



DPC: 23 / 30473799 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 17 May 2023

Origin: International

Latest date for receipt of comments: 5 July 2023

Project No. 2021/03553

Responsible committee: PEL/121/1 Low voltage switchgear and controlgear

Interested committees:

Title: BS EN IEC 60947-7-1 Low-voltage switchgear and controlgear

Part 7-1: Ancillary equipment - Terminal blocks for copper conductors

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

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- iii) requires additional national guidance or information

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Responsible Committee Secretary: **Mr Simon Bounds (BSI)**
Direct tel: **0208 996 7281**
E-mail: simon.bounds@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



121A/560/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:
IEC 60947-7-1 ED4

DATE OF CIRCULATION:
2023-05-12

CLOSING DATE FOR COMMENTS:
2023-08-04

SUPERSEDES DOCUMENTS:
121A/468/CD, 121A/493A/CC

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR	
SECRETARIAT: France	SECRETARY: Mr Michaël LAHEURTE
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	

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TITLE:

Low-voltage switchgear and controlgear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors

NOTE FROM TC/SC OFFICERS:

SC121A Officers support circulation of CD2 for project IEC 60947-7-1 ED4.

Secretary Note: NC experts are kindly requested to refer their comments to line number.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 7-1: Ancillary equipment –
Terminal blocks for copper conductors**

FOREWORD

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International Standard IEC 60947-7-1 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low-voltage.

This fourth edition cancels and replaces the third edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Scope extension for smaller conductor cross-sections;
- b) Implementation of a contact pressure via insulation material (CoPI) test;
- c) Introduction of new informative Annex E for larger cross sections;
- d) Reorganisation of all tables merged into two tables for electrical and mechanical values;
- e) Implementation of AWG-sizes conductor types as an equivalent type with examples in Annex C;

f) Reorganisation of Annex D test disconnect terminal blocks to enhance readability.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
121A/XX/FDIS	121A/XX/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at https://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at <https://www.iec.ch/standardsdev/publications>.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this document the stability date is 202X..

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 7-1: Ancillary equipment – Terminal blocks for copper conductors

1 Scope

This part of IEC 60947 specifies requirements for terminal blocks with screw-type or screw-less-type clamping units primarily intended for industrial or similar use and to be fixed to a support to provide electrical and mechanical connection between copper conductors. It applies to terminal blocks intended to connect round copper conductors, with or without special preparation, having a cross-section between 0,05 mm²/AWG 30 and 300 mm²/600 kcmil, intended to be used in circuits of a rated voltage not exceeding 1 000 V AC up to 1 000 Hz or 1 500 V DC. The tests on terminal blocks are made with AC or DC supply as required in relevant clauses of this document.

Terminal blocks are electrical components, which are typically installed in enclosures according to IEC 60947-1:2020 clause 3.3.16 enclosure: part providing a specified degree of protection of equipment against certain external influences and a specified degree of protection against approach to or contact with hazardous live parts and hazardous mechanical part. For this kind of components IEC Guide 116 states that there are "however, other electrical components that are intended to be incorporated into other electrical equipment".

NOTE 1 No IP degree listing for terminal blocks is required, but possible.

NOTE 2 AWG is the abbreviation of "American Wire Gage" (Gage (US) = Gauge (UK))

kcmil = 1 000 cmil;

1 cmil = 1 circular mil = surface of a circle having a diameter of 1 mil

1 mil = 1/1 000 inch

This document may be used as a guide for

- terminal blocks requiring the fixing of special devices to the conductors, for example quick connect terminations or wrapped connection, etc.;
- terminal blocks providing wire-binding screw (see IEC 60947-1:2020, Annex D, Figure D.2), stud and nut terminations (see IEC 60947-1:2020, Annex D, Figure D.4 and D.5), lug terminations (see IEC 60947-1:2020, Annex D, Figure D.6) and terminal blocks providing direct contact to the conductors by means of edges or points penetrating the insulation, for example insulation displacement connection (IDC) (see IEC 60352-4:2020, Figure 2), etc.;
- special types of terminal blocks, for example with diodes or varistors or similar component holders, etc.;
- terminal blocks with capability to connect conductors with cross sections larger than 600 kcmil, see Annex E.

Where applicable in this document, the term "clamping unit" has been used instead of the term "terminal". This is taken into account in case of reference to IEC 60947-1:2020.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60068-2-1:2007 *Environmental testing - Part 2-1: tests - Test A: Cold*

IEC 60068-2-2:2007 *Environmental testing - Part 2-2: tests - Test B: dry heat*

IEC 60352-4: 2020, *Solderless connections - Part 4: Non-accessible insulation displacement (ID) connections - General requirements, test methods and practical guidance*

IEC 60695-11-5: 2016, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60947-1: 2020, *Low-voltage switchgear and controlgear Part 1: General rules*

ISO 4046-4: 2016, *Paper, board, pulp and related terms – Vocabulary – Part 4: Paper and board grades and covered products*

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 60947-1:2020, together with the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

terminal block

insulation part carrying one or more mutually insulated terminal assemblies and intended to be fixed to a support

3.2

rated cross-section

value of the maximum cross-section of all connectable types of conductors, rigid (solid and stranded) and flexible, stated by the manufacturer, and to which certain thermal, mechanical and electrical requirements are referred

3.3

rated connecting capacity

range of cross-section and, if applicable, the number of connectable conductors, for which the terminal block is designed

3.4

terminal assembly

two or more clamping units fixed to the same conductive part

3.5

contact pressure via insulating material (for a clamping unit) [CoPI]

contact force of a clamping unit where at least one of its contact surfaces is made from insulating material

4 Classification

Distinction is made between various types of terminal blocks as follows:

- method of fixing the terminal block to the support;
- number of poles;

- 294 – type of clamping units: screw-type clamping units or screwless-type clamping units;
- 295 – ability to receive prepared conductors (see 3.5.28 of IEC 60947-1:2020);
- 296 – terminal assemblies with identical or dissimilar clamping units;
- 297 – number of clamping units on each terminal assembly;
- 298 – service conditions;
- 299 – ability to receive different types of conductors, e.g, solid, rigid stranded or flexible
- 300 conductors.

301 **5 Characteristics**

302 **5.1 Summary of characteristics**

303 The characteristics of a terminal block are as follows:

- 304 – type of terminal block (see 5.2);
- 305 – rated and limiting values (see 5.3).

306 **5.2 Type of terminal block**

307 The following shall be stated:

- 308 – type of clamping units (e.g. screw-type, screwless-type);
- 309 – number of clamping units.

310 **5.3 Rated and limiting values**

311 **5.3.1 Rated voltages**

312 Subclauses 5.3.1.2 and 5.3.1.3 of IEC 60947-1:2020 apply.

313 **5.3.2 Short-time withstand current**

314 A specified RMS value of current which a terminal block shall be able to withstand during a
315 specified short-time under prescribed conditions of use and behaviour (see 8.2.3 and 9.4.6)

316 **5.3.3 Standard cross-section**

317 The standard values of cross-sections of round copper conductors to be used are contained in
318 Table 1.

319 **5.3.4 Rated cross-section**

320 The rated cross-section shall be selected from the standard cross-sections given in Table 1.

321 **5.3.5 Rated connecting capacity**

322 The rated connecting capacity shall be selected from the standard cross-sections given in Table
323 1. The manufacturer shall state the types and the maximum and minimum cross sections of
324 conductors that can be connected and, if applicable, the number of conductors simultaneously
325 connectable to each clamping unit. The manufacturer shall also state any necessary preparation
326 of the end of the conductor.

327 For terminal blocks with a rated cross-section of 35 mm² or smaller, the rated connecting
328 capacity contained in Table 1 applies. When applying the connecting capacity in Table 1, the
329 conductors may be rigid (solid or stranded) or flexible.

6 Product information

6.1 Marking

6.1.1 Manufacturer or trade mark

All terminal blocks shall be marked in a durable and legible manner with the name of the manufacturer or a trademark by which the manufacturer can be readily identified.

6.1.2 Type reference

All terminal blocks shall be marked in a durable and legible manner with a type reference permitting its identification in order to obtain relevant information from the manufacturer or his product documentation (e.g. machine-readable code with reference to internet, electronic catalogues, web-link on the package unit or product inserts, etc.).

6.1.3 Very small terminal blocks

For very small terminal blocks with limited practical space for marking, only 6.1.1 applies. Information of 6.1.2 shall be permitted to be marked on the smallest package unit or product inserts.

6.2 Additional information

The following information shall be stated by the manufacturer, if applicable, e.g. in the product documentation (e.g. machine-readable code with reference to internet, electronic catalogues, web-link on the package unit or product inserts, etc.):

- a) IEC 60947-7-1, if the manufacturer claims compliance with this document;
- b) the rated cross-section;
- c) the rated connecting capacity, if different from Table 1;
- d) the rated insulation voltage (U_i);
- e) the rated impulse withstand voltage (U_{imp}), when determined;
- f) service conditions, if different from those of Clause 7;
- g) conventional free air thermal current (I_{th});
- h) following information for non-universal terminal blocks, depending on the classification, shall be used:
 - for clamping units declared for solid conductors “solid” or the abbreviations “s” or “sol”;
 - for clamping units declared for rigid stranded conductors “rigid stranded” or the abbreviation “r”;
 - for clamping units declared for flexible conductors “flexible” or the abbreviation “f”;
- i) special preparation of the end of the conductor;
- j) number of conductors simultaneously connectable, if different from one;
- k) the manufacturer's declared tightening torque, either from Table 4 of IEC 60947-1:2020 or higher;
- l) installation manual;
- m) safety instructions.

NOTE In some countries tightening torque values lower than those as listed in Table 4 of IEC 60947-1:2020 are allowed according to their national product standards: United States of America and Canada.

7 Normal service, mounting and transport conditions

Clause 7 of IEC 60947-1:2020 applies.

8 Constructional and performance requirements

8.1 Constructional requirements

8.1.1 Clamping units

Subclause 8.1.8.1 of IEC 60947-1:2020 applies with following modifications.

The clamping units shall allow the conductors to be connected by means ensuring that a reliable mechanical linkage and electrical contact is properly maintained.

Screw-type clamping units are not suitable for the connection of flexible conductors with tin soldered ends.

The clamping units shall be able to withstand the force that can be applied through the connected conductors.

Compliance is checked by inspection and by the tests of 9.3.3.1, 9.3.3.2 and 9.3.3.3.

If contact pressure of the clamping unit is transmitted through insulating material other than ceramic or pure mica, the test described in 9.4.8 contact pressure via insulating material (CoPI) test shall be performed to prove that there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage of the insulation material.

8.1.2 Mounting

Terminal blocks shall be provided with means that allow them to be securely attached to a rail or a mounting surface.

Tests shall be made in accordance with 9.3.2.

NOTE Information on mounting on rails can be found in IEC 60715.

8.1.3 Clearances and creepage distances

For terminal blocks for which the manufacturer has stated values of rated impulse withstand voltage (U_{imp}) and rated insulation voltage (U_i), minimum values of clearances and creepage distances are given in Table 13 and Table 15 of IEC 60947-1:2020.

For terminal blocks for which the manufacturer has not declared a value of rated impulse withstand voltage (U_{imp}), guidance for minimum values is given in Annex H of IEC 60947-1:2020.

Electrical requirements are given in 8.2.2.

8.1.4 Terminal identification and marking

Clause 8.1.8.4 of IEC 60947-1:2020 applies with the following addition.

A terminal block shall have provision, or at least space, for identification marks or numbers for each clamping unit or terminal assembly related to the circuit of which it forms a part.

For the identification of the terminal blocks the colour combination green-yellow is not allowed.

NOTE Such provision may consist of separate marking items, such as marking tags, identification labels, etc.

8.1.5 Resistance to abnormal heat and fire

The insulation material of the terminal block shall not be adversely affected by abnormal heat and fire.

408 Compliance is checked by the needle flame test according to IEC 60695-11-5:2016 as specified
409 in 9.5 of this document.

410 **8.1.6 Rated cross-section and rated connecting capacity**

411 Terminal blocks shall be so designed that conductors of the rated cross-section and the rated
412 connecting capacity, if applicable, can be accepted.

413 Compliance is checked by the test described in 9.3.3.4.

414 The verification of the rated cross-section may be performed by the special test according to
415 9.3.3.5.

416 **8.2 Performance requirements**

417 **8.2.1 Temperature rise**

418 Terminal blocks shall be tested in accordance with 9.4.5. The temperature-rise of the terminals
419 shall not exceed 45 K.

420 **8.2.2 Dielectric properties**

421 If the manufacturer has declared a value of the rated impulse withstand voltage (U_{imp}) (see
422 5.3.1.3 of IEC 60947-1:2020), the requirements of 8.2.3.1 except item c) and 8.2.3.2 of
423 IEC 60947-1:2020 apply. If applicable, the impulse withstand voltage test shall be carried out
424 in accordance with 9.4.3 a) of this document. For the verification of solid insulation, the
425 requirements of 8.2.3.1 except item c) of IEC 60947-1:2020 apply. The power-frequency
426 withstand voltage test shall be carried out in accordance with 9.4.3 b).

427 The verification of sufficient clearances and creepage distances shall be made in accordance
428 with 9.4.2.

429 For terminal blocks for which the manufacturer has not declared a value of rated impulse
430 withstand voltage (U_{imp}), guidance for minimum values is given in Annex H of
431 IEC 60947-1:2020.

432 **8.2.3 Short-time withstand current**

433 A terminal block shall be capable of withstand for 1 s the short-time withstand current which
434 corresponds to 120 A/mm² of its rated cross-section, in accordance with 9.4.6.

435 **8.2.4 Voltage drop**

436 The voltage drop on a terminal block, measured according to 9.4.4, shall not exceed the values
437 specified in 9.4.4 and, where applicable, in 9.4.7.

438 **8.2.5 Electrical performance after ageing (for screwless-type terminal blocks only)**

439 Screwless-type terminal blocks without contact pressure via insulating material shall be capable
440 of withstanding the ageing test comprising 192 temperature cycles in accordance with 9.4.7.

441 Screwless-type terminal blocks with contact pressure via ceramic or pure mica shall be capable
442 of withstanding the ageing test comprising 192 temperature cycles in accordance with 9.4.7.

443 Screwless-type terminal blocks with contact pressure via insulating material other than ceramic
444 or mica shall be evaluated using the, contact pressure via insulating material (CoPI)
445 requirements in accordance with 8.2.6.

8.2.6 Contact pressure via insulating material (CoPI)

Terminal blocks with contact pressure via insulating material other than ceramic or pure mica, shall be capable of withstanding the ageing test sequence including preconditioning and comprising 384 temperature cycles in accordance with 9.4.8.

8.3 Electromagnetic compatibility

Clause 8.3 of IEC 60947-1:2020 applies.

Compliance is checked by the test described in 9.6.

9 Tests

9.1 Kinds of test

Subclause 9.1.1 of IEC 60947-1:2020 applies with the following addition.

No routine tests are specified. The verification of the rated cross-section according to 9.3.3.5 is a special test. All other tests are type tests.

9.2 General

Unless otherwise specified, terminal blocks are tested in new and in clean condition, and installed as for normal use (see 7.3 of IEC 60947-1:2020) at an ambient temperature of $(20 \pm 5) ^\circ\text{C}$.

NOTE 1 "Normal use" means that five terminal blocks are mounted on their support, the remaining open side closed by an end plate and fixed by end brackets, if applicable.

The tests are carried out in the same order in which the subclauses describe them.

Each test is made on new separate specimens.

The tests of 9.3.3.2 and 9.3.3.3 are made on the same specimens.

The surface of the conductors shall be free of contamination and corrosion which degrades performance.

Care shall be taken when stripping conductors to avoid cutting, nicking, scraping or otherwise damaging the conductors.

In case where the manufacturer has stated that special preparation of the end of the conductor is necessary, the test report shall indicate the method of preparation used.

The tests are carried out with the type of conductor (rigid or flexible) from Table 2 as stated by the manufacturer. Testing covers conductor sizes that are within the cross-sectional area envelope of the sizes tested, as determined by the cross-section of the conductor. See Table 1 or Table 2 for conductor area, in mm^2 and AWG/kcmil, for conductor stranding, and for conductor diameters, of both metric and AWG/kcmil conductor.

NOTE 2 Examples for testing with both metric conductors and AWG/kcmil, see Annex C.

If one of the terminal blocks does not withstand one of the tests, this test shall be repeated on a second set of terminal blocks, all of which shall then comply with the repeated test. If this test is a part of a test sequence, the complete test sequence shall be repeated.

9.3 Verification of mechanical characteristics

9.3.1 General

The verification of mechanical characteristics includes the following tests:

- Attachment of the terminal block on its support (see 9.3.2);
- mechanical strength of clamping units (see 9.3.3.1);
- attachment of the conductors to the clamping units (see 9.3.3.2 and 9.3.3.3);
- rated cross-section and rated connecting capacity (see 9.3.3.4 and 9.3.3.5).

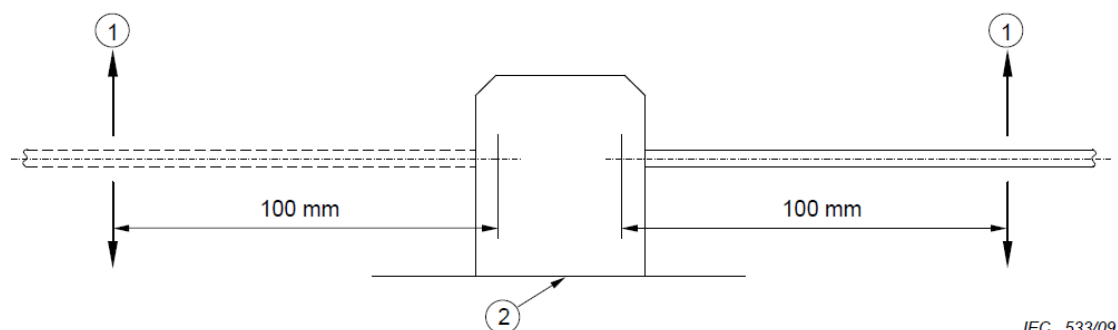
9.3.2 Attachment of the terminal block on its support

The test shall be made on two clamping units at the centre terminal block out of five terminal blocks mounted as in normal use on the appropriate support according to the manufacturer's instructions.

The steel pin of 150 mm length and of a diameter as specified in Table 2 is clamped successively in each clamping unit. The tightening torque shall be in accordance with Table 4 of IEC 60947-1:2020 or, alternatively, in accordance with the higher torque value stated by the manufacturer. A force corresponding to the values of Table 2 is applied to the pin regularly and without shocks at a distance of 100 mm from the centre of the clamping unit, according to Figure 1.

NOTE In some countries tightening torque values lower than those as listed in Table 4 of IEC 60947-1:2020 are allowed according to their national product standards: United States of America and Canada.

During the test, no terminal block shall work free from its rail or support, nor suffer any other damage.



Key

- 1 Force
- 2 Rail or support

Figure 1 – Arrangement for test according to 9.3.2

9.3.3 Mechanical properties of clamping units

9.3.3.1 Test of mechanical strength of clamping units

Subclause 9.2.5.1 and 9.2.5.2 of IEC 60947-1:2020 apply with the following addition.

The test shall be made on two clamping units at the centre terminal block out of five terminal blocks mounted as in normal use on the appropriate support according to the manufacturer's instructions.

After verification of the voltage drop according to 9.4.4 with a connected rigid conductor of the rated cross-section stated by the manufacturer and subsequently, if applicable, with a connected flexible conductor of the minimum cross-section stated by the manufacturer, rigid