN 60695-2-11:2001, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

BS EN 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

BS EN 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*

2 Terms and definitions

For the purposes of this British Standard, the definitions given in BS EN 60947-1:2007 apply, together with the following.

2.1 cut-out assemblies, fuses and their components

2.1.1 cut-out assembly

combination of fuse-link(s), neutral terminal(s), earth terminal(s), combined neutral and earth terminal(s), ancillary terminals block(s), connecting units and anti-tamper facilities, as applicable, so as to provide facilities for terminating service cables and a means of protection, isolation, and earthing of electricity supplies to buildings

2.1.2 fuse (cut-out)

device that by fusing of one or more of its specially designed and proportioned components opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time

NOTE The fuse comprises all the parts that form the complete device.

[BS EN 60269-1:2007+A1, IEC 60050-441:1984+A1]

2.1.3 fuse-base (fuse-mount)

fixed part of a fuse provided with contacts and terminals

NOTE Where applicable, covers are considered as part of the fuse-base.

[BS EN 60269-1:2007+A1, IEC 60050-441:1984+A1]

2.1.4 fuse-base contact (fuse-mount contact)

contact piece of a fuse-base designed to engage with a corresponding part of a fuse

[IEC 60050-441:1984+A1]

2.1.5 fuse-carrier

moveable part of a fuse designed to carry a fuse-link

[BS EN 60269-1:2007+A1, IEC 60050-441:1984+A1]

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2.1.6 fuse-carrier contact
contact piece of a fuse-carrier designed to engage with a corresponding part of a fuse

[IEC 60050-441:1984+A1]

2.1.7 fuse-holder
combination of a fuse-base with its fuse-carrier

[BS EN 60269-1:2007+A1, IEC 60050-441:1984+A1]

2.1.8 fuse-link
part of a fuse [including the fuse-element(s)] intended to be replaced after the fuse has operated

[BS EN 60269-1:2007+A1, IEC 60050-441:1984+A1]

2.1.9 fuse-link contact
contact piece of a fuse-link designed to engage with a corresponding part of a fuse

[IEC 60050-441:1984+A1]

2.1.10 fuse-unit
fuse-holder incorporating neutral and earth terminals within an integral enclosure(s) which can also include a protective cover for the termination of multi-core cables

2.1.11 interconnecting unit
unit providing additional insulation protection and security for the conductors connecting a fuse-unit to a tariff meter

NOTE The tariff meter is assumed to conform to BS EN 60051-1.

2.2 protection and insulation

2.2.1 basic insulation
insulation applied to live parts to provide basic protection against electric shock

[BS EN 60335-1:2002+A2]

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

[BS EN 60335-1:2002+A2]

2.2.3 double insulation
insulation comprising both basic insulation and supplementary insulation

[BS EN 60335-1:2002+A2, BS IEC 60050-195:1998]

2.2.4 reinforced insulation
single insulation 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 It is not implied that the term insulation system is one homogeneous piece. The insulation might comprise several layers which cannot be tested singly as supplementary or basic insulation.

[BS EN 60335-1:2002+A2]

3 Classification

3.1 General

The fuse type shall be classified as described in **3.2** to **3.18**.

3.2 Type A1 fuse-unit

A single-phase fuse-holder incorporating separate neutral and earth terminals with protective multiple earthing (PME) link. If specified by the purchaser, a separate cable termination cover shall be provided.

3.3 Type A2 fuse-unit

A single-phase fuse-holder incorporating combined neutral/earth terminals. If specified by the purchaser, a separate cable termination cover shall be provided.

3.4 Type A3 fuse-unit

A single-phase fuse-holder incorporating separate neutral and earth terminals but excluding a PME link. If specified by the purchaser, a separate cable termination cover shall be provided.

3.5 Type A4 three-phase fuse-unit

A three-phase and neutral assembly comprising a Type A1 fuse-unit and two Type B fuse-holders.

3.6 Type A5 three-phase fuse-unit

A three-phase and neutral assembly comprising a Type A2 fuse-unit and two Type B fuse-holders.

3.7 Type A6 three-phase fuse-unit

A three-phase and neutral assembly comprising a Type A3 fuse-unit and two Type B fuse-holders.

3.8 Type A7 fuse

A Type A1 fuse-unit fitted with an appropriate fuse-link.

3.9 Type A8 fuse

A Type A2 fuse-unit fitted with an appropriate fuse-link.

3.10 Type A9 fuse

A Type A3 fuse-unit fitted with an appropriate fuse-link.

3.11 Type A10 fuse

A Type A4 fuse-unit fitted with an appropriate fuse-link.

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3.12 Type A11 fuse

A Type A5 fuse-unit fitted with an appropriate fuse-link.

3.13 Type A12 fuse

A Type A6 fuse-unit fitted with an appropriate fuse-link.

3.14 Type B fuse-holder

A single-pole fuse-holder.

3.15 Type B fuse

A Type B fuse-holder fitted with an appropriate fuse-link.

3.16 Type C1 terminal block

A terminal block comprising a single-pole terminal assembly, with facilities for individually terminating three incoming and three outgoing single-core cables, housed in an enclosure manufactured from insulating material.

3.17 Type C2 terminal block

A terminal block comprising two mutually insulated single-pole terminal assemblies, where each terminal assembly incorporates facilities for terminating five incoming or outgoing single-core cables, housed in an enclosure manufactured from insulating material.

3.18 Type D interconnecting unit

A unit providing additional insulation, protection and security for the conductors connecting a fuse-unit to a tariff meter.

4 Characteristics

4.1 General

BS EN 60947-1:2007, **4.1**, applies.

4.2 Type of equipment

BS EN 60947-1:2007, **4.2**, applies.

4.3 Rated and limiting values for the main circuits

4.3.1 Rated voltages

4.3.1.1 Rated operational voltage (U_e)

BS EN 60947-1:2007, **4.3.1.1**, applies with the following addition.

Fuses, terminal blocks and interconnecting units shall be capable of operating on low-voltage public electricity supply systems with a maximum voltage up to 440 V a.c.

4.3.1.2 Rated insulation voltage (U_i)

BS EN 60947-1:2007, **4.3.1.2**, applies.

4.3.1.3 Rated impulse withstand voltage (U_{imp})

BS EN 60947-1:2007, **4.3.1.3**, applies.

4.3.2 Currents

4.3.2.1 Vacant

4.3.2.2 Vacant

4.3.2.3 Vacant

4.3.2.4 Rated uninterrupted current (I_u)

BS EN 60947-1:2007, **4.3.2.4**, applies with the following additions.

a) Fuses.

A fuse shall be capable of carrying current up to its rated uninterrupted current and the currents associated with the operation under fault conditions of any fuse-link conforming to BS 88-3 which the fuse is designed to accommodate. In addition, the incoming phase and neutral terminals of Type A fuses shall have a rated uninterrupted current of 130 A.

b) Terminal blocks and interconnecting units.

The terminal blocks and interconnecting units shall be capable of carrying the rated uninterrupted current.

4.3.3 Rated frequency

BS EN 60947-1:2007, **4.3.3**, applies.

4.3.4 Vacant

4.3.5 Vacant

4.3.6 Short-circuit characteristics

4.3.6.1 Vacant

4.3.6.2 Vacant

4.3.6.3 Vacant

4.3.6.4 Rated conditional short-circuit current

BS EN 60947-1:2007, **4.3.6.4**, applies.

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5 Product information

5.1 Vacant

5.2 Marking

Fuse components shall be clearly and permanently marked as follows.

a) Fuse-carriers:

1) manufacturer's name or trademark;

2) rated operational voltage (U_e) 230 V a.c. (see BS EN 60947-1:2007, **4.3.1.1**);

3) rated uninterrupted current (I_u) (see BS EN 60947-1:2007, **4.3.2.4**);

4) as being suitable for accommodating a fuse-link in accordance with BS 88-3.

b) Fuse-carriers or manufacturer's documentation:

1) value of the rated frequency (f_n) 50 Hz;

2) rated insulation voltage (U_i) 440 V a.c. r.m.s.;

3) rated impulse withstand voltage (U_{imp}) 6 kV;

4) rated conditional short-circuit current (see BS EN 60947-1:2007, **7.2.3.2**);

5) IP code (see **7.1.12** and BS EN 60947-1:2007, Annex C);

6) pollution degree 3.

c) All major components with the identity of the manufacturer and marque or style.

Terminal blocks and interconnecting units shall be clearly and permanently marked with the manufacturer's name or trademark and the uninterrupted current rating.

5.3 Instructions for installation, operation and maintenance

BS EN 60947-1:2007, **5.3**, applies.

6 Normal service and mounting conditions

6.1 Normal service conditions

BS EN 60947-1:2007, **6.1**, applies with the following modifications.

a) BS EN 60947-1:2007, **6.1.1**, Ambient air temperature.

The lower limit of the ambient air temperature shall be –25 °C.

NOTE When a 100 A fuse and associated equipment is installed in a meter box, derating of the fuse is necessary. Guidance on derating for typical installations is provided in Annex A.

b) BS EN 60947-1:2007, **6.1.3.2**, Pollution degree.

All fuses, terminal blocks and interconnecting units shall be suitable for operation in a pollution degree 3 environment.

6.2 Vacant

6.3 Mounting

6.3.1 General

All fuses, terminal blocks and those interconnecting units which are not self-supporting shall be capable of being fixed to a mounting board 12 mm thick constructed from plywood, chipboard or similar. Fasteners shall be supplied with the device.

6.3.2 Type A fuse-units

Where screws are the means of fastening the fuse-base to the mounting board, two fixing screw positions shall be provided.

6.3.3 Type B fuse-holders, terminal blocks and interconnecting units

Where screws are the means of fastening the device to the mounting board, a maximum of two screw positions shall be provided.

7 Constructional and performance requirements

7.1 Constructional requirements

*COMMENTARY ON **7.1**.*
*BS EN 60947-1:2007, **7.1**, applies with the following modifications.*

7.1.1 Vacant

7.1.2 Materials

7.1.2.1 General

Replace the existing subclause with the following.

The insulating integral enclosures shall conform to BS EN 60335-1 for Class II appliances using reinforced insulation.

All components manufactured of insulating materials that form part of an enclosure, or which are used to retain current carrying parts, shall conform to **7.1.2.2** to **7.1.2.6**.

*NOTE 1 If an identical material having representative cross-sections has already satisfied the test requirements detailed in **7.1.2.2** to **7.1.2.6**, then those representative tests need not be repeated.*

*NOTE 2 As an alternative to conducting the tests detailed in **7.1.2.2** to **7.1.2.6**, the manufacturer may provide data on the suitability of materials from the insulating material supplier to demonstrate compliance with these requirements.*

7.1.2.2 Resistance to normal heat

The manufacturer shall demonstrate either by reference to the insulation temperature index (determined, for example, in accordance

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with BS EN 60216-1) or by compliance with BS EN 60085, that the insulating materials are suitable for the temperatures prevailing at rated uninterrupted current.

7.1.2.3 Resistance to abnormal heat

When tested in accordance with the glow wire test in BS EN 60695-2-10:2001, Clause **4** to Clause **10**, and BS EN 60695-2-11, at a test temperature of 960 °C, the insulating materials shall conform to BS EN 60695-2-11:2001, Clause **12**.

7.1.2.4 Resistance to fire

When tested in accordance with BS EN 60695-11-10, insulating materials shall be flame retardant to Category V-1.

7.1.2.5 Material classification

Insulating materials shall be Material Group I or Material Group II as classified in BS EN 60947-1:2007, **7.2.3.4**a). The minimum comparative tracking index (CTI) shall be 500.

7.1.2.6 Moisture absorption

When tested in accordance with **8.2.1.2**, insulating materials shall resist the absorption of moisture.

7.1.3 Current carrying parts and their connections

BS EN 60947-1:2007, **7.1.3**, applies with the following additions.

a) Fuse-carriers.

Fuse-carriers shall have a rated uninterrupted current of either 60 A or 100 A and both shall fit all associated fuse-bases. It shall be possible to correctly fit the fuse-carrier to the fuse-base with either end up unless intended asymmetry is obvious.

The 60 A fuse-carrier shall be suitable for accepting fuse-links type IIa conforming to BS 88-3.

The 100 A fuse-carrier shall be suitable for accepting fuse-links type IIb conforming to BS 88-3.

Constant pressure shall be maintained between fuse-carrier contacts and fuse-base contacts, and this shall be unaffected by the means provided for clamping the fuse-links.

The fuse-carriers shall be designed to facilitate withdrawal by hand from the fuse-bases.

If the fuse-carrier insulation dismantles to receive the fuse-link, then the fixing for the components forming the fuse-carrier insulation shall be captive.

Fuse-carrier contacts shall be fabricated from high conductivity copper, or equally suitable copper alloys.

b) Fuse-bases.

Fuse-bases shall be suitable for use with 60 A and 100 A fuse-carriers specified in **7.1.3**a).

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7.1.4 Clearances and creepage distances

The minimum distances for clearance and for creepage shall be as specified in BS EN 60947-1:2007, Table 13 and Table 15.

7.1.5 Actuator

BS EN 60947-1:2007, **7.1.5**, is not applicable.

7.1.6 Indication of the contact points

BS EN 60947-1:2007, **7.1.6**, is not applicable.

7.1.7 Additional requirements for equipment suitable for isolation

BS EN 60947-1:2007, **7.1.7**, is not applicable.

7.1.8 Terminals

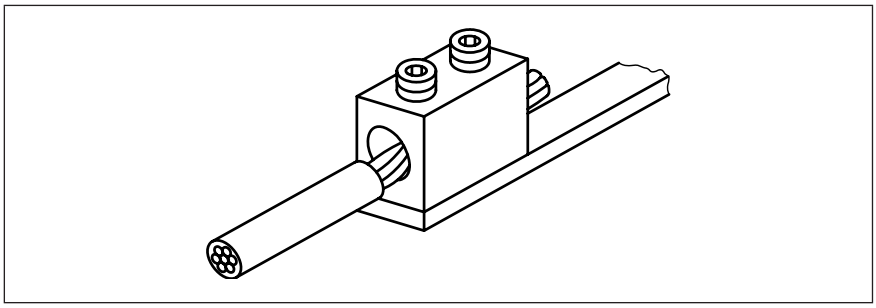
7.1.8.1 Constructional requirements

BS EN 60947-1:2007, **7.1.8.1**, applies with the following additions.

All parts of the terminals which maintain contact and carry current shall have adequate mechanical strength. When tested in accordance with **8.2.4.1**, there shall be no signs of failure, e.g. cracks, visible by normal or corrected vision. When tested in accordance with **8.2.4.2**, the conductor shall neither slip out of the terminal nor break near the clamping unit during the test.

Terminals shall be suitable for receiving unprepared copper and aluminium conductors, with both solid and stranded formations. The aluminium and copper conductor cables to be terminated shall conform to BS 5467, BS 6004, BS 7870-3.10 or BS 7870-3.11. Terminals shall be of the pillar type with direct pressure on the conductor in accordance with Figure 1. All terminal assemblies shall be captive within the device. This shall be achieved by securing each terminal assembly by the installation of a conductor.

Figure 1 **Pillar terminal with direct pressure**



7.1.8.2 Connecting capacity

BS EN 60947-1:2007, **7.1.8.2**, applies with the following additions.

All terminals shall be suitable for receiving single core cables with a minimum cross-section of 2.5 mm^2.

a) Type A fuse-units and Type B fuses.

Two incoming and two outgoing terminals for the phase connections shall be provided, suitable for conductors with a cross-section of up to 35 mm^2.

It shall be possible to connect the incoming phase terminal assembly of a Type A fuse with the incoming phase terminal assembly of a Type B fuse by means of a bus-bar protected with basic insulation. The bus-bar shall have a positive metal-to-metal contact with the fuse terminals and shall not rely on pressure between the terminal assemblies and the base moulding.

b) Type A fuse-units.

Incoming terminals shall be approximately in line (same distance from the bottom) and close to the bottom of the fuse-unit, to facilitate the entry of the service cable and to allow interchangeability between the products of different manufacturers.

A neutral terminal suitable for conductors with a cross-section of up to 10 mm^2 shall also be provided to permit connection of a tariff control device.

c) Type A1 fuse-units.

Two incoming and two outgoing terminals for conductors with a cross-section of up to 35 mm^2 shall be provided for the neutral connections.

Two incoming and two outgoing earth terminals shall be provided. Both the incoming and outgoing terminals shall be suitable for copper conductors with a cross-section of up to 25 mm^2.

A link for connecting the neutral terminal assembly to the earth terminal assembly shall be provided. It shall be designed so that the link can also be held captive in the open position on the neutral terminal assembly. The link shall be of protective plated copper with a minimum cross-section of 16 mm^2 and its fixing holes or slots shall have closed ends.

d) Type A2 fuse-units.

Two terminals suitable for conductors with a cross-section of up to 35 mm^2 shall be provided for both the incoming neutral/earth connections and the outgoing neutral connections.

Two outgoing earth terminals suitable for copper conductors with a cross-section of up to 25 mm^2 shall be provided for consumer earth connections.

e) Type A3 fuse-units.

Cable terminals shall be as specified for the Type A1 fuse-unit.

f) Terminal blocks Type C1 and Type C2.

Terminals shall be suitable for conductors with a cross-section of up to 35 mm^2.

g) Interconnecting units type D.

Any incorporated terminals shall be to the same specification as the equivalent terminals for which they are substituted. Their connection capacity shall be adequate for the size of the cables to be terminated.

*NOTE See also **7.1.8.1**.*

7.1.8.3 Connection

BS EN 60947-1:2007, **7.1.8.3**, applies.

7.1.8.4 Terminal identification and marking

BS EN 60947-1:2007, **7.1.8.4**, applies.

7.1.8.5 Terminal positions

With a fuse-unit in its normal service orientation and viewed from the front, the order of the terminals from left to right shall be phase, neutral and earth.

7.1.9 Additional requirements for equipment provided with a neutral pole

BS EN 60947-1:2007, **7.1.9**, is not applicable.

7.1.10 Provisions for protective earthing

BS EN 60947-1:2007, **7.1.10**, is not applicable.

7.1.11 Enclosures for equipment

7.1.11.1 Design

7.1.11.1.1 General

Paragraphs 3, 4, 6, 7 and 8 of BS EN 60947-1:2007, **7.1.11.1**, are replaced by the following.

An insulating integral enclosure shall be provided which has a mechanical strength sufficient to withstand the forces which might be expected to occur in normal service.

When tested in accordance with **8.2.2.1**, the units tested shall show no significant damage and no accessible live parts. The appearance of small dents shall be ignored provided that there are no associated cracks detrimental to the serviceability of the device. Where any doubt of conformity arises, it shall be resolved by carrying out a test to **8.3.3.4**.

When tested in accordance with **8.2.2.2**, there shall be no evidence of cracks in the sealing lugs after removal of the load. The appearance of small dents or marks as a result of pressure applied by the sealing wire rope can be ignored.

7.1.11.1.2 Cable termination cover for Type A fuse-units

Where required for the protection of incoming multi-core cables, a cover capable of interlocking with the appropriate fuse-base so that the cover cannot be removed until the fuse-carrier has been withdrawn shall be provided. It shall contain a maximum of two screw fixing positions.

The cover shall have two cable entry ports provided at the bottom for which grommets shall be supplied. The width of the cable termination cover shall be equal to the nominal width of the appropriate fuse-unit. The distance for terminating cables shall as a minimum conform to BS 5372.

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7.1.11.1.3 Neutral and earth cover for Type A fuse-units

Access to all incoming and outgoing neutral and earth terminals shall be prevented by means of an interlocking insulated cover. This cover shall be removable only if the fuse-carrier is fully withdrawn. However, when required by the user, access to specified outgoing earth terminals shall be provided.

7.1.11.2 Vacant

7.1.12 Degrees of protection of enclosed equipment

BS EN 60947-1:2007, **7.1.12**, applies with the following additions.

Segregation shall be provided by insulating barriers between any adjacent terminal assemblies. The barriers shall be designed to prevent inadvertent bridging, by the fuse-carrier, of the phase and neutral/earth terminals.

Fuse-links, fuse-carrier contacts and terminals shall be shielded to protect persons from accidental contact with live parts.

The incoming phase contacts on a Type A fuse-unit shall be identified by means of red marking adjacent to the contacts. This shall be visible when the fuse-carrier is removed.

Except where specifically agreed otherwise with the user, access to any internal parts, including those enclosed by cable termination covers, shall only be possible once the seals applied for security purposes have been removed. All cable entries shall be protected to prevent unauthorized access.

Both ends of a fuse-carrier shall be secured to the fuse-base by means of security wire and seals. The sealing holes shall be positioned to prevent inadvertent entry of the sealing wire to the interior of the fuse. Installed fixing screws shall only be capable of release by first opening the respective security seal(s). Sealing tabs shall be provided for all accessible screws.

The sealing lug holes shall allow the insertion of two meter sealing wire ropes (one at the top and one at the bottom of the fuse-holder) of maximum overall diameter 0.914 mm, and shall prevent the passage of a 3 mm diameter ferrule. Each sealing rope shall have seven zinc coated strands of high tensile wire. When tested in accordance with **8.2.2.1**, the material surrounding the hole shall show no significant damage and no accessible live parts. The appearance of small dents shall be ignored provided that there are no associated cracks detrimental to the serviceability of the device. There shall be adequate clearance around the sealing lugs, with or without a cable termination cover, to facilitate the fixing and removal of the security systems.

When all removable parts of the device are in place and all security seals applied, with any combination of units mounted in a normal service operating position, the degree of protection provided against direct contact with hazardous live parts shall be not less than IP XXD as specified in BS EN 60947-1:2007. With all security seals in place and the fuse-carrier partially withdrawn against the seals, the degree of protection against access to live parts shall be IP XXC. With the security seals removed and the fuse-carrier partially withdrawn from a fuse-base, but with the fuse-carrier contact remaining in contact with the fuse-base contact, the degree of protection shall be not less than IP XXB.

7.1.13 Conduit pull-out, torque and bending with metallic conduits

BS EN 60949-1, **7.1.13**, is not applicable.

7.2 Performance requirements

*COMMENTARY ON **7.2**.*
*The requirements in **7.2** apply to clean, new devices manufactured in accordance with this standard.*

7.2.1 Vacant

7.2.2 Temperature-rise

7.2.2.1 General

The temperature-rise at rated current of a device shall have no deleterious effect on the materials of the device, the connecting cables, fuse-link or the mounting support.

When tested in accordance with **8.3.3.3.4.2**, under the conditions specified in **8.3.2.1**, the temperature-rise of the different parts of main circuit shall be no greater than the values given in Table 1.

Table 1 **Maximum temperature-rise at rated current**

Rated current	**Fuse**	**Terminal block**	**Interconnecting unit**
	60 A and 100 A	**100 A**	**100 A**
Terminal assemblies	50 K	30 K	30 K [A)]
Fuse-carrier contacts	55 K	—	—
Manual operating means – fuse-carrier grip	25 K [B)]	—	—
Parts intended to be touched but not hand held – insulation integral to the enclosure	40 K	40 K	40 K

[A)] Required when applicable.

[B)] Limit increased to 50 K for cut-out assemblies located in meter boxes and multi-service distribution boards (see BS EN 60439-1).

7.2.2.2 Long term contact stability

Adequate contact shall be maintained between the fuse-carrier contacts and the fuse-base contacts and between the conductors and the terminals after a fuse has remained in service and undisturbed for a long period. When tested in accordance with **8.3.3.3.4.5**, there shall be no deterioration visible by normal or corrected vision that could affect the normal operation of the equipment and the temperature-rises recorded under **8.3.3.3.4.5**b) shall exceed those observed at the end of the test in **8.3.3.3.4.2** by no more than 3 K.

7.2.2.3 Mechanical endurance

Adequate contact shall be maintained between the fuse-carrier contacts and the fuse-base contacts of fuses after repeated disengagement and re-engagement. When tested in accordance with **8.3.3.3.4.3**, the recorded temperature-rises shall differ from those observed at the end of the test in **8.3.3.3.4.2** by no more than 3 K.

7.2.3 Dielectric properties

7.2.3.1 General

When tested in accordance with **8.3.3.4**, there shall be no disruptive discharges during the power frequency tests and the insulation resistance shall be not less than 50 MΩ. If the power frequency voltage cannot be maintained at the specified value, or there is evidence visible to a person with normal or corrected vision without additional magnification of sparking or tracking, this shall be regarded as failure of the test.

7.2.3.2 Performance on overload and short circuits

A fuse shall be capable of carrying overload and short circuit currents as limited by the operation of a fuse-link conforming to BS 88-3.

The peak test current shall conform to Table 2.

Table 2 **Peak test current**

Current rating	Peak test current
A	kA
60	18
100	18

When tested in accordance with **8.3.3.3.4.4**, there shall be no deterioration visible by normal or corrected vision and the temperature-rises shall exceed those observed at the end of the test in **8.3.3.3.4.2** by no more than 3 K.

When tested in accordance with **8.3.4**, there shall be no significant damage to the contacts (i.e. the fuse-carrier has not been moved or ejected) visible to a person with normal or corrected vision and there shall be adequate engagement of the contacts for normal service. After the test, it shall be possible to operate the equipment by its normal operating means.

8 Tests

8.1 Kinds of tests

8.1.1 General

BS EN 60947-1:2007, **8.1.1**, applies.

8.1.2 Type tests

BS EN 60947-1:2007, **8.1.2**, applies with the following addition.

Unless otherwise stated in the relevant test, devices shall be tested in batches, each of which shall consist of a sample of six selected at random from the manufacturer's stock of new devices.

Type tests shall be carried out for each new batch and where appropriate, in sequence, as indicated in Table 3.

Certain of the type tests are carried out on combinations of fuses and since it is impractical to test all combinations of fuses, the manufacturer shall have available a homogeneous range.

The following tests shall only be considered to be valid when:

a) the only differences between the 60 A fuses and 100 A fuses are the differences to the fuse-link contact necessary to accommodate the alternative types of fuse-link;

b) the design of the Type B fuses is fundamentally the same as the phase in a Type A fuse;

c) the design of cut-out assemblies for use in protective multiple earthing (PME) installations is fundamentally the same as those for separate neutral and earth (SNE) systems and they are manufactured from essentially the same parts.

The combinations of fuse indicated in Table 3 shall be used for type tests.

Table 3 **Type tests**

Test	**Test arrangement**	**No. of samples/ combinations of samples tested**	**Test sequence/Specification**
Dielectric properties	All types and rating of cut-out assemblies including their associated ancillaries, terminal blocks interconnecting units, etc. Type A units to be complete with cable termination covers.	6	**8.3.3.4.1**
Creepage distances and clearances	All types and rating of cut-out assemblies including their associated ancillaries, terminal blocks and interconnecting units, etc. Type A units to be complete with cable termination covers.	6	**8.3.3.4.1**
Operational performance sequence	A1 (60 A)	6	Temperature-rise: **8.3.3.3.4.2**, Test 1 + Mechanical endurance and temperature-rise: **8.3.3.3.4.3** + Overload and temperature-rise: **8.3.3.3.4.4**
	A1 (100 A)	6	Temperature-rise: **8.3.3.3.4.2**, Test 1 + Mechanical endurance and temperature-rise: **8.3.3.3.4.3** + Overload and temperature-rise: **8.3.3.3.4.4**
	A1 (60 A) bus-barred to a B (100A)	6	Temperature-rise: **8.3.3.3.4.2**, Test 2 + Mechanical endurance and temperature-rise: **8.3.3.3.4.3** + Overload and temperature-rise: **8.3.3.3.4.4** + Dielectric (dry only): **8.3.3.4**
	A1 (100 A) looped to A1 (60 A)	6	Temperature-rise: **8.3.3.3.4.2**, Test 3
	Three-phase + neutral [A1 (100 A) + 2 off B (100A)]	1	Temperature-rise: **8.3.3.3.4.2**, Test 4 + Mechanical endurance and temperature-rise: **8.3.3.3.4.3** + Overload and temperature-rise: **8.3.3.3.4.4**

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Table 3 **Type tests** *(continued)*

Test	Test arrangement	No. of samples/ combinations of samples tested	Test sequence/Specification
Operational performance sequence *(continued)*	C1 looped to C2 terminal block	6	Temperature-rise: **8.3.3.3.4.2**, Test 5
	A1 (100 A) in a meter box	1	Temperature-rise: **8.3.3.3.4.2**, Test 6
Cyclic loading	A1 (100 A) or A1 (60 A) + bus-bar connected B (100 A)	6	**8.3.3.3.4.5**
Short circuit	A1 (100 A)	6	**8.3.4**
Protection	All types and rating of cut-out assemblies including their associated ancillaries, terminal blocks and interconnection unit, etc.	1	**8.2.3**
Strength of sealing lugs	Each type of sealing lug as incorporated in fuses, terminal blocks and interconnecting units.	6 samples of each type of sealing lug to be tested	**8.2.2.2**
Flammability	Each type of material used in the integral enclosures of fuses, terminals blocks and interconnecting units.	1 set of samples per material	**8.2.1.1**
Terminal torque	Each type of terminal for 35mm^2 and each type of terminal for 16/25mm^2 conductor.	6 samples of each size and type of terminal	**8.2.4.1**
Terminal pull	Each type of terminal for 35mm^2 and each type of terminal for 16/25mm^2 conductor.	6 samples of each size and type of terminal	**8.2.4.2**
Impact	Test individually, A1 (100 A), A2 (100 A), B, C1, C2 and interconnecting unit.	2 batches comprising 6 samples of each type of unit to be tested	**8.2.2.1**
Moisture absorption	A1 (100 A)	6	**8.2.1.2**

8.2 Conformity to constructional requirements

8.2.1 Materials

8.2.1.1 Flammability test

Materials used for the insulating integral enclosure of all fuses, terminal blocks and interconnecting units shall conform to BS EN 60695-11-10:1999, Category V-1. At the cut-out assembly manufacturer's discretion, conformity shall be demonstrated by testing samples of materials in accordance with BS EN 60695-11-10, or alternatively, by reference to the material manufacturer's test data.

8.2.1.2 Moisture absorption test

The moisture resistance capability of insulating materials used in fuses shall be tested in accordance with BS EN 60269-1:2007+A1, **8.2**.

8.2.2 Equipment

8.2.2.1 Impact test

This test shall be carried out on two batches of new fuse-units, terminal blocks and interconnecting units by means of the impact test apparatus described and illustrated in Figure 2.

The unit being tested shall be held firmly against a rigid frame and mounted so that the point of impact lies in the vertical plane containing the suspension axis of the pendulum. For each blow, the striking head of 0.15 kg weight shall be released from a pre-set height of 340 mm under free fall through an arc (impact energy 0.50 J).

The impact tests shall be carried out at an ambient temperature between 15 °C and 35 °C and shall comprise the following.

a) Test 1a. With all barriers, baffles and plugs for main phase and neutral conductor ports removed, the sample cut-out assemblies, barriers, baffles and plugs shall be pre-conditioned by keeping them in an ambient temperature of between 15 °C and 35 °C for not less than 18 h. The impact test shall consist of three blows to each of the left-hand side, right-hand side and front surface of the sample under test. The blows shall be aimed at the considered weaker spots on each surface of the insulating integral enclosure.

b) Test 1b. The plugs, barriers and baffles shall be replaced in the samples used in Test 1a. The impact test shall consist of three blows to each of the plugs, barriers and baffles of all the main phase and neutral cable ports in the top and bottom of the sample under test.

c) Test 2a. Test 1a shall be repeated using new samples, but following pre-conditioning of the cut-out assemblies by keeping them at a maximum temperature of –25 °C for a period of not less than 18 h.

d) Test 2b. Test 1b shall be repeated but using the samples from Test 2a and plugs, barriers and baffles that have been pre-conditioned by keeping them at a maximum temperature of –25 °C for a period of not less than 18 h.

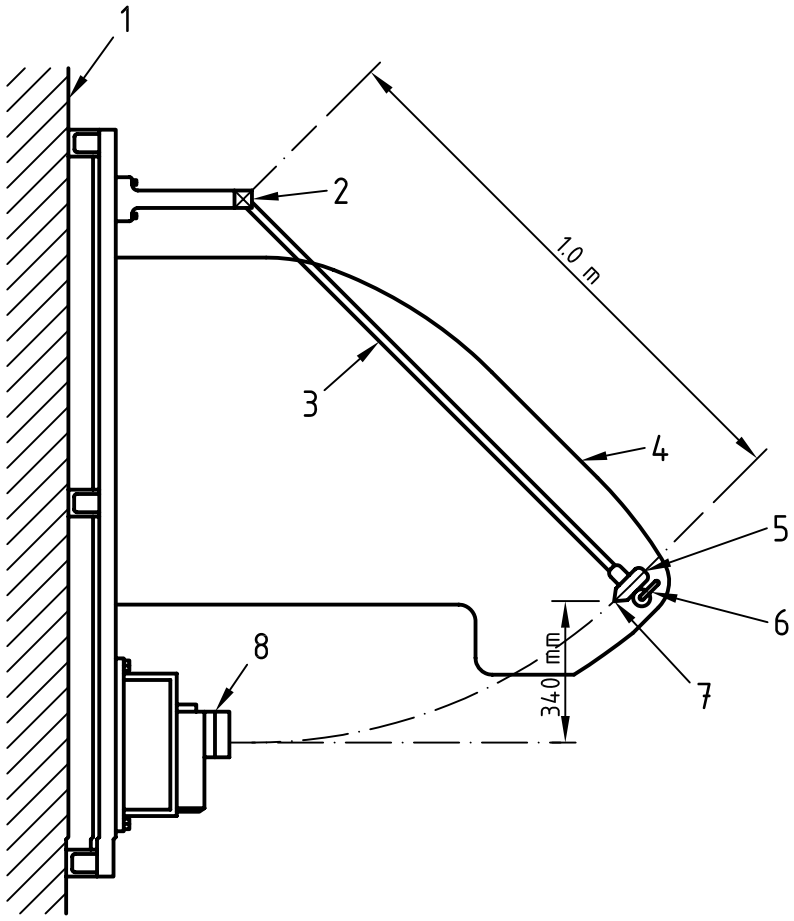
The tested units shall be inspected for significant damage and accessible live parts as a result of damage incurred during the test. The appearance of small dents shall be ignored provided that there are no associated cracks detrimental to the serviceability of the device.

8.2.2.2 Mechanical tests on security sealing lugs

The test shall be conducted on a batch of new devices containing six pairs of security sealing lugs. A tensile load of (20 $\pm$0.2) kg shall be applied to each of the sealing lugs in turn, using a loop of high tensile meter sealing wire rope having seven zinc coated strands of maximum overall diameter 0.914 mm. The load shall be applied in the directions shown in Figure 3 for not less than 30 s.

The devices shall be inspected for evidence of significant damage after removal of the load.

Figure 2 **Apparatus for impact test**



Key

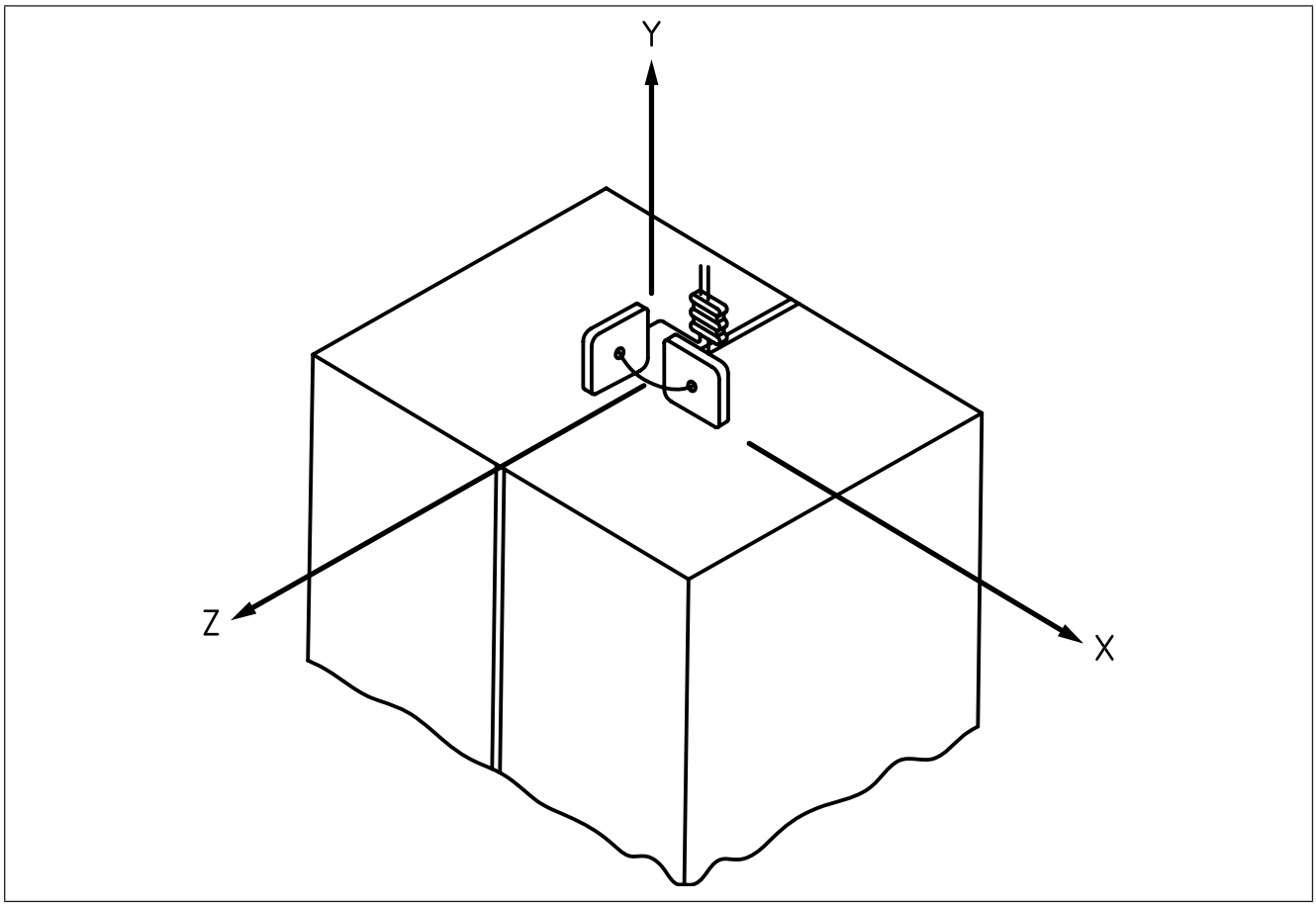
1 Rigid support structure
2 Pendulum suspended to swing in vertical plane only
3 Pendulum
4 Mounting plate for release mechanism
5 Hammer 0.15 kg
6 Release mechanism
7 Radius of head 12.5 mm
8 Fuse under test

Materials:

Hammer head – Hornbeam or European Ash; Pendulum arm – steel tube (9 mm diameter, 0.5 mm wall thickness)

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

Figure 3 **Mechanical tests on security sealing lugs**



8.2.3 Enclosures for equipment

BS EN 60947-1:2007, **8.2.3**, applies with the following addition.

Degree of protection test.

The fuse-unit shall be tested for the degree of protection in accordance with BS EN 60947-1:2007, **7.1.12**.

8.2.4 Mechanical properties of terminals

8.2.4.1 Terminal torque test

The test shall be carried out on a batch of six new terminals of each type. The terminals and screws shall be unplated and the screws shall be free running in the terminals before the commencement of the test.

a) Test 1. Phase and neutral terminals for the connection of conductors with a cross-section of 35 mm^2 shall be tightened on to a hard drawn copper rod of 8 mm diameter and shall be subjected to a clamping torque of twice the manufacturer's recommended terminal torque for a period of 1 h.

b) Test 2. Terminals for the connection of conductors with a maximum cross-section of 25 mm^2 and 16 mm^2 shall be tightened on to a hard drawn copper rod of 6 mm diameter and shall be subjected to a clamping torque of twice the manufacturer's recommended terminal torque for a period of 1 h.

The terminals shall be inspected for signs of failure.

8.2.4.2 Terminal pull test

The test shall be carried out on a batch of six new terminals of each type to be tested. The terminals and screws shall be unplated and the screws shall be free running in the terminals before the commencement of the test.

A short length of cable shall be terminated into each terminal of the type and size defined in Table 4. Terminals shall be tightened to the manufacturer's recommended tightening torque. A pull force acting directly away from the direction of insertion of the conductor into the terminal, as defined in Table 4, shall be applied to the conductor. The force shall be applied without jerks for 1 min.

Table 4 **Test values for terminal pull tests**

Maximum terminal capacity	Test conductor type	Size of test conductor	Pulling force
25 mm^2	Stranded copper	25 mm^2	135 N
35 mm^2	Solid aluminium	35 mm^2	125 N

*NOTE See **7.1.8.1** for the pass criteria for this test.*

8.3 Performance

8.3.1 Test sequences

The type tests and, where appropriate, sequences of tests for fuses and associated items shall be as given in Table 3.

8.3.2 General test conditions

8.3.2.1 General requirements

BS EN 60947-1:2007, **8.3.2.1**, applies amplified as follows.

Cable terminals shall be tightened to the manufacturer's recommended tightening torque.

For the tests of **8.3.3.3.4.2**, **8.3.3.3.4.3**, **8.3.3.3.4.4** and **8.3.3.3.4.5**, the devices shall be mounted in a vertical position on a mounting board in accordance with the requirements of **6.3**. No part of the edge of any device shall lie within 150 mm of the edge of the mounting board.

Type A fuses shall be complete with cable termination cover for tests of **8.3.3.3.4.2**, **8.3.3.3.4.3**, **8.3.3.3.4.4** and **8.3.3.3.4.5** and **8.3.4**.

Where fuse-links are required to be fitted to the fuse-units for a particular test, they shall conform to **7.1.3**a), have the same current rating as the fuse-carriers and a power dissipation at rated current not less than 4.7 W for a 60 A fuse-link and 5.4 W for a 100 A fuse-link.

8.3.2.2 Test quantities

8.3.2.2.1 Values of test quantities

BS EN 60947-1:2007, **8.3.2.2.1**, applies amplified as follows.

Values of test current shall be as stated in the appropriate tests of this standard.

8.3.2.2.2 Tolerances on test quantities

BS EN 60947-1:2007, **8.3.2.2.2**, applies with the following modifications.

The wave forms of alternating currents or voltages shall be approximately sinusoidal with a frequency of (50 ±5) Hz.

Currents are r.m.s. quantities and shall be measured to an accuracy of ±1%. Temperature change shall be measured to an accuracy of ±1 K.

Watts are r.m.s. quantities and shall be measured to an accuracy of ±5%.

8.3.2.3 Vacant

8.3.2.4 Test reports

BS EN 60947-1:2007, **8.3.2.4**, applies.

8.3.3 Performance under no load, normal load and overload conditions

8.3.3.1 Vacant

8.3.3.2 Vacant

8.3.3.3 Temperature-rise

8.3.3.3.1 Ambient air temperature

BS EN 60947-1:2007, **8.3.3.3.1**, applies.

8.3.3.3.2 Measurement of the temperature of parts

BS EN 60947-1:2007, **8.3.3.3.2**, applies.

8.3.3.3.3 Temperature-rise of a part

BS EN 60947-1:2007, **8.3.3.3.3**, applies.

8.3.3.3.4 Temperature-rise of the main circuit

8.3.3.3.4.1 General

BS EN 60947-1:2007, **8.3.3.3.4**, applies with the following additions and modifications.

All temperature rise, overload and cyclic loading tests shall be carried out with the cable termination covers fitted.

The following test connections shall be made.

a) Incoming terminals of a fuse-unit.

   A polymeric insulated, single-phase concentric service cable, at least 2 m long, having a circular solid aluminium phase conductor and a concentric layer of bare copper wires forming a combined neutral–earth conductor and including a polymeric oversheath, in accordance with BS 7870-3.10 or BS 7870-3.11.

b) All other terminals.

   A single-core polymeric/polymeric cable with stranded copper conductors conforming to BS 6004.

8.3.3.3.4.2 Test for temperature-rise at rated current

The tests for temperature-rise at rated current shall be as follows.

a) Test 1: Type A fuses. One batch each of new 100 A and 60 A Type A fuses shall be tested for temperature-rise at the rated uninterrupted current.

The following test connections shall apply.

1) The incoming phase and neutral terminals shall be supplied using service cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**a).

2) The outgoing phase terminal shall be connected to the outgoing neutral terminal by a 300 mm length of cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**b).

The steady state temperature-rises shall be recorded and the test of **8.3.3.3.4.3** carried out immediately.

b) Test 2: Type A and B fuses, bus-barred arrangement. One batch each of new 60 A Type A and 100 A Type B fuses shall be selected and each 60 A fuse bus-barred to a 100 A fuse. Each pair of fuses shall then be tested for temperature-rise.

The following test connections shall apply.

1) The cable connected to the incoming terminals of the Type A fuse shall be service cable with a cross-section of 35 mm^2, conforming to **8.3.3.3.4.1**a).

2) The outgoing phase terminal of the Type A fuse shall be connected to the outgoing neutral terminal by a suitable length of cable with a cross-section of 16 mm^2, conforming to **8.3.3.3.4.1**b).

3) The outgoing phase terminal of the Type B fuse shall be connected to the outgoing neutral terminal of the Type A fuse by a 400 mm length of cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**b).

The circuit shall be arranged so that a current of 100 A flows in the Type B fuse and 30 A in the Type A fuse.

The steady state temperature-rises shall be recorded and the test of **8.3.3.3.4.3** carried out immediately.

c) Test 3: Type A and B fuses, looped arrangement. One batch each of new 60 A Type A fuses and 100 A Type B fuses shall be selected and each 60 A fuse looped to a 100 A fuse. Each pair of fuses shall then be tested for temperature-rise.

The following test connections shall apply.

1) The cable connected to the incoming terminals of the 60 A fuse shall be service cable with a cross-section of 35 mm^2, conforming to **8.3.3.3.4.1**a).

2) The outgoing phase and neutral terminals of the 60 A fuse shall be connected by a suitable length of cable with a cross-section of 16 mm^2, conforming to **8.3.3.3.4.1**b).

3) The outgoing phase and neutral terminals of the 100 A fuse shall be connected by a 300 mm length of cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**b).

4) The incoming phase and neutral terminals of the 60 A fuse shall be connected (looped) to the incoming phase and neutral terminals of the 100 A fuse by means of a service cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**a).

The circuit shall be arranged so that a current of 100 A flows in the 100 A fuse, and 30 A in the 60 A fuse.

The steady state temperature-rises of the 60 A fuse shall be recorded.

d) Test 4: Three-phase fuses. One new 100 A Type A and two new 100 A Type B fuses shall be arranged in a three-phase and neutral configuration. The three-phase assembly shall be tested for temperature-rise at the rated uninterrupted current of 100 A.

The following test connections shall apply.

1) The incoming phase terminals shall be supplied using service cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**a).

2) The outgoing phase terminals shall be short circuited using three, 1 000 mm long, single-core cables with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**b).

The steady state temperature-rises shall be recorded and the test of **8.3.3.3.4.3** carried out immediately.

e) Test 5: Terminal blocks Type C1 and Type C2. One batch of new terminal blocks shall be tested for temperature-rise at the rated current.

The following test connections shall apply.

1) Any two terminals of terminal blocks Type C1 shall be supplied using cable with a cross-section of 25 mm^2, of minimum length 300 mm, conforming to **8.3.3.3.4.1**b).

2) One terminal on each pole of terminal blocks Type C2 shall be supplied using cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**b), of minimum length 300 mm and both terminal assemblies shall be connected (looped) together with a 300 mm length of the same cable.

The steady state temperature-rises shall be recorded.

f) Test 6: Type A fuse in a meter box. One new 100 A Type A fuse shall be tested for temperature-rise at the rated uninterrupted current, when located in a meter box, as in a typical service arrangement.

The meter box shall be located in a brick, cavity wall with insulation such that the wall has a *U* value of 0.3 W/m^2K. The wall shall extend 1 m below and 0.5 m above and to the sides of the meter box. The meter box shall be made of insulating material, have inside dimensions not exceeding 510 mm high × 345 mm wide × 175 mm deep, and shall not include any ventilation.

The following test connections shall apply.

1) The incoming phase and neutral terminals shall be supplied using cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**a).

2) The outgoing phase terminal shall be connected to the outgoing neutral terminal by a 300 mm length of cable with a cross-section of 25 mm^2, conforming to **8.3.3.3.4.1**b).

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The incoming cable shall approach from vertically below the meter box. Two arrangements of incoming cable shall be separately tested, as follows.

i) Incoming cable located on the outer leaf of the wall and within a 32 mm internal diameter polyethylene tube.

ii) Incoming cable routed between the two leaves of the cavity wall and within a 32 mm internal diameter polyethylene tube.

The steady state temperature-rises shall be recorded.

NOTE When installation conditions differ from those included in the foregoing tests, derating of the cut-out assembly might be necessary. The manufacturer should be consulted for details of ratings applicable to other service arrangements.

8.3.3.3.4.3 Mechanical endurance test: Type A and B fuses

The test current shall be switched off. The fuse-carriers shall then be disengaged and re-engaged 20 times before significant cooling takes place, after which **8.3.3.3.4.2**, Test 1, Test 2 or Test 4, as appropriate, shall be repeated.

The temperature-rises shall be recorded.

The current shall be switched off and the test batch allowed to cool to ambient temperature. No adjustments shall be made before the overload test given in **8.3.3.3.4.4** is carried out.

8.3.3.3.4.4 Overload test: Type A and B fuses

In the case of bus-barred arrangements, the fuse-carrier of the Type A fuse shall be removed. No other adjustments shall be made.

The test circuit shall be switched on and the current maintained at the value shown in column a of Table 5 for 4 h. The current shall then be increased to the value shown in column b and maintained for 30 min. Then, if any fuse-link has not operated, the current shall be increased to the value shown in column c until all fuse-links have operated.

NOTE In order to allow for the probable sequential operation of the fuse-links, the test circuit may be arranged with shorting switches to permit the continued passage of current through those fuse-links remaining intact until the last fuse-link has operated. A momentary interruption of the test current following the operation of each fuse-link is acceptable.

Table 5 **Values of overload test current**

Rated current of fuse-link A	**Test current** A		
	a	b	c
60	81	90	99
100	135	150	165

After the fuses have been allowed to cool to ambient temperature, all fuse-links shall be replaced by new fuse-links conforming to **8.3.2.1**. No other adjustments shall be made.

Test 1, Test 2 or Test 4 of **8.3.3.3.4.2**, as appropriate, shall be repeated.

The connected cables and any bus-barred fuses shall be removed and the impulse withstand voltage dry tests and power frequency withstand voltage dry tests of **8.3.3.4** carried out on the test pieces only.

The test pieces shall be inspected for signs of deterioration and the temperature-rises shall be recorded.

8.3.3.3.4.5 Cyclic loading temperature-rise tests: Type A and Type B fuses

The temperature-rise stability of contacts shall be confirmed by means of a cyclic loading test consisting of 2 000 cycles. At the discretion of the manufacturer, either one batch of 100 A Type A cut-outs shall be tested using a circuit as specified in **8.3.3.3.4.2**, Test 1, or one batch of 60 A Type A plus one batch of 100 A Type B fuses using a circuit as specified in **8.3.3.3.4.2**, Test 2.

The test conditions shall be as follows.

a) Each cycle shall be of 2 h duration (1 h on and 1 h off).

b) Full tests for temperature-rise at the rated current shall be carried out initially and at every sequence of (100 ±25) cycles. The temperature-rises for all terminal assemblies and fuse-carrier contacts shall be recorded.

c) The current shall not fall below the rated current at any time while the fuses are on load and shall be sufficient to ensure that the minimum temperature-rises attained at each point of measurement for every cycle shall at least equal those recorded at the last previous full temperature-rise tests for the corresponding point [see b)], subject to a tolerance of $^{0}_{-1}$ K.

*NOTE 1 For this test, fuse-links conforming to **8.3.2.1**, but without eutectic zones on the elements, are acceptable.*

NOTE 2 For a specific fuse type, this test may be omitted on condition that its performance on temperature-rise tests is at least as good as that of a fuse which has successfully completed the cyclic loading temperature-rise test. This condition is only permitted for fuses which form part of a homogeneous range and where the current carrying components and other relevant design features are effectively identical to those of a fuse which has successfully passed this cyclic loading temperature-rise test.

The test pieces shall be inspected for signs of deterioration that could affect the normal operation of the equipment and the temperature-rises shall be recorded.

8.3.3.4 Dielectric properties

8.3.3.4.1 Type tests

One batch of each type of fuse, terminal block and interconnecting unit shall be subjected to impulse withstand voltage dry tests and 1 min power frequency (alternating) voltage withstand dry tests in accordance with BS 923-1. The tests shall be carried out immediately after each complete device has been exposed to the ambient conditions for at least 24 h.

Each device shall be placed on an earthed, unpainted metal plate and fixed by means of metal bolts and nuts in all normal fixing holes.

One pole of the test supply shall be earthed and all terminals on the test piece which are not effectively connected to the live pole shall be connected to the earthed pole. The metal foil referred to in a1) and b1) shall be in contact with the metal plate. The live pole shall be connected to the first named component in a1) to a3) or b1) and b2), as appropriate.

Impulse withstand voltage tests shall be performed with voltages of both positive and negative polarity, using the standard impulse 1.2/50.

Ten consecutive impulses having a peak value of 6 kV shall be applied for each test condition and each polarity at intervals of not less than 3 s.

Power frequency voltage withstand tests shall be performed with a test voltage raised to 3.75 kV r.m.s. and maintained for 1 min. Both tests shall be performed with test voltages applied between the following.

a) Fuses.

   1) All electrically separate terminals connected together and metal foil completely enclosing, and in contact with, all external surfaces of the Type A fuse-unit.

      The test piece fuse-units shall then be bus-barred to Type B fuse-holders.

   2) The incoming and outgoing phase terminals.

      Fuse-links shall then be fitted in the fuse-carriers, which shall be installed and sealed to the fuse-bases with the sealing wire effectively connected to the metal plate.

   3) A phase terminal and the metal plate. Also, the neutral and earth terminals of Type A1 fuses.

b) Terminal blocks and interconnecting units.

   1) All electrically separate terminals connected together and metal foil completely enclosing, and in contact with, all surfaces of the device.

   2) Each electrically separate terminal and all other terminals and the metal plate connected together.

After completing the power frequency withstand voltage test for each condition, the insulation resistance shall be measured between the same points, using a d.c. voltage of not less than 500 V.

8.3.3.4.2 Routine tests

Routine testing is not required.

8.3.4 Performance under short-circuit conditions for Type A fuses

In a Type A fuse which relies on spring pressure alone for the effectiveness of its contact, one test shall be performed on a Type A1 (100 A) cut-out assembly, at any convenient value of voltage with the fuse-link replaced by a copper link.

The value of the test current shall be such that the peak value caused to flow through the fuse-carrier and fuse-base shall be not less than the appropriate value given in Table 2 for a period of not more than 0.02 s.

NOTE The intended duration of the current flow is the minimum necessary to allow the current to rise to the specified peak value and should be no longer than 0.02 s. This limitation can, for example, be achieved by a series connected fuse.

Each test connection length shall be at least 1 m. They shall be arranged either side of the fuse-unit in the plane of the connecting device and in the direction of the axis of the fuse-unit for a length of approximately 200 mm, then bent at right angles in a direction such as to produce maximum blow-out force on the fuse-carrier.

The fuse-carrier contacts and fuse-base contacts shall be inspected for significant damage to the contacts and for the level of engagement of the contacts.

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Annex A (informative)

Guide to the uninterrupted rated current of fuses under various conditions of installation

The fuses specified in this standard have a maximum uninterrupted rated current of 100 A when installed on a mounting board in free air having a maximum ambient temperature of 40 °C and supplied by a 25 mm^2 service cable with solid aluminium phase conductor, of the type specified in **8.3.3.3.4.1**a), which is routed in free air for a distance of at least 300 mm immediately preceding entry to the cable termination cover.

When a 100 A fuse and other service equipment is installed in a meter box, derating of the fuse is necessary. Similarly, enclosing a cable in a duct or tube causes an increase in the cable core temperature which can cause heat to be transmitted to the fuse, thus further reducing its rating.

Table A.1 gives examples of the derating caused by certain types of installation.

Table A.1 **Examples of derating for typical installation methods**

Cable size	Installation method	Fuse rating	Rating with interconnecting unit
mm^2		A	A
25	External [A)]	87	82
35	External [A)]	93	88
25	Cavity [B)]	84	79
35	Cavity [B)]	89	84

A) "External" refers to a cable which is mounted on the outer leaf of the wall within a 32 mm internal diameter polyethylene tube.

B) "Cavity" refers to a cable which is routed between the two leaves of a cavity wall within a 32 mm internal diameter polyethylene tube.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 60439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies*

BS EN 60051-1, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*

BS IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Chapter 195: Earthing and protection against electric shock*

IEC 60050-441:1984+A1:2000, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

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