

TECHNICAL REPORT

RAPPORT TECHNIQUE

Electrical accessories – Harmonization of general rules

Petit appareillage – Harmonisation des règles générales

IEC/TR 61916:2009

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ELECTRICAL ACCESSORIES – HARMONIZATION OF GENERAL RULES

FOREWORD

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IEC 61916, which is a technical report, has been prepared by IEC technical committee 23: Electrical accessories.

The second edition cancels and replaces the first edition published in 1998 and constitutes a technical revision. The main technical changes with regard to the previous edition are as follows:

- Updated reference standards.
- Introduction of appropriate dimensioning of insulation distances criteria.
- Interpretation on glow wire test.
- Indication of standard conditions for operation in service.

- Modification of Clauses 6 and 7 by including an explanatory introduction concerning how to apply the relevant tests and a simple reference to the horizontal standard.
- Modification of Clause 12: Tolerances.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
23/469/DTR	23/478B/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

In this standard the following print types are used:

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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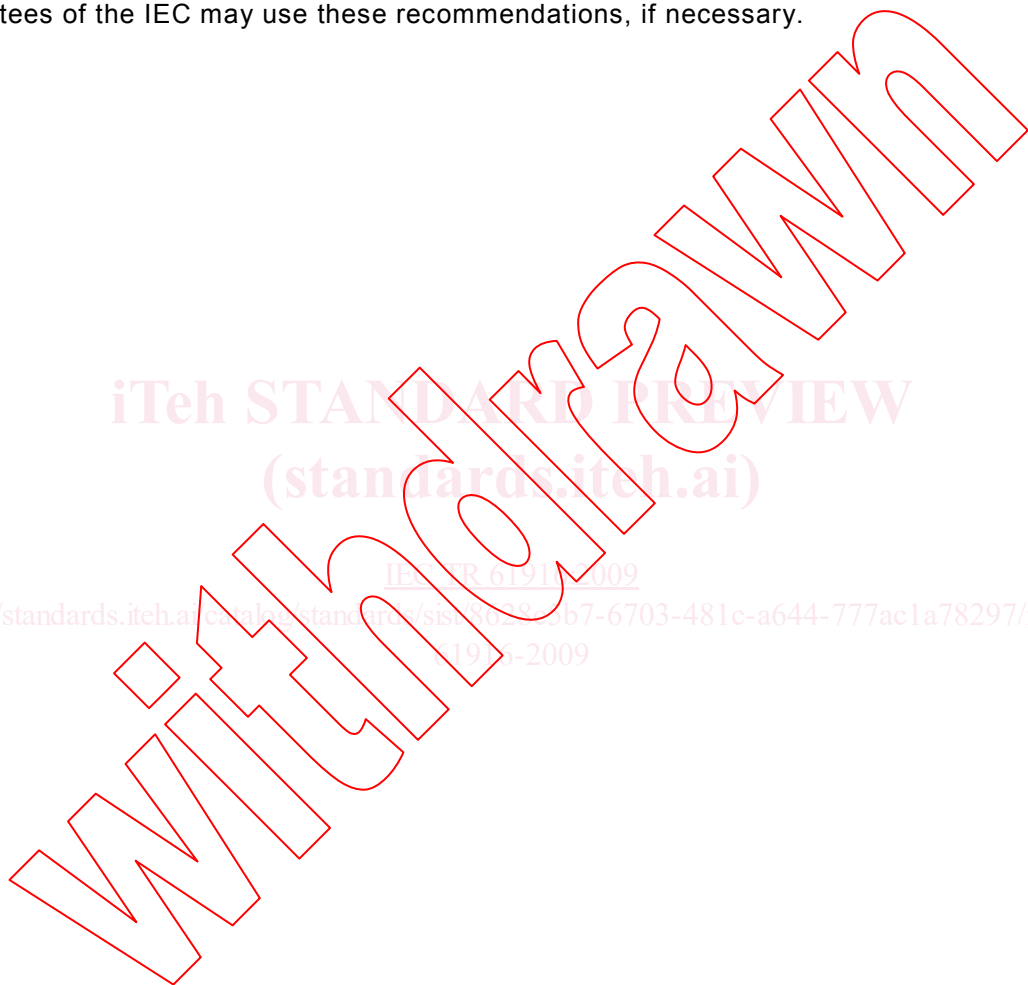
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INTRODUCTION

The purpose of this Technical Report is to have harmonized rules on the same subjects in all the Standards published by TC 23 and its subcommittees, in order to give coordinated indications to subcommittees when making their standards.

These recommendations are meant as a guide. Consequently, subcommittees, according to their own particularities, may use whole or part of the document which is not meant to be compulsory.

In publishing these recommendations, TC 23 wishes to spread the information so that other committees of the IEC may use these recommendations, if necessary.



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ELECTRICAL ACCESSORIES – HARMONIZATION OF GENERAL RULES

1 Scope

This technical report provides recommendations and test requirements applicable to electrical accessories. It aims to harmonize general rules for the preparation of international standards in this field. It gives to that effect recommendations which are intended to be used as a guide.

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.

IEC 60068-2-31: 2008, *Environmental testing – Part 2-31: Tests. Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-75: 1997, *Environmental testing – Part 2: Tests – Test Eh: Hammer tests*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60228:2004, *Conductors of insulated cables*

IEC 60664-1: 2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-4 :2005, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 60664-5:2007, *Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm*

IEC 60669-1:1998, *Switches for household and similar fixed-electrical installations – Part 1: General requirements*
Amendment 1 (1999)
Amendment 2 (2006)

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products*

IEC 60695-10-2:2003, *Fire hazard testing - Part 10-2: Abnormal heat - Ball pressure test*

IEC 60898-1:2002, *Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*
Amendment 1 (2002) and 2 (2003)

IEC 60998-1:2002, *Connecting devices for low voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 60998-2-1:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units*

IEC 60999 (all parts), *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units*

IEC/TR 62062: 2002, *Results of the Round Robin series of tests to evaluate proposed amendment to IEC 60112*

IEC Guide 104: *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO 1456:2009, *Metallic and other inorganic coatings – Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium*

ISO 2081:2008, *Metallic and other inorganic coatings – Electroplated coatings of zinc with supplementary treatments on iron or steel*

ISO 2093:1986, *Electroplated coatings of tin – Specification and test methods*

3 General requirements

This guidance is applicable to the relevant clause(s) of a TC 23 standard covering general requirements and/or scope.

Before tests, the specimen is stored for at least 24 h in an atmosphere having a temperature between 15 °C and 35 °C and relative humidity between 45 % and 75 %, except for the test of Clause 7 where IEC 60112 applies.

Accessories shall be so designed and constructed so that, in normal use, their performance is reliable and safe for the user and the surroundings.

Standard conditions for operation in service for electrical accessories complying with the existing standards should be suitable for use at ambient temperatures not normally exceeding + 40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C.

4 Resistance to heat

This guidance is applicable to the relevant clause(s) of a TC 23 standard covering requirements and tests to determine the resistance to heat of accessories.

NOTE These recommendations are in accordance with IEC 60669-1 (1998) + Amd. 1 (1999) + Amd. 2 (2006).

The text includes two subclauses:

- Requirements (4.1)
- Tests (4.2)

For editing purposes the order and the numbers may be altered if necessary.

4.1 Requirements

Accessories including enclosures, if any, shall be sufficiently resistant to heat.

Compliance is checked by the tests of 4.2.

4.2 Tests

Verification of resistance to heat

- a) for surface mounting boxes, separable covers, separable cover plates and separable frames by the test of 4.2.3;
- b) for accessories, with the exception of the parts, if any, covered by 1), by the tests of 4.2.1, 4.2.2 and, with the exception for the accessories made from natural or synthetic rubber or a mixture of both, by the test of 4.2.3.

4.2.1 The specimens are kept for 1 h in a heating cabinet at a temperature of $100\text{ °C} \pm 2\text{ °C}$.

During the test, they shall not undergo any change impairing their further use, and sealing compound, if any, shall not flow to such an extent that live parts are exposed.

After the test and after the specimens have been allowed to cool down to approximately room temperature, there shall be no access to live parts which are normally not accessible when the specimens are mounted as in normal use, even if probe B of IEC 61032 is applied with a force not exceeding 5 N.

After the test, markings shall still be legible.

Discoloration, blisters or slight displacement of the sealing compound is disregarded provided that safety is not impaired within the meaning of the relevant standard.

4.2.2 Parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position are subjected to a ball-pressure test according to IEC 60695-10-2, except that the insulating parts necessary to retain the earthing terminals in a box shall be tested instead to the test as specified in 4.2.3.

A current carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.

In case of doubt, to determine whether an insulating material is necessary to retain current carrying parts and parts of the earthing circuit in position, the specimen is examined without conductors while held in all positions with the insulating material in question removed.

Before the test is started, the ball and the support on which the specimen shall be placed, are brought to the temperature specified. The part under test shall be placed on a 3 mm thick steel plate in direct contact with it, so as to be supported to withstand the test force.

NOTE When it is not possible to carry out the test on the specimens, the test should be carried out on a piece at least 2 mm thick which is cut out of the specimen. If this is not possible, up to and including four layers, each cut out of the same specimen, may be used, in which case the total thickness of the layers should be not less than 2,5 mm.

The test load and the supporting means shall be placed within the heating cabinet for a sufficient time to ensure that they have attained the stabilized testing temperature before the test commences.

The test is made in a heating cabinet at a temperature of $125\text{ °C} \pm 2\text{ °C}$.

After $60\text{ }_{-0}^{+2}\text{ min}$, the ball is removed from the specimen which is then cooled and treated according to Clause 7 of IEC 60695-10-2.

The diameter of the impression caused by the ball is measured in accordance with IEC 60695-10-2 and shall not exceed 2 mm.

4.2.3 Parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are subjected to a ball pressure test in accordance with 4.2.2, but the test is made at a temperature of $70\text{ °C} \pm 2\text{ °C}$ or $40\text{ °C} \pm 2\text{ °C}$ plus the highest temperature rise determined for the relevant part during the test of clause “Temperature rise test”, whichever is the higher.

5 Screws, current-carrying parts and connections (electrical and mechanical)

This guidance is applicable to the relevant clause(s) of a TC 23 standard covering the requirements and tests of screws, current-carrying parts and connections (electrical and mechanical) of accessories.

NOTE These recommendations are in accordance with IEC 60669-1 (1998) + Amd. 1 (1999) + Amd. 2 (2006).

The text includes three subclauses as follows:

- Definitions (5.1)
- Requirements (5.2)
- Tests (5.3)

For editing purposes, the order and numbers may be altered, if necessary.

5.1 Definitions

5.1.1 Thread-forming screw

A tapping screw having an uninterrupted thread which by screwing-in forms a thread by displacing material in the cavity.

An example of a thread-forming screw is shown in Figure 1.

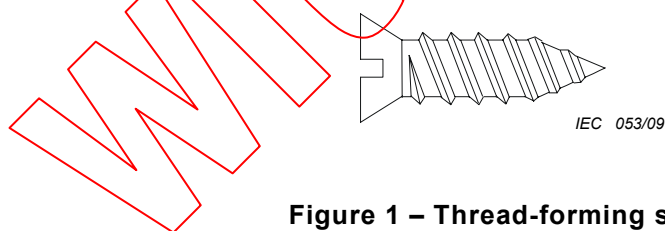


Figure 1 – Thread-forming screw

5.1.2 Thread-cutting screw

A screw having an interrupted thread which, by screwing-in, makes a thread by removing material from the cavity.

An example of thread-cutting screw is shown in Figure 2.

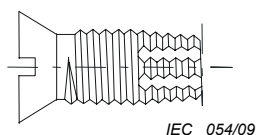


Figure 2 – Thread-cutting screw

5.2 Requirements

5.2.1 Connections, electrical or mechanical, using screws and nuts, shall withstand the mechanical stresses occurring in normal use.

Screws and nuts which transmit contact pressure shall be of metal and shall be in engagement with a metal thread. Screws and nuts which are operated when mounting an accessory during installation, and/or which are likely to be operated during the life of the accessory, shall be in engagement with a metal thread.

Screws for connecting external conductors shall not be tapping screws.

Screws and nuts operated when mounting the accessory during installation, and/or which are likely to be operated during the life of the accessory, shall not be of the thread cutting type.

NOTE 1 Screws and nuts which are operated when mounting the accessory include screws for fixing cover of cover plates, etc., but not connecting means for screwed conduits and screws for fixing the base of the accessory.

Compliance is checked by inspection and by the test of 5.3.

NOTE 2 Attention is drawn to the fact that screwed connections also have to comply with the requirements applicable to the accessory.

5.2.2 For screws in engagement with a thread of insulating material and screws of insulating material, which are used for the installation of the accessory and/or which are likely to be operated during the life of the accessory, correct introduction of the screw into the screw hole or nut shall be ensured.

Screws of insulating materials shall not be used in cases when the replacement with metal screws could impair the insulation of the accessory.

Compliance is checked by inspection and by manual test.

NOTE The requirements with regard to correct introduction are met if introduction of the screw in a slanting manner is prevented, for example by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

5.2.3 Screws and rivets, intended to be used for electrical connections and screws and rivets intended to be used for mechanical connection, shall be locked against loosening or turning.

Compliance is checked by inspection and manual test.

NOTE Spring washers may provide satisfactory locking. For rivets, a non-circular shank or an appropriate notch may be sufficient. Sealing compound which softens on heating provides satisfactory locking only for screw connections not subjected to torsion in normal use.

5.2.4 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

NOTE The suitability of the material is considered as regards the stability of the dimensions.

5.2.5 Current-carrying parts, including those of terminals (also earthing terminals), shall be of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Compliance is checked by inspection and, if necessary, by chemical analysis.

Examples of suitable metals, when used within a permissible temperature range and under normal conditions of chemical pollution are:

- copper;
- an alloy containing at least 58 % copper for parts that are worked cold or at least 50 % copper for other parts;
- stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
- steel provided with an electroplated coating of zinc according to ISO 2081, the coating having a thickness of at least:
 - 5 µm (ISO service condition 1) for ordinary equipment
 - 8 µm (ISO service condition 2) for drip-proof and splash-proof equipment
 - 12 µm (ISO service condition 3) for jet-proof and watertight equipment;
- steel provided with an electroplated coating of nickel and chromium according to ISO 1456, the coating having a thickness of at least:
 - 10 µm (ISO service condition 1) for ordinary equipment
 - 20 µm (ISO service condition 2) for drip-proof and splash-proof equipment
 - 30 µm (ISO service condition 3) for jet-proof and watertight equipment;
- steel provided with an electroplated coating of tin, according to ISO 2093, the coating having a thickness equal to at least that specified for:
 - 12 µm (ISO service condition 1) for ordinary equipment
 - 20 µm (ISO service condition 2) for drip-proof and splash-proof equipment
 - 30 µm (ISO service condition 3) for jet-proof and watertight equipment

Parts which may be subjected to mechanical wear, shall not be made of steel provided with an electroplated coating;
- steel provided with an electroplated coating of zinc is only permitted for prime current-carrying parts if no fixed connection is intended to be made. For connection, an electroplated coating of zinc is permissible only on parts which do not participate directly in current transmission, such as screws or washers used for certain types of terminals in which they transmit only the contact pressure.

NOTE 1 This requirement is not intended to apply to contacts, magnetic circuits, heating elements, bimetallic components, shunts, parts of electronic devices, etc.

NOTE 2 Screws, nuts, washers, clamping plates and similar parts of terminals are not regarded as current-carrying parts.

NOTE 3 New requirements to be verified by a test for determining the resistance to corrosion are under consideration. These requirements should permit other materials to be used if suitably coated.

Under moist conditions, metals having a great difference of electrochemical potential with respect to each other, shall not be used in contact with each other.

Compliance is checked by inspection.

5.2.6 Thread-forming screws and thread-cutting screws shall not be used for the connection of current-carrying parts. Thread-forming screws and thread cutting screws may be used to provide earthing continuity, provided that it is not necessary to disturb the connection in normal use and at least two screws are used for each connection.

Compliance is checked by inspection.

NOTE The use of thread-forming screws without displacing of material which are operated when mounting the accessory are under consideration.

5.3 Tests

Compliance with the requirements of 5.2.1 is checked by inspection and by the following test.

The screws and nuts are tightened and loosened:

- 10 times for metal screws in engagement with a thread of insulating material and for screws of insulating material;
- 5 times in all other cases.

Screws or nuts in engagement with a thread of insulating material and screw of insulating material are completely removed and re-inserted each time.

The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 1.

The shape of the blade of the test screwdriver shall suit the head of the screw for screws and nuts which are operated when mounting and connecting up the device by the following test.

The screws and nuts shall be tightened smoothly. In the case of a test on terminals, the conductor is moved each time the screw or nut is loosened.

Table 1 – Torque per thread diameter

Nominal diameter of thread mm	Torque Nm				
	I	II	III	IV	V
Up to and including 2,8	0,2	–	0,4	0,4	–
over 2,8 up to and including 3,0	0,25	–	0,5	0,5	–
over 3,0 up to and including 3,2	0,3	–	0,6	0,6	–
over 3,2 up to and including 3,6	0,4	–	0,8	0,8	–
over 3,6 up to and including 4,1	0,7	1,2	1,2	1,2	1,2
over 4,1 up to and including 4,7	0,8	1,2	1,8	1,8	1,8
over 4,7 up to and including 5,3	0,8	1,4	2,0	2,0	2,0
over 5,3 up to and including 6,0	1,2	1,8	2,5	3,0	3,0
over 6,0 up to and including 8,0	2,5	2,5	3,5	6,0	4,0
over 8,0 up to and including 10,0	–	3,5	4,0	10,0	6,0
over 10,0 up to and including 12,0	–	4,0	–	–	8,0
over 12,0 up to and including 15,0	–	5,0	–	–	10,0

Column I applies to screws without head if the screw when tightened does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to nuts of mantle terminals which are tightened by means of a screwdriver.

Column III applies to other screw which are tightened by means of a screwdriver.

Column IV applies to screws and nuts other than nuts of mantle terminals which are tightened by means other than a screwdriver

Column V applies to nuts of mantle terminals which are tightened by means other than a screwdriver.