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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Cable cleats for electrical installations

Brides de câbles pour installations électriques

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and nongovernmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61914 has been prepared by subcommittee 23A: Cable management systems, of IEC technical committee 23: Electrical accessories.

The text of this standard is based on the following documents:

FDIS	RVD
23A/588/FDIS	23A/592/RVD

Full information on the voting for the approval of this standard 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.

NOTE The following print types are used:

– requirements: in roman type
– *test specifications: in italic type*
– notes: in small 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

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- withdrawn;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

CABLE CLEATS FOR ELECTRICAL INSTALLATIONS

1 Scope

This International Standard specifies requirements and tests for cable cleats and intermediate restraints used for securing cable in electrical installations. Cable cleats provide resistance to electromechanical forces where declared. This standard includes cable cleats that rely on a mounting surface specified by the manufacturer for axial and/or lateral retention of cables.

This standard does not apply to:

– cable glands;

– cable ties.

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 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

ISO 868:2003, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 4287:1997, *Geometrical product specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*

ISO 4892-2:2006, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 9227:2006, *Corrosion tests in artificial atmospheres – Salt spray tests*

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1
cable cleat
device designed to provide securing of cables when installed at intervals along the length of cables

NOTE A cable cleat is provided with a means of attachment to a mounting surface but does not rely on an unspecified mounting surface for the retention of the cables. Examples of mounting surfaces that may be specified are ladder, tray, strut or rail, wire and beam (see Figures A.8 and A.9). Where declared, cable cleats provide resistance to electromechanical forces

3.2
intermediate restraint
cable retaining device designed to be used with cable cleats to hold the cables together in order to provide resistance to electromechanical forces. Intermediate restraints are not attached to the mounting surface

3.3
metallic
consisting of metal only

3.4
non-metallic
consisting of non-metallic material only

3.5
composite
consisting of metallic and non-metallic materials

3.6
short-circuit current
overcurrent resulting from a circuit condition in which the current flows through an abnormal or unintended path of negligible impedance between live conductors, or between a live conductor and an earth, having a difference in potential under normal operating conditions

3.7
peak short-circuit current
i_p
maximum possible instantaneous value of the short-circuit current (see Annex B)

3.8
initial r.m.s. symmetrical short-circuit current
I''_k
r.m.s. value of the a.c. symmetrical component of a short-circuit current, applicable at the instant of the short circuit if the impedance remains at the zero-time value (see Annex B)

3.9
decaying (aperiodic) component of short-circuit current
$i_{d.c.}$
mean value between the top and bottom envelope of a short-circuit current decaying from an initial value to zero (see Annex B)

3.10
steady-state short-circuit current
I_k
r.m.s. value of the short-circuit current which remains after the decay of the transient phenomena (see Annex B)

3.11
trefoil formation
the formation of three cables so laid as to be mutually equidistant. Viewed in cross-section, the lines joining the cable centres form an equilateral triangle (see Figure 5)

NOTE The formation is known as “close trefoil” formation when the cables are touching each other.

3.12
flat formation
the formation of a number of cables laid in a plane, usually with equal spacing between adjacent cables (see Figure 6)

3.13
electromechanical forces
induced forces acting on current-carrying conductors

3.14
retention
limiting the lateral and/or axial movement of the cable

3.15
securing
fixing to or from a mounting surface or another product

3.16
environmental influences
effect of corrosive substances or solar radiation, etc.

4 General requirements

Products covered by this standard shall be so designed and constructed that, when assembled and installed as for normal use according to the manufacturer's instructions, they ensure securing of cables as declared in accordance with Clause 6 and shall not cause damage to the cable.

Compliance is checked by the relevant tests specified in this standard.

5 General notes on tests

5.1 Tests according to this standard are type tests. All sizes shall comply with Clause 8 and 9.1a). Where there are a number of cleats in a range, the range is divided into one or more classes. In this case, the smallest, the largest and any critical size of cleat in each class are tested, except for the test in 9.5. The test in 9.5 is performed on the most critical size in each class.

NOTE For guidance in determining classes, cable cleats or intermediate restraints having material, construction characteristics, and classifications according to Clause 6 below, in common, are considered of the same class.

5.2 Unless otherwise specified, all tests shall be carried out on three new samples of each size selected as in 5.1 assembled and installed as for normal use according to the manufacturer's or responsible vendor's instructions.

5.3 Tests on non-metallic and composite cleats and intermediate restraints shall not commence earlier than 168 h after manufacture.

5.4 Unless otherwise specified, the tests shall be carried out at an ambient temperature of (23^{+5}_{-5}) °C.

5.5 Compliance with this standard is satisfied if all the test requirements are achieved. If only one of the samples does not satisfy a test due to a manufacturing fault, then that test and any preceding one which may have influenced the results of the test shall be repeated and also the tests which follow shall be made in the same required sequence on another full set of samples, all of which shall comply with the requirements.

NOTE The applicant, when submitting the first set of samples, may also submit an additional set of samples, which may be necessary should one sample fail. The test house should then, without further request, test the additional set of samples and should only reject if a further failure occurs. If the additional set of samples is not submitted at the same time, a failure of one sample would entail rejection.

5.6 When toxic or hazardous processes are used, due regard shall be taken of the safety of persons within the test area.

6 Classification

6.1 According to material

6.1.1 Metallic

6.1.2 Non-metallic

6.1.3 Composite

6.2 According to maximum and minimum temperature

Table 1 – Maximum temperature for permanent application

A. Maximum temperature °C
+ 40
+ 60
+ 85
+ 105
+ 120

Table 2 – Minimum temperature for permanent application

B. Minimum temperature °C
+ 5
− 5
− 15
− 25
− 40
− 60

NOTE For temperature values above 120 °C and below −60 °C, the manufacturer or responsible vendor may declare temperatures outside the values tabulated above.

6.3 According to resistance to impact

6.3.1 Very light

6.3.2 Light

6.3.3 Medium

6.3.4 Heavy

6.3.5 Very heavy

6.4 According to type of retention or resistance to electromechanical forces or both

6.4.1 With lateral retention

6.4.2 With axial retention

6.4.3 Resistant to electromechanical forces, withstanding one short circuit

6.4.4 Resistant to electromechanical forces, withstanding more than one short circuit

Manufacturers of cleats shall declare a classification under 6.4.1 and may also declare a classification under 6.4.2. Manufacturers of cleats may also declare a classification under 6.4.3 or 6.4.4.

Manufacturers of intermediate restraints shall declare a classification under 6.4.3 or 6.4.4.

6.5 According to environmental influences

6.5.1 Resistant to ultraviolet light for non-metallic and composite components

6.5.1.1 Not declared

6.5.1.2 Resistant to ultraviolet light

6.5.2 Resistant to corrosion for metallic and composite components

6.5.2.1 Low

6.5.2.2 High

7 Marking and documentation

7.1 Marking

Each cleat and intermediate restraint shall be marked with

– the manufacturer’s or responsible vendor’s name or logo or trademark;
– the product identification or type.

Where it is not possible to apply the marking directly onto the product, then the marking shall be placed on the smallest supplied package.

7.2 Durability and legibility

Marking on the product shall be durable and easily legible to normal or corrected vision.

Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

After the test, the marking shall remain legible to normal or corrected vision.

Marking made by moulding, pressing or engraving is not subjected to the rubbing test.

NOTE Marking may be applied, for example, by moulding, pressing, engraving, printing, adhesive labels, etc.

7.3 Documentation

The manufacturer or responsible vendor shall provide in their literature:

– the classifications according to Clause 6;
– the maximum and minimum cable or bundle diameters;
– the lateral load for cleats declared under 6.4.1;
– the axial load for cleats declared under 6.4.2;
– the method of assembly and installation including tightening torques, where appropriate.

Additionally, for cleats and/or intermediate restraints declared under 6.4.3 or 6.4.4:

– the peak short-circuit current;
– the initial r.m.s. symmetrical short-circuit current;
– the cable outside diameter used in the test in 9.5;
– the maximum spacing, D, as shown in Figure 4.

Compliance is checked by inspection.

NOTE Some or all of this information may also be required to be provided on packaging or instruction sheets supplied with the product.

8 Construction

The surfaces of cleats and intermediate restraints shall be free from sharp edges, burrs, flash, etc. that are likely to damage cables or inflict injury to the installer or user.

Compliance is checked by visual and manual inspection of the surface.

9 Mechanical properties

9.1 Requirements

Cleats and intermediate restraints shall be:

a) capable of accommodating the size or range of cable or cable bundle diameter declared by the manufacturer or responsible vendor without cracking or breaking, or stripping screw threads;

   Compliance is checked by measurement and by visual and manual inspection.

b) resistant to impact at the minimum declared temperature;

   Compliance is checked by the test according to 9.2.

c) capable of withstanding the lateral load at the maximum declared temperature;

Compliance is checked by the test according to 9.3.

d) capable of withstanding the axial load at the maximum declared temperature where declared in 6.4.2;

Compliance is checked by the test in 9.4.

e) resistant to electromechanical forces, where declared in 6.4.3 or 6.4.4.

Compliance is checked by the test in 9.5.

9.2 Impact test

The impact test is carried out using a typical arrangement as shown in Figure 1. The component transmitting the impact to the cleat or intermediate restraint shall have a spherical radius of (300^{+5}_{-5}) *mm at the point of contact.*

Before the test, the samples are assembled onto a solid polyamide 66 test mandrel having a diameter equivalent to the maximum declared diameter for which the cleat is designed and mounted on a rigid support.

For cleats and intermediate restraints taking more than one cable, the appropriate number of mandrels is used.

For metallic cleats and intermediate restraints, the test is carried out at ambient temperature.

For composite and non-metallic cleats and intermediate restraints, the samples are conditioned at the declared lowest temperature according to Table 2 with a tolerance of $(^{+2}_{-2})$ *°C for a period of* (60^{+5}_{0}) *min. The impact is applied within a period of* (10^{0}_{-2}) *s after removal from the refrigerator.*

Each sample is placed in position on the steel base as shown in Figure 1. The energy value of the hammer is as declared in Table 3.

The impact is applied at the weakest point of the cleat or intermediate restraint and the direction of impact is radial to the centre of the mandrel.

After the test, the samples shall show no signs of disintegration nor shall there be any cracks or damage, visible to normal or corrected vision, that are likely to impair normal use. In case of doubt, the samples are subjected to the test of 9.3.

Table 3 – Impact test values

Classification	Impact energy J	Equivalent mass kg	Height mm (± 1%)
Very light	0,5	0,25	200
Light	1,0	0,25	400
Medium	2,0	0,5	400
Heavy	5,0	1,7	300
Very heavy	20,0	5,0	400

9.3 Lateral load test

The cleat is mounted on a test rig as shown in Figure 2, or a similar arrangement. The mounting surface can be made of steel or aluminium plate, plywood or other material. For the purpose of applying the load, a rigid mandrel of circular, or other appropriate cross-section, is positioned within the cleat's aperture. Care is taken to ensure that the load acts through the centre line of the cleat's aperture. The mandrel size is the minimum for which the cleat is designed.

For metallic cable cleats, the declared load is applied gradually and held for a period of (5^{+1}_{0}) *min.*

For non-metallic and composite cleats, the sample assembly is placed in a full draft air-circulating oven. The tests are carried out after the oven temperature has reached and maintained the declared maximum temperature from Table 1 with a tolerance of $(^{+2}_{-2})$ *°C. The load is applied gradually and then held for a period of* (60^{+5}_{0}) *min.*

The test load as declared by the manufacturer or responsible vendor is applied in the most onerous direction of normal use.

Movement of the mandrel shall be less than 50 % of the mandrel diameter.

NOTE The test is meant to determine the lateral retention of the cleat and not the strength of the mounting surface.

9.4 Axial load test

The test is carried out using a mandrel with an overall diameter equivalent to the minimum declared cable diameter for which the cleat is designed. The test mandrel shall have a diametrical tolerance of $(^{+0,2}_{-0,2})$ *mm for mandrels up to and including 16 mm diameter and of* $(^{+0,3}_{-0,3})$ *mm for larger diameters. In the case of non-circular cables, a profile is to be used simulating the outer cable dimension, as declared by the manufacturer or responsible vendor.*

All mandrels shall have a surface roughness less than or equal to 7 μm R_a *in accordance with ISO 4287. For test temperatures below 105 °C, test mandrels shall be solid polyamide 66 having a hardness of* (70^{+15}_{-15}) *Shore D points in accordance with ISO 868. Metallic mandrels shall be used for test temperatures 105 °C and higher.*

The cleat is mounted on a rigid mounting surface and assembled in the test rig as shown in Figure 3, or a similar arrangement. The mounting surface can be made of steel or aluminium plate, plywood or other material.

For metallic cable cleats, the declared load is applied gradually and held for a period of (5^{+1}_{0}) *min.*

For non-metallic and composite cleats, the sample assembly is placed in a full draft air-circulating oven. The tests are carried out after the oven temperature has reached and maintained the declared maximum temperature from Table 1 with a tolerance of $(^{+2}_{-2})$ *°C. The load is applied gradually and held for a period of* (5^{+1}_{0}) *min.*

After the test, the displacement of the mandrel with respect to the cleat shall not be more than 5 mm.