

INTERNATIONAL STANDARD

Low-voltage docking connectors for removable energy storage units

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Low-voltage docking connectors for removable energy storage units

FOREWORD

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IEC 63066 has been prepared by subcommittee 23H: Plugs, socket-outlets and couplers for industrial and similar applications, and for electric vehicles, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This first edition cancels and replaces the first edition of IEC TS 63066 published in 2017. This edition constitutes a technical revision.

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

- a) introduction of standard sheets;
- b) alignment with IEC 60309-1:2021;
- c) technical improvements, e.g. short circuit tests according the I^2t - methodology.

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

Draft	Report on voting
23H/592/FDIS	23H/615/RVD

Full information on the voting for its approval 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.

In this document, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- explanatory matter: in smaller roman type.

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 www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This document is to be used in conjunction with IEC 60309-1:2021.

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- withdrawn, or
- revised.

INTRODUCTION

Pluggable energy storage technology has a perspective of a large demand in certain areas.

With the advent of electric vehicles, which are expected to become one of the most significant types of electric users of electric energy, together with the heating and cooling of buildings, the demand of electric energy from renewable sources rather than from fossil fuels will rapidly increase.

Due to the intrinsic discontinuity of the renewable sources (wind, solar light), energy storage units for renewable energy are becoming a possible solution to cover peak power demands, when in an increasingly decentralized electric power network infrastructure.

Guidance is needed to ensure safe and reliable operation, interoperability, environmental protection and efficiency of energy storage technology, once made available in a connectorized, thus pluggable, form.

This document is intended to meet the industry needs of standardized docking connector interfaces as a means to promote the development of this promising technology and the popularization of pluggable energy storage units.

Compared to other accessories, for the connectors required by this technology several specific aspects are considered:

- the connector mating process cannot have haptic support by the operator to find the correct position between the two parts of the connector;
- the connector mating process can have a mechanical feed which precludes the finding of the correct position between the two parts of the connector.

To overcome these issues, the design of the accessories can consist partly of moveable parts to compensate a mechanical feed and constructional tolerances.

1 Scope

This document applies to docking connectors (hereinafter referred to as accessories) incorporated in or fixed to electrical equipment, intended to connect energy storage units, either removable or swappable, or both, to a dedicated electric power conversion unit, to an energy consuming unit or to another energy storage unit.

These accessories are intended for DC and can include either a protective earth contact or optional auxiliary contacts for signalling and data transmission, or both. These accessories have a rated current of up to 2 000 A and rated operating voltages not exceeding 1 500 V DC.

This document also applies to accessories intended to be used at extra-low voltage.

The list of preferred ratings is not intended to exclude other ratings.

These accessories are not suitable for mating or unmating under load. These accessories are intended to be installed by instructed persons (IEC 60050-195:2021, 195-04-02) or skilled persons (IEC 60050-195:2021, 195-04-01) only.

This document applies to accessories for use under environmental conditions as described in Clause 31.

These accessories are intended to be connected to current carrying parts in copper or copper alloy only, plated or not plated.

In locations where special conditions prevail, additional requirements can apply.

NOTE For conditions other than operation, additional requirements can be applicable, for instance, IEC 62133 (all parts) and UN Recommendations on the Transport of Dangerous Goods (2002), section 38.338.3.

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.

Clause 2 of IEC 60309-1:2021 applies, except as follows:

Additional normative references:

IEC 60068-2-2, *Environmental testing - Part 2-2: Tests - Test B: Dry heat*

IEC 60068-2-14, *Environmental testing - Part 2-14: Tests - Test N: Change of temperature*

IEC 60068-2-30, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-38, *Environmental testing - Part 2-38: Tests - Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-52, *Environmental testing - Part 2-52: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-60, *Environmental testing - Part 2-60: Tests - Test Ke: Flowing mixed gas corrosion test*

IEC 60227-3, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 3: Non-sheathed cables for fixed wiring*

IEC 60309-1:2021, *Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 1: General requirements*

IEC 60352 (all parts), *Solderless connections*

IEC 60364-5-54:2011, *Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors*
IEC 60364-5-54:2011/AMD1:2021

IEC 60417, *Graphical symbols for use on equipment*, available at <http://www.graphical-symbols.info/equipment>

IEC 60512-2-2, *Connectors for electronic equipment – Tests and measurements – Part 2-2: Electrical continuity and contact resistance tests – Test 2b: Contact resistance – Specified test current method*

IEC 61140:2016, *Protection against electric shock - Common aspects for installation and equipment*

IEC 61373:2010, *Railway applications - Rolling stock equipment - Shock and vibration tests*

IEC 62619:2022, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC 62840-2:2025, *Electric vehicle battery swap system – Part 2: Safety requirements*

IEC PAS 62840-3:2021, *Electric vehicle battery swap system - Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems*

ISO/IEC TR 29106:2007, *Information technology - Generic cabling - Introduction to the MICE environmental classification*
ISO/IEC TR 29106:2007/AMD1:2012
ISO/IEC TR 29106:2007/AMD2:2019

ISO 16750-3:2023, *Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads*

EN 13601:2021, *Copper and copper alloys - Copper rod, bar and wire for general electrical purposes*

DIN 43671:1975-12, *Stromschienen aus Kupfer; Bemessung für Dauerstrom*, only available in German

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60309-1:2021 and the following apply.

ISO and IEC maintain terminology 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

docking connector

electrical connection accessory where the two complementary accessories are equipped with guiding means allowing their connection without the haptic support of an operator

3.2

unmated condition

position of the accessory without any contact between both parts

3.3

mated condition

service condition and position where the two parts of the accessory are in a position as described in the relevant standard sheet

3.4

guiding means

mechanical structure intended to ensure the proper alignment of the two complementary accessories before their mating

3.5

RESU

removable energy storage unit

energy storage unit, which can be easily detached and inserted into a rack to establish the electrical connection with an accessory

3.6

rack

mechanical structure intended to incorporate one or more removable energy storage units

3.7

electric power conversion unit

device converting electric energy from one form to another, converting between AC and DC, or changing the voltage or frequency, or a combination of these

3.8

shutter

movable part incorporated into an accessory arranged to automatically shield at least the live contacts when the complementary accessory is withdrawn

[SOURCE: IEC 60884-1:2022, 3.29, modified – "socket-outlet" is replaced with "an accessory", and "socket-contacts automatically when the plug is withdrawn" is replaced with "contacts when the complementary accessory is withdrawn".]

3.9

superordinate system

overall technical system as a set of components or systems with relationships between the components or systems and between their attributes

4 General

Clause 4 of IEC 60309-1:2021 applies, except as follows:

4.1 General requirements

Replacement of the fourth paragraph with:

Accessories shall have a minimum IP degree of protection as indicated in Table 7, test variable TV1.

In the case of a superordinate system providing the IP degree of protection, the IP-tests shall be performed with the superordinate system.

4.2 General notes on tests

Subclause 4.2 of IEC 60309-1:2021 applies.

Additional subclause:

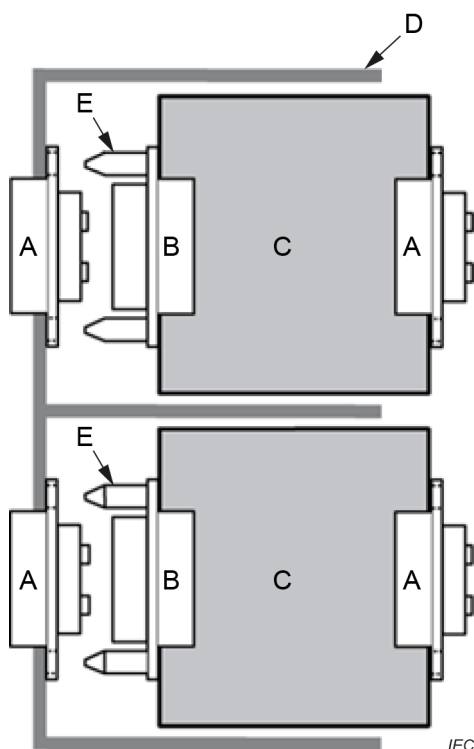
4.3 Type of accessories

Requirements mentioned for docking accessories called fixed socket-outlet or portable socket-outlet are applicable for accessories Type A.

Requirements mentioned for complementary docking accessories called plug or appliance inlet are applicable for accessories Type B.

Figure 1 shows an example of how the accessory can be used.

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**Key**

A docking accessory Type A

B complementary docking accessory Type B

C removable energy storage unit

D rack

E guiding means (optional)

Figure 1 – Diagram showing the use of the accessories**4.4 General construction**

Different possibilities for the movement, adjustment and mating of components and accessories are stated in Table 1.

Table 1 – General design and usage of accessories

Case of use	Accessory Type A		Accessory Type B		RESU
	Possibility of movement relative to the structure of the rack or RESU	Self-adjustment to the nominal position of the movable part after disconnecting	Possibility of movement relative to the structure of the RESU	Self-adjustment to the nominal position of the movable part after disconnecting	Possibility of movement relative to the rack
1	Not movable	No	Not movable	No	Not movable
2	Not movable	No	Not movable	No	Movable
3	Not movable	No	Movable	No	Not movable
4	Not movable	No	Movable	Yes	Not movable
5	Movable	Yes	Not movable	No	Not movable
6	Movable	No	Not movable	No	Not movable
NOTE Other combinations are not excluded.					

See standard sheets for implementations of accessories. Annex B shows additional accessories for information only.

4.5 Visual examination tests

If required by a test and unless otherwise specified, visual examination tests shall be performed with the naked eye. The following characteristics shall be checked:

- quality of assembling before test;
- marking;
- materials;
- marks of corrosion;
- colour, change of colour after the test;
- impurities, contamination, particles of abrasion after the test;
- damages, holes, cracks;
- damaged and loosened parts;
- status and location of lubrication and glues.

No noticeable problems shall occur which could impair normal operation or show a deviation from this document.

4.6 Cable to be used

Unless otherwise specified by the manufacturer, the following stranded cable shall be used for the power contacts: H07V as specified in IEC 60227-3.

NOTE The DUT's technical specifications are a factor in cable selection.

4.7 Voltage and current for test purposes

As deviation from the referred test standards, tests can be performed with AC or DC.

5 Standard ratings

Clause 5 of IEC 60309-1:2021 applies, except as follows:

5.2 Replacement:

Preferred rated currents are given in Table 2.

Table 2 – Preferred rated currents

Rated current A DC
16
32
63
125
250
315
400
630
800

Additional subclause:

5.3 Ratings for data, communication and control

Rated current for data, communication and control circuit purposes is 2 A or less according to the manufacturer's specification.

Rated voltage for data, communication and control circuit purposes is 30 V or less according to the manufacturer's specification.

6 Classification of accessories

Clause 6 of IEC 60309-1:2021 does not apply.

Replacement:

6.1 According to the type:

- accessories of Type A;
- accessories of Type B.

6.2 According to where the specified IP rating is provided:

- accessories that themselves provide the specified IP protection rating;
- accessories where the specified IP degree of protection is provided by the superordinate system.

NOTE Minimum IP rating is specified by Table 7.

6.3 According to earthing facilities:

- accessories without earthing contact;
- accessories with earthing contact.

6.4 According to the method of connecting the cable:

- rewirable accessories;
- non-rewirable accessories.

6.5 According to interlocking facilities:

- accessories without interlock;
- accessories with mechanical interlock (with latching device);
- accessories with electrical interlock (without latching device);
- accessories with latching device and electrical interlock.

6.6 According to the type of terminals:

- screw type terminals;
- screwless type terminals;
- insulation displacing terminals.

6.7 According to the type of conductors for screwless type and insulation displacing terminals:

- for solid conductors only;
- for rigid (both solid and stranded) conductors only;
- for rigid (both solid and stranded) and flexible conductors.