BRITISH STANDARD

BS 7656:1993
+A1:2013

Specification for

Low-voltage pole-mounting fuses (cut-outs) — 400 A rating

ICS 29.120.50

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/10, upon which the following bodies were represented:

ASTA Certification Services

Association of Control Manufacturers TACMA (BEAMA Ltd.)

Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)

British Industrial Truck Association

ERA Technology Ltd.

Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)

Electricity Association

Electronic Components Industry Federation

Engineering Equipment and Materials Users' Association GAMBICA (BEAMA Ltd.)

Health and Safety Executive

Institution of Electrical Engineers

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Contents

Foreword

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution.

BS 7656:1993+A1:2013 supersedes BS 7656:1993, which is withdrawn.

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee. It is based on the Electricity Association Technical Specification 12-20, and has been updated to reflect current practice and standards. This standard was originally submitted to CENELEC under the Vilamoura Procedure, but in the absence of interest by other national committees, it was derogated to the UK for publication as a national standard.

This standard is to be read in conjunction with BS EN 60947-1:2007+A1:2011 and therefore for ease of cross-reference it has clause numbering following the style of BS EN 60947-1:2007+A1:2011.

Subclauses, tables or figures which are additional to those in BS EN 60947-1:2007+A1:2011 are numbered starting from Figure 101.

Text introduced or altered by Amendment No. 1 is indicated in the text by tags A1 A1. Minor editorial changes are not tagged.

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.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 10, an inside back cover and a back cover.

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

1 General

1.1 Scope

This standard specifies the requirements for single-pole fuses (cut-outs) of [A1] 400 [A1] A rating which are mounted on poles for low-voltage network protection, sectioning or sub-fusing. The fuses (cut-outs) may be mounted on a high-voltage/low-voltage transformer pole where the high-voltage equipment earth is led down the pole. They are for use on a single phase, or one phase of a three phase low-voltage public electricity supply system 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 are applicable to this standard where 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+A1:2011, for example BS EN 60947-1:2007 +A1:2011, **1.2.3**, BS EN 60947-1:2007+A1:2011, Table 5, or BS EN 60947-1:2007+A1:2011, Annex A.

1.2 *Vacant*

1.3 References

1.3.1 Normative references

[A1] The referenced documents on page 11 of this document 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. [A1]

2 Definitions

[A1] For the purpose of this British Standard, the definitions given in BS EN 60947-1:2007+A1:2011 apply, together with the following. [A1]

2.1
fuse-carrier [A1] *Text deleted.* [A1]
moveable part of a fuse designed to carry a fuse-link.

[SOURCE: BS EN 60127-1:2006+A1:2011, **3.12**]

2.2
fuse-base (fuse-mount) [A1] *Text deleted.* [A1]
fixed part of a fuse provided with terminals for connection to the system. The fuse-base comprises all the parts necessary for insulation

[A1] NOTE Where applicable, covers are considered as part of the fuse-base. [A1]

2.3
fuse-holder [A1] *Text deleted.* [A1]
combination of a fuse-base with its fuse-carrier

[SOURCE: BS EN 60127-1:2006+A1:2011, **3.9**]

2.4
fuse-link [A1] *Text deleted.* [A1]
part of a fuse (including the fuse-elements) intended to be replaced after the fuse has operated

[SOURCE: BS EN 60127-1:2006+A1:2011, **3.3**]

2.5
fuse (cut-out) [A1] *Text deleted.* [A1]
device that, by fusion of one or more of its specifically 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. The fuse comprises all the parts that form the complete device

2.6
fuse-link contact [A1] *Text deleted.* [A1]
conducting part of a fuse-link designed to engage with a fuse-base contact or with a fuse-carrier contact

2.7
fuse-base contact (fuse-mount contact)
[A1] *Text deleted.* [A1]
conducting part of a fuse-base connected to a terminal designed to engage with a fuse-carrier contact or with a fuse-link contact

2.8
basic insulation [A1] *Text deleted.* [A1]
insulation applied to live parts to provide basic protection against electric shock

[SOURCE: BS EN 60335-1:2012, **3.3.1**]

2.9
supplementary insulation [A1] *Text deleted.* [A1]
[A1] independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of basic insulation

[SOURCE: BS EN 60335-1:2012, **3.3.2**] [A1]

2.10
double insulation [A1] *Text deleted.* [A1]
insulation comprising both basic insulation and supplementary insulation

[SOURCE: BS EN 60335-1:2012, **3.3.3**]

2.11
reinforced insulation [A1] *Text deleted.* [A1]
single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this standard

[A1] NOTE It is not implied that the term insulation system is of one homogeneous piece. The insulation might comprise several layers which cannot be tested singly as supplementary or basic insulation. [A1]

[SOURCE: BS EN 60335-1:2012, **3.3.4**]

3 *Vacant*

4 Characteristics

Clause **4** of BS EN 60947-1 applies only in relation to the following characteristics, and with deletions and additions to the subclauses as indicated:

Rated operational voltage (U_e);

Rated insulation voltage (U_i);

Rated impulse withstand voltage (U_{imp});

Rated uninterrupted current (I_u);

Rated frequency;

〉A1〈 Rated conditional short-circuit current. 〉A1〈

4.1 General

〉A1〈 *Text deleted.* 〉A1〈 BS EN 60947-1:2007+A1:2011, **4.1** applies.

4.2 Type of equipment

BS EN 60947-1:2007+A1:2011, **4.2** applies.

4.3 Rated and limiting values for the main circuits

〉A1〈 BS EN 60947-1:2007+A1:2011, **4.3** applies modified as follows:

The following subclauses do not apply:

4.3.2.1 Conventional free air thermal current (I_{th})

4.3.2.2 Conventional enclosed thermal current (I_{the})

4.3.2.3 Rated operational current (I_e) or rated operational power

4.3.4 Rated duties

4.3.5 Normal load and overload characteristics

4.3.6.1 Rated short-time withstand current (I_{cw})

4.3.6.2 Rated short-circuit making capacity (I_{cm})

4.3.6.3 Rated short-circuit breaking capacity (I_{cn}) 〉A1〈

Additions:

4.3.2.4.101 *Fuses*

A fuse shall be capable of carrying current up to its rated uninterrupted current of 〉A1〈 400 〉A1〈 A, and the currents associated with the operation under fault conditions of any fuse-link which the fuses are designed to accommodate.

4.3.1.1 *Rated operational voltage (U_e)*

Fuses shall operate on low-voltage public electricity supply systems with a maximum voltage up to 440 V a.c.

5 Product information

5.1 Nature of information

BS EN 60947-1:2007+A1:2011, **5.1** applies with the following modification.

Characteristics:

〉A1〈 Delete all the characteristics listed and replace them with the following:

— rated operational voltage (U_e) 440/250 V a.c. (see BS EN 60947-1:2007+A1:2011, **4.3.1.1**);

— rated uninterrupted current (I_u) (see BS EN 60947-1:2007+A1:2011, **4.3.2.4.101** and **4.3.2.4**);

— the value of the rated frequency ~ 50 Hz;

— rated insulation voltage (U_i) 440 V a.c. r.m.s (see BS EN 60947-1:2007+A1:2011, **4.3.1.2**);

— rated impulse withstand voltage (U_{imp}) 6.0 kV. (see BS EN 60947-1:2007+A1:2011, **4.3.1.3**);

— rated conditional short-circuit current 18 kA a.c. r.m.s (see BS EN 60947-1:2007+A1:2011, **4.3.6.4**);

— IP code (see BS EN 60947-1:2007+A1:2011, **7.1.11** and Annex C);

— pollution degree 4 (see BS EN 60947-1:2007 +A1:2011, **6.1.3.2**). 〉A1〈

5.2 Marking

〉A1〈 The fuse-carrier shall be clearly and permanently marked according to of BS 88-1, **6.1**. In order to correlate the fuse carrier and fuse base, the fuse-base shall be indentified with the manufacturer's product identification reference. 〉A1〈

5.3 Instructions for installation, operation and maintenance

BS EN 60947-1:2007+A1:2011, **5.3** applies.

6 Normal service and mounting conditions

6.1 Normal service conditions

BS EN 60947-1:2007+A1:2011, **7.1.1.2** applies with the following modifications and additions:

6.1.1 ***Ambient air temperature***

Modification:

The requirements for the lower limit of the ambient air temperatures are to be as follows:

The lower limit of the ambient air temperature shall be – 25 °C as required by 〉A1〈 BS EN 61439-1 〉A1〈 for outdoor installed low-voltage switchgear and controlgear assemblies.

6.1.3.2 *Pollution degree*

Addition:

The fuses shall be suitable for operating in a pollution degree 4 environment which is subject to solar radiation.

6.2 *Vacant*

6.3 Mounting

The fuse-holder shall be capable of being fixed to a flat surface or curved convex surfaces with minimum radius of 90 mm.

When mounted for multiphase application at [A1] a minimum 300 [A1] mm vertical spacing between fixing points, there shall be sufficient access for safe insertion and removal of fuse-carriers.

Preferably, a single point fixing arrangement shall be provided which is sufficiently secure to prevent movement during cable installation and fuse-carrier removal and insertion.

7 Constructional and performance requirements

7.1 Constructional requirements

[A1] BS EN 60947-1:2007+A1:2011, **7.1**, applies with the following modifications. [A1]

7.1.2 ***Materials***

[A1] *Text deleted* [A1]

[A1] **7.1.2.1** *General material requirements*

Replace BS EN 60947-1:2007+A1:2011, **7.1.2.1** with the following.

The insulating integral enclosures shall conform to BS EN 60335-1:2012, 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**, **7.1.2.3**, and **7.1.2.101** to **7.1.2.105** inclusive.

NOTE 1 If an identical material having representative cross-sections has already satisfied the test requirements detailed in **7.1.2.2**, **7.1.2.3**, and **7.1.2.101** to **7.1.2.105** inclusive, then those representative tests need not be repeated.

NOTE 2 As an alternative to conducting the tests detailed in **7.1.2.2**, **7.1.2.3**, and **7.1.2.101** to **7.1.2.105** inclusive, 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 *Glow wire testing*

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

7.1.2.3 *Test based on flammability category*

Requirements not applicable.

7.1.2.101 *Resistance to normal heat*

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

7.1.2.102 *Resistance to fire*

When tested in accordance with BS EN 60695-11-10:2013, insulating materials shall be flame retardant to Category V-2.

7.1.2.103 *Material classification*

Insulating materials shall be Material Group I or Material Group II as classified in BS EN 60947-1:2007+A1:2011, **7.2.3.4**a). The minimum comparative tracking index (CTI) shall be 500.

7.1.2.104 *Moisture absorption*

When tested in accordance with **8.2.1.101**, insulating materials shall resist the absorption of moisture.

7.1.2.105 *Resistance to ultra-violet radiation*

External parts of the cutouts shall be resistant to ultra-violet radiation in accordance with BS EN 61439-1:2011, **8.1.4**. [A1]

7.1.3 ***Current carrying parts and their connections***

BS EN 60947-1:2007+A1:2011, **7.1.3** applies with the following additions.

7.1.3.101 *Fuse-carriers*

Fuse-carriers shall have a rated uninterrupted current of [A1] 400 [A1] A and shall fit the fuse-bases to **7.1.3.102**.

It shall be possible for the fuse-carrier with fuse-link to be inserted by hinge action pivoted on either of the fuse-base contacts and be withdrawn by snatch action.

If the fuse-carrier is designed for hand operation, the handle shall be of through-grip construction.

The fuse-carrier shall be suitable for accepting [A1] type gU [A1] fuse-links, with fixing centres at 82 mm, [A1] in accordance with BS 88-2. [A1]

The fuse-carrier shall afford a secure connection for the fuse-link to the fuse-base contacts. If this is provided by means of wedge connections and a thumbscrew tightening mechanism, conformity to **8.2.2.102** and **8.3.3.2.2** is required.

7.1.3.102 *Fuse-bases*

Fuse-bases shall be suitable for use with fuse-carriers to **7.1.3.101**.

The contacts and terminals shall be firmly secured in the fuse-base so that no misalignment of contacts can occur during the installation of the cable, removal or insertion of the fuse-carrier, or by the temperature-rise produced in service.

7.1.4 ***Clearances and creepage distances***

The minimum distance for clearance and for creepage shall be 12.5 mm.

7.1.5 ***Actuator***

BS EN 60947-1:2007+A1:2011, **7.1.5** is not applicable.

7.1.6 ***Indication of contact positions***

BS EN 60947-1:2007+A1:2011, **7.1.6** is not applicable.

7.1.7 ***Additional requirements for equipment suitable for isolation***

7.1.7.2 *Supplementary requirements for equipment with provision for electrical interlocking with contactors or circuit breakers*

BS EN 60947-1:2007+A1:2011, **7.1.7.2** is not applicable.

7.1.7.3 *Supplementary requirements for equipment provided with means for padlocking in the open position*

BS EN 60947-1:2007+A1:2011, **7.1.7.3** is not applicable.

7.1.8 ***Terminals***

7.1.8.1 *Constructional requirements*

Text deleted.

Replace all except the first paragraph of BS EN 60947-1:2007+A1:2011, **7.1.8.1** with the following.

Lug terminals as shown in Figure D.5 of BS EN 60947-1:2007+A1:2011 shall be provided with an M12 stud or through bolt to accept a cable lug, preferably of the type which can be compressed onto the cable ends. Other methods of termination are not excluded providing that they satisfy the type tests of **8.1.2**.

The contact surfaces and threaded parts shall not deteriorate under the environmental conditions of normal service.

The threads of all studs and bolts shall be in accordance with BS 3643-1.

7.1.9 ***Additional requirements for equipment provided with a neutral***

BS EN 60947-1:2007+A1:2011, **7.1.9** is not applicable.

7.1.10 ***Provision for protective earthing***

BS EN 60947-1:2007+A1:2011, **7.1.10** is not applicable.

7.1.11 ***Enclosures for equipment***

7.1.11.1 *Design*

Only paragraphs 1, 2 and 5 of **7.1.11.1** of BS EN 60947-1:2007+A1:2011 apply with the following addition.

An insulating integral enclosure shall be provided which shall have a mechanical strength sufficient to withstand the forces which may be expected to occur in normal service. This requirement shall be verified by the test of **8.2.2.101**.

The insulating integral enclosure shall be capable of accepting cables from 12.5 mm to 30 mm maximum overall diameter, and shall be designed so that the cables can be led downwards from transformers and overhead lines and turned through a drip loop prior to entry into the fuse. A shrouding arrangement shall be provided to ensure the specified minimum level of protection (IP) is maintained when fitted with smaller sizes of cables.

7.1.12 ***Degrees of protection of enclosed equipment***

Deleted text.

Addition:

When a fuse is mounted in a normal service operating position with all removable parts of the fuse in place, the degree of protection provided to all internal or live parts shall not be less than IP 43 as specified in BS EN 60947-1:2007+A1:2011, Annex C.

An alternative carrier or blanking cover which is of a colour clearly distinguishable from the insulating integral enclosure, shall be available to replace the normal fuse-carrier, when no through connection is required. The degree of protection afforded by the alternative carrier when properly inserted shall be not less than that afforded by the normal fuse-carrier when properly inserted.

7.2 Performance requirements

The following requirements apply to clean new fuse-holders installed in accordance with this standard.

7.2.1 ***Temperature-rise***

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

The temperature-rise of the parts of a fuse measured during tests of **8.3.3.3.4.101**, under the conditions specified in **8.3.2.1** shall not exceed the values stated in Table 102.

7.2.1.101 *Long term contact stability* A1 *– cyclic loading* A1

Adequate contact shall be maintained between the fuse-link 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. This requirement shall be verified by the test given in **8.3.3.3.4.102**.

7.2.2 ***Overload performance*** A1

Cutouts shall be capable of withstanding an overload current as limit by the fuse link. This requirement shall be verified by the test given in **8.3.3.3.4.103**. A1

7.2.3 ***Dielectric properties***

The dielectric properties of the fuses shall be verified by the tests given in **8.3.3.4**.

7.2.4 *Vacant*

7.2.5 ***Short circuit performance*** A1

A fuse shall be capable of carrying the short time currents associated with the operation under fault conditions of any fuse-link to **7.1.2.101**. This requirement shall be verified by the tests of **8.3.4**. A1

7.2.6 *Vacant*

7.2.7 *Vacant* A1

7.3 Electromagnetic compatibility (EMC) A1

The requirements of BS EN 60947-1:2007+A1:2011, **7.3** apply. A1

8 Tests

8.1 Kinds of tests

8.1.1 ***General***

BS EN 60947-1:2007+A1:2011, **8.1.1** applies.

8.1.2 ***Type tests***

BS EN 60947-1:2007+A1:2011, **8.1.2** applies with the following A1 changes A1.

Unless otherwise stated in the relevant test, fuse-holders 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 fuse-holders.

The type tests A1 and verifications A1 applicable are as follows:

a) *Constructional requirements:*

A1 — glow wire performance (see BS EN 60947-1:2007+A1:2011, **8.2.1.1.1**);

— resistance to normal heat (see **8.2.1.1.101**);

— resistance to fire (see **8.2.1.1.102**);

— material classification (see **7.1.2.103**);

— moisture absorption (see **8.2.1.101**);

— resistance to ultra-violet radiation (see **8.2.1.102**); A1

— impact strength (see **8.2.2.101**);

— protection (see **8.2.3.101**);

— thumbscrew torque withstand (see **8.2.2.102**).

b) *Performance*;

— temperature-rise at rated current (see **8.3.3.3.4.101**);

— cyclic loading temperature-rise (see **8.3.3.3.4.102**);

— overload performance (see **8.3.3.3.4.103**);

— dielectric properties (see **8.3.3.4**);

— short circuit withstand (see **8.3.4**).

Type tests shall be carried out for each new batch in the order indicated in Table 101.

8.1.3 ***Routine tests***

Tests shall be carried out on the thumbscrews of the wedge tightening device of fuse-carriers in accordance with **8.3.3.3.4.102**.

8.2 Conformity with constructional requirements

8.2.1 ***Materials***

8.2.1.1 *Test of resistance to abnormal heat and fire* A1

8.2.1.1 of BS EN 60947-1:2007+A1:2011 applies with the following additions and deletions.

8.2.1.1.2 *Flammability, hot wire ignition and arc ignition tests (on materials)*

BS EN 60947-1:2007+A1:2011, **8.2.1.1.2** is not applicable.

8.2.1.1.101 *Resistance to normal heat*

Determine the temperature index as defined in BS EN 60216-1 for each of the insulating materials used in the cutout, by test in accordance with BS EN 60216 or by reference to the material manufacturer's data. Alternatively, determine from the material manufacturer's data the thermal class of each of the insulating materials in accordance with BS EN 60085.

Resistance to normal heat is verified for the part being considered if the temperature index and/or the temperature assigned to the thermal class is at least equal to maximum temperature rise of the insulating part and/or any conductors in contact with it, as determined in **8.3.3.3.4.101**, plus the maximum daily average ambient temperature.

8.2.1.1.102 *Resistance to fire*

Materials used for the insulating integral enclosure of all fuses, terminal blocks and interconnecting units shall conform to BS EN 60695-11-10:2013, Category V-2. At the cut-out assembly manufacturer's discretion, conformity shall be demonstrated by testing samples of materials in accordance with BS EN 60695-11-10:2013, or alternatively, by reference to the material manufacturer's test data.

8.2.1.101 *Moisture absorption test*

The moisture resistance capability of insulating materials used in fuses shall be tested in accordance with BS EN 60269-1:2007+A1:2009, **8.2**.

8.2.1.102 *Resistance to ultra-violet radiation*

Representative samples of the enclosure material shall be tested in accordance with BS EN 61439-1, **10.2.4**. 〈A1〉

8.2.2 ***Equipment***

8.2.2.101 *Impact test*

〈A1〉 Impact tests shall be carried out in accordance with IK07 of BS EN 62262 at the following temperatures. 〈A1〉

〈A1〉 *Text deleted* 〈A1〉

Test 1. The test shall be carried out at an ambient air temperature between 15 °C and 35 °C immediately after the fuse-holders to be tested have been kept within these temperatures for not less than 18 h.

Test 2. The test shall be carried out at an ambient air temperature between 15 °C and 35 °C immediately after the fuse-holders have been kept at a maximum temperature of – 25 °C for a period of not less than 18 h.

〈A1〉 *Text deleted.* 〈A1〉

Conformity is checked by inspection. The fuse-units are to show no significant damage, and no accessible live parts; the appearance of small dents is to be ignored provided that there are no associated cracks detrimental to the serviceability of the fuse. Where any doubt of conformity arises, it is to be resolved by carrying out a test to **8.3.3.4.1**.

8.2.2.102 *Thumbscrew torque withstand*

The test shall be carried out on a batch of six new insulated wedge operating thumbscrews. The metal portion of each thumbscrew shall in turn be placed in a vice and a torque of 12 N·m applied in a clockwise direction to the insulating knob of the thumbscrew using a torque spanner adapted for the purpose.

Conformity is checked by inspection that each insulated thumbscrew has withstood the torque without fracturing and without the insulating knob turning on the shank of the wedge operating screw.

8.2.3 ***Enclosures for equipment***

BS EN 60947-1:2007+A1:2011, **8.2.3** applies with the following addition:

8.2.3.101 *Degree of protection test*

The fuse to be tested shall be fitted with a 〈A1〉 400 〈A1〉 A fuse-link and the test shall be carried out with cables, one of 12.5 mm diameter and one of 〈A1〉 30 〈A1〉 mm diameter, installed in the appropriate positions. The fuse shall be tested for the degree of protection required in **7.1.11**, except that the test probe shall be in a 1 m length of 1 mm diameter straight steel wire applied from all directions from below at a distance of 1 m from the fuse mounted in its normal service position.

Conformity is checked by inspection for degree of protection.

8.2.4 *Vacant*

8.3 Performance

8.3.1 ***Test sequences***

The type test sequence for fuses 〈A1〉, where applicable, is given in Table 101. 〈A1〉

8.3.2 ***General test conditions***

8.3.2.1 *General requirements*

BS EN 60947-1:2007+A1:2011, **8.3.2.1** applies amplified as follows.

For tests **8.3.3.3.4.101** to **8.3.3.3.4.103**, the fuses shall be mounted in a vertical position on a mounting board as shown in Figure 〈A1〉 101 〈A1〉. No part of the edge of any fuse shall lie within 150 mm of the edge of the mounting board.

Where fuse-links are required to be fitted to the fuse-holders for a particular test, they shall conform to **7.1.2.101** and have a current rating of 〈A1〉 400 A. The power loss of the fuse links used in the test shall be specified in the test report. 〈A1〉

〈A1〉 *Figure 101 deleted.* 〈A1〉

Table 101. Type tests [A1] /verifications [A1]

Test	Subclause	Number of samples
Constructional requirements:		
Protection [A1] (IP code) [A1]	**8.2.3.101**	1 new sample
[A1] Impact Test 1 [A1]	**8.2.2.101**	6 new samples
[A1] Impact Test 2 [A1]	**8.2.2.101**	6 new samples
[A1] resistance to UV [A1]	**8.2.1.102**	1 new specimen
[A1] resistance to normal heat [A1]	[A1] **8.2.1.1.101** [A1]	[A1] 1 new specimen [A1]
[A1] resistance to fire [A1]	[A1] **8.2.1.1.102** [A1]	[A1] 1 new specimen [A1]
[A1] glow wire test [A1]	[A1] **8.2.1.1.1** [A1]	[A1] 1 new specimen [A1]
thumbscrew torque withstand	**8.2.2.102**	6 new samples
[A1] moisture absorption [A1]	[A1] **8.2.1.101** [A1]	[A1] 1 new specimen [A1]
[A1] material classification [A1]	[A1] **7.1.2.103** [A1]	[A1] Material data [A1]
Performance:		
dielectric properties	**8.3.3.4.1**	6 new samples
temperature-rise at rated current	**8.3.3.3.4.101**	6 new samples
[A1] long term contact stability – cyclic loading temperature-rise [A1]	**8.3.3.3.4.102**	See note 2
overload	**8.3.3.3.4.103**	See note 2
short-circuit	**8.3.4**	1 new sample
NOTE 1 The dielectric properties tests include lightning impulse withstand voltage dry tests, power frequency withstand voltage dry tests and measurement of insulation resistance. These tests are repeated after completion of the overload test of **8.3.3.3.4.103**.		
NOTE 2 These tests are to be carried out in the stated sequence on the same samples as used for the temperature-rise at rate current test.		

[A1] Fuse-holders shall be complete with any cable shrouds necessary to meet the specified degree of protection (IP) for tests **8.3.3.3.4.101** to **8.3.3.3.4.103**, **8.3.3.4.1** and **8.3.4**. [A1]

8.3.2.2 *Test quantities*

8.3.2.2.1 *Values of test quantities*

BS EN 60947-1:2007+A1:2011, **8.3.2.2.1** applies amplified as follows.

Values of test current are stated in the appropriate tests of this standard.

8.3.2.2.2 *Tolerances on test quantities*

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

[A1] *Text deleted.* [A1]

8.3.2.3 *Vacant*

8.3.2.4 *Test reports*

BS EN 60947-1:2007+A1:2011, **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*

[A1] BS EN 60947-1:2007+A1:2011, **8.3.3.3.1** applies with the following change. [A1]

The ambient air temperature shall not be less than 20 °C and not vary by more than 3 K/h during any temperature-rise test. The test environment shall allow a maximum air circulation of 0.447 m/s.

[A1] *Text deleted.* [A1]

8.3.3.3.2 *Measurement of the temperature of parts*

BS EN 60947-1:2007+A1:2011, **8.3.3.3.2** applies with the following addition:

The temperature of any test piece shall be within 3 K of ambient air temperature at the commencement of each test unless otherwise specified.

8.3.3.3.3 *Temperature-rise of a part*

BS EN 60947-1:2007+A1:2011, **8.3.3.3.3** applies.

8.3.3.3.4 *Temperature-rise of the main circuit*

At the end of the temperature-rise test the different parts of the main circuit shall not exceed the values given in Table 102.

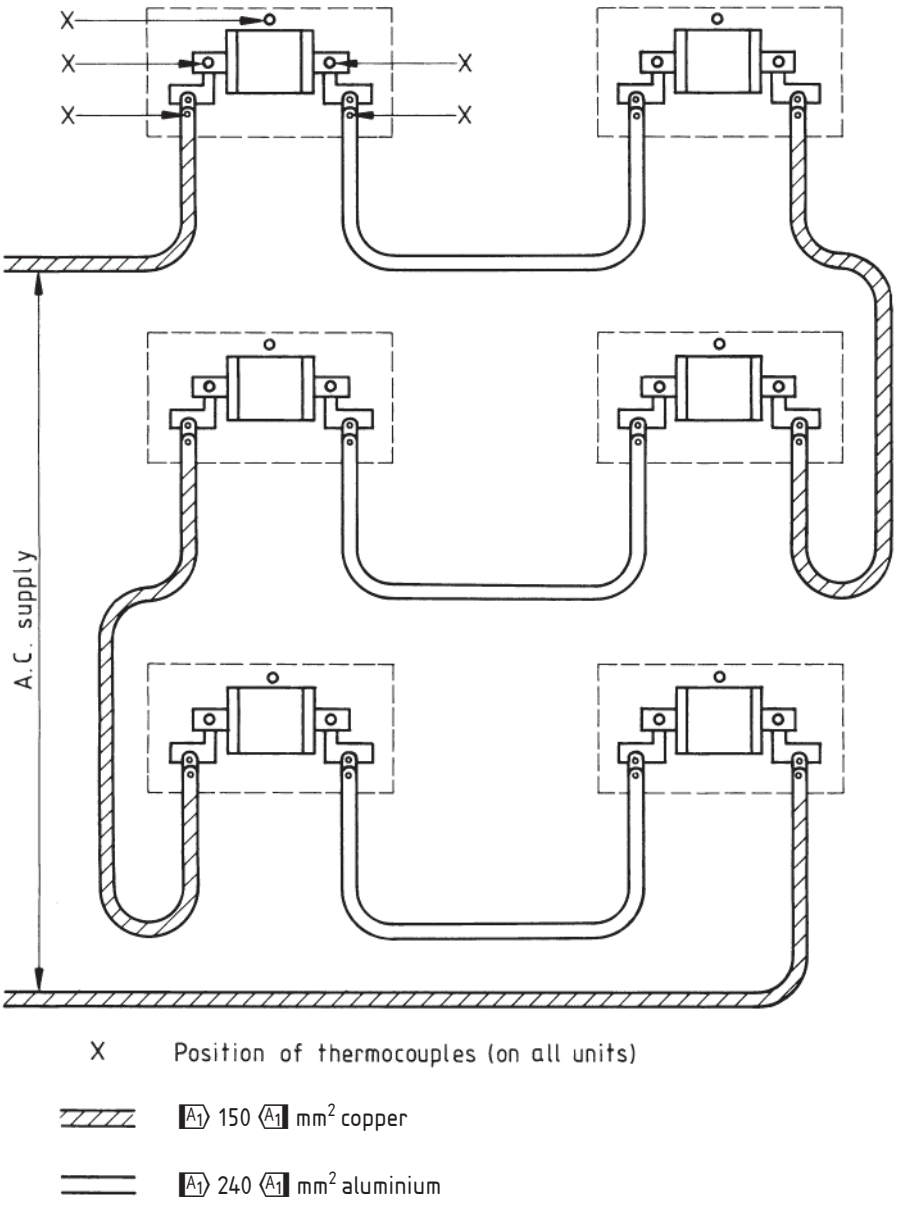

Figure [A1] 101 [A1] — Arrangement of test circuit

Table 102 — Maximum temperature-rise at rated current

Terminal lugs	[A1] 70 [A1] K
Fuse-link contacts	[A1] 75 [A1] K
Manual operating means:	
Fuse-carrier handle and wedge operating thumbscrews	25 K
Parts intended to be touched but not hand held:	
Insulating integral enclosure	40 K

The following test connections shall apply.

The six sample fuse-holders shall be connected in series as shown in Figure [A1] 101 [A1].

One terminal of each fuse-holder shall be connected to a terminal of the adjacent fuse-holder by a solid shaped aluminium phase conductor in accordance with [A1] BS EN 60228 [A1] which shall comprise a phase core extracted from [A1] 240 [A1] mm² cross-section three phase cross linked polyethylene insulated cable with concentric combined neutral and earth conductor.

The circuit supply and connections to the remaining terminals shall be made with [A1] 150 [A1] mm^2 cross-section PVC insulated and sheathed single core cable having a stranded copper conductor in accordance with BS [A1] 6004 [A1].

8.3.3.3.4.101 *Test for temperature-rise at rated current*

A batch of new fuses shall be tested for temperature-rise at rated uninterrupted current.

The steady state temperature-rises shall be recorded. The test current shall then be switched off and the test circuit allowed to cool to ambient temperature. No adjustments shall be made before the cyclic loading temperature-rise test of **8.3.3.3.4.102** is carried out.

Conformity is checked by verification that the recorded temperature-rises do not exceed the requirements of Table 102.

8.3.3.3.4.102 *Cyclic loading temperature-rise test*

The fuses shall be tested for not less than 500 cycles for stability of temperature-rise using the circuit of **8.3.3.3.4.101**.

The following test conditions are required:

a) each cycle shall be of 3 h duration (2 h on and 1 h off);

b) full tests for temperature-rise at the rated uninterrupted current shall be carried out initially and at every sequence of 100 cycles ± 25 cycles. The temperature-rises for all lug terminals 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 – 1 K;

d) for this test, fuse-links referred to in **8.3.2.1**, but without eutectic zones on the elements, are acceptable.

The test current shall then be switched off and the test circuit allowed to cool to ambient temperature.

Conformity is checked by inspection that there are no signs of deterioration that could affect the normal operation of the equipment and that the temperature-rises recorded in b) do not exceed those recorded initially by more than 3 K.

8.3.3.3.4.103 *Overload test*

All fuse-links shall be replaced by new fuse-links referred to in **8.3.2.1**. 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 103 for 4 h. The current shall then be increased to the value shown in column b) of Table 103 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) of Table 103 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 103 — Values for overload test current

a)	b)	c)
[A1] 510 [A1] A	[A1] 570 [A1] A	[A1] 630 [A1] A

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

The test specified in **8.3.3.3.4.101** shall now be repeated.

[A1] *Text deleted.* [A1]

Conformity is checked by inspection for the absence of signs of deterioration and by verification that the temperature rises recorded do not exceed those first recorded by more than 5 K.

8.3.3.4 *Dielectric properties*

8.3.3.4.1 *Type tests*

A batch of new fuse-holders, complete with cable entry shrouds and terminal lugs suitable for [A1] 240 [A1] mm^2 cross-section aluminium conductors, shall be subjected to lightning impulse withstand voltage dry tests and 1 min power frequency (alternating) voltage withstand dry tests in accordance with [A1] BS 923-1 [A1]. The tests shall be carried out immediately after each complete fuse-holder has been exposed to ambient conditions for at least 24 h.

Each fuse-holder shall be placed on an earthed, unpainted metal plate and fixed by means of a metal bolt and nut in the normal fixing hole.

One pole of the test supply shall be connected to the metal plate and earthed. The metal foil referred to in a) shall be in contact with the metal plate.

Lightning impulse withstand voltage tests shall be performed with voltages of both positive and negative polarity, using the standard lightning impulse 1.2/50. Ten consecutive lightning 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 the test voltages applied between the following:

a) one of the terminals and metal foil completely enclosing, and in contact with, all external surfaces of the fuse. This test shall be carried out with a fuse-link fitted in the fuse-carrier;

b) the terminals with the fuse-cartier fitted but without a fuse-link.

The power frequency withstand voltage test shall then be repeated for condition b) but in addition, for 10 min, immediately preceding the test and during the time voltage is applied, the fuses shall be exposed to simulated natural rain of the characteristics and equipment described in ⟩A1⟨ BS 923-1 ⟩A1⟨.

After completing the power frequency wet withstand voltage test, the fuse-holders shall be dried off and the insulation resistance measured between the same point, using a d.c. voltage of not less than 500 V which shall be applied for a time sufficient for the reading of the instrument to become practically steady.

Conformity is checked by inspection that there are no disruptive discharges and the insulation resistance is not to be 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 is to be regarded as failure of the test.

⟩A1⟨ Following completion of the insulation resistance tests the fuse carrier shall be removed and a test to confirm suitability for isolation shall be carried out. This test shall be in accordance with BS EN 60947-3, **8.3.3.5** for a utilisation category of AC-20B. ⟩A1⟨

8.3.3.4.2 *Routine tests*

⟩A1⟨ Routine dielectric tests shall be carried out on a representative sample of thumbscrews used in the fuse-carriers. ⟩A1⟨

Sampling for routine tests shall be in accordance with ⟩A1⟨ BS 6001-1 ⟩A1⟨ using the maximum acceptable quality level (normal inspection). In the event of electrical breakdown of any component on test, it shall be examined for the cause of failure. In accordance with the maximum quality acceptance level in ⟩A1⟨ BS 6001-1 ⟩A1⟨, 100 % of that production batch shall be subjected to the routine tests.

Each thumbscrew under test shall have the major accessible portion of the insulated section encased in conducting foam. ⟩A1⟨ The conducting foam shall be carbon loaded with a surface resistivity of Ω/m^2 in accordance with BS EN 61340-5-1. A test voltage 7 kV, 50 Hz shall then be applied for 5 s between the metal insert of the thumbscrew and the conducting foam. ⟩A1⟨.

All traces of carbon shall be removed after the test.

If the test 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 is to be regarded as failure of the test.

8.3.4 ***Performance under short-circuit conditions***

⟩A1⟨ A fuse fitted with a 400A fuse link shall be tested in accordance with Test Sequence IV of BS EN 60947-3:2009+A1:2012 for a fuse disconnector, excluding the temperature rise test, at a prospective short circuit current of 18kA. ⟩A1⟨

Conformity is checked by inspection of the fuse-carrier contacts and fuse-base contacts for adequate engagement and that these contacts have not suffered damage capable of hindering their further use.

List of references (see clause 1.3)

Normative references

[A1] The referenced documents on page [X] of this document 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. [A1]

[A1] BS 88-1:2007, *Low-voltage fuses – Part 1: General requirements* [A1]

[A1] BS 88-2:2010, *Low-voltage fuses – Part 1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to J* [A1]

[A1] BS 923-1, *Guide on high-voltage testing techniques – Part 1: General* [A1]

[A1] BS 3643-1:2007, *ISO metric screw threads Part 1– Principles and basic data* [A1]

[A1] BS 3643-2:2007, *ISO metric screw threads. Specification for selected limits of size* [A1]

[A1] BS 6001-1, *Sampling procedures for inspection by attributes– Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection* [A1]

[A1] 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* [A1]

[A1] BS EN 60085, *Electrical insulation – Thermal evaluation and designation* [A1]

[A1] 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* [A1]

[A1] BS EN 60228:2005, *Conductors of insulated cables* [A1]

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

[A1] BS EN 60335-1:2012, *Household and similar electrical appliances – Safety – Part 1: General requirements* [A1]

[A1] 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* [A1]

[A1] 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* [A1]

[A1] BS EN 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods* [A1]

[A1] BS EN 60947-1:2007+A1:2011, *Low-voltage switchgear and controlgear – Part 1: General rules* [A1]

[A1] BS EN 60947-3:2009+A1:2012, *Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units* [A1]

[A1] BS EN 61340-5-1:2007, *Electrostatics. Protection of electronic devices from electrostatic phenomena. General requirements* [A1]

[A1] BS EN 61439-1:2011, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules* [A1]

[A1] BS EN 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)* [A1]

Informative references

[A1] *Text deleted.* [A1]

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