

EUROPEAN STANDARD

**EN 62561-4**

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2017

ICS 29.020; 91.120.40

Supersedes EN 62561-4:2011

English Version

**Lightning protection system components (LPSC) - Part 4:  
Requirements for conductor fasteners  
(IEC 62561-4:2017)**

Composants de systèmes de protection contre la foudre  
(CSPP) - Partie 4: Exigences pour les fixations de  
conducteur  
(IEC 62561-4:2017)

Blitzschutzsystembauteile (LPSC) - Teil 4: Anforderungen  
an Leitungshalter  
(IEC 62561-4:2017)

This European Standard was approved by CENELEC on 2017-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## **European foreword**

The text of document 81/564/FDIS, future edition 2 of IEC 62561-4, prepared by IEC/TC 81, "Lightning protection", was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62561-4:2017.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2018-06-01
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2020-12-01

This document supersedes EN 62561-4:2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

### **Endorsement notice**

The text of the International Standard IEC 62561-4:2017 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 62305 (series)                      NOTE      Harmonized as EN 62305 (series).

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-52	1996	Environmental testing -- Part 2-52: Tests Test Kb: Salt mist, cyclic (sodium chloride solution)	-EN 60068-2-52	1996
IEC 60068-2-75	2014	Environmental testing - Part 2-75: Tests Test Eh: Hammer tests	-EN 60068-2-75	2014
IEC 62305-3	-	Protection against lightning -- Part 3: Physical damage to structures and life hazard	EN 62305-3	-
IEC 62561-1	2017		EN 62561-1	2017
ISO 4892-2	2013	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps	EN ISO 4892-2	2013
ISO 4892-3	-		EN ISO 4892-3	2016
ISO 4892-4	-	Plastics - Methods of exposure to- laboratory light sources - Part 4: Open- flame carbon-arc lamps		-
ISO 6957	1988	Copper alloys; ammonia test for stress- corrosion resistance		-
ISO 6988	1985	Metallic and other non-organic coatings Sulfur dioxide test with general condensation of moisture	-EN ISO 6988	1994





IEC 62561-4

Edition 2.0 2017-07

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

---

**Lightning protection system components (LPSC) –  
Part 4: Requirements for conductor fasteners**

**Composants de système de protection contre la foudre (CSPF) –  
Partie 4: Exigences pour les fixations de conducteur**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 29.020; 91.120.40

ISBN 978-2-8322-4633-7

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

CONTENTS .....	2
FOREWORD .....	4
INTRODUCTION .....	6
1 Scope .....	7
2 Normative references .....	7
3 Terms and definitions .....	7
4 Classification .....	8
4.1 According to material of conductor fastener .....	8
4.2 According to fixing arrangement of the conductor within the conductor fastener .....	8
4.3 According to conductor clamping arrangement .....	8
5 Requirements .....	8
5.1 General .....	8
5.2 Environmental requirements .....	8
5.2.1 Corrosion resistance .....	8
5.2.2 Ultraviolet (UV) light resistance .....	9
5.3 Mechanical strength .....	9
5.3.1 Perpendicular and axial loads .....	9
5.3.2 Impact tests .....	9
5.4 Installation instructions .....	9
5.5 Marking .....	9
6 Tests .....	9
6.1 General test conditions .....	9
6.2 Preparation of the specimen .....	10
6.3 Environmental influence test .....	10
6.3.1 General .....	10
6.3.2 Metallic .....	11
6.3.3 Non-metallic .....	11
6.3.4 Composite .....	12
6.4 Resistance to mechanical effects .....	12
6.4.1 Lateral load test .....	12
6.4.2 Axial load test .....	13
6.4.3 Impact test .....	14
6.5 Installation instructions .....	15
6.6 Marking test .....	16
6.6.1 General conditions for tests .....	16
6.6.2 Acceptance criteria .....	16
6.7 Construction .....	16
7 Electromagnetic compatibility (EMC) .....	16
8 Structure and content of the test report .....	16
8.1 General .....	16
8.2 Report identification .....	17
8.3 Specimen description .....	17
8.4 Conductor .....	17
8.5 Standards and references .....	17
8.6 Test procedure .....	17

8.7	Testing equipment description .....	18
8.8	Measuring instruments description .....	18
8.9	Results and parameters recorded .....	18
8.10	Statement of pass/fail .....	18
Annex A (normative) Environmental test for metallic and composite conductor fasteners .....		19
A.1	General.....	19
A.2	Salt mist treatment.....	19
A.3	Humid sulphurous atmosphere treatment .....	19
A.4	Ammonia atmosphere treatment.....	19
Annex B (normative) Environmental test for non-metallic and composite conductor fasteners – Resistance to ultraviolet light .....		20
B.1	General.....	20
B.2	The test .....	20
B.3	First alternative test to B.2 .....	20
B.4	Second alternative test to B.2 .....	20
Annex C (normative) Flow chart of tests for conductor fastener .....		21
Bibliography.....		22
Figure 1 – Basic arrangement of specimens.....		11
Figure 2 – Basic arrangement of lateral load test .....		13
Figure 3 – Typical arrangement for axial movement test .....		14
Figure 4 – Impact test apparatus.....		15
Figure C.1 – Flowchart.....		21

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

## LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

### Part 4: Requirements for conductor fasteners

#### 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 non-governmental 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62561-4 has been prepared by IEC technical committee 81: Lightning protection.

This second edition cancels and replaces the first edition, published in 2010. This edition constitutes a technical revision.

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

- new detailed flow chart of the tests;
- in Annexes A and B, composite fasteners have been added.



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

FDIS	Report on voting
81/564/FDIS	81/567/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.

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

A list of all parts in the IEC 62561 series, published under the general title *Lightning protection system components (LPSC)*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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.

## INTRODUCTION

This part of IEC 62561 deals with the requirements and tests for lightning protection system components (LPSC), specifically conductor fasteners used for the installation of a lightning protection system (LPS) designed and implemented according to IEC 62305 (all parts).

## LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

### Part 4: Requirements for conductor fasteners

#### 1 Scope

This part of IEC 62561 deals with the requirements and tests for metallic and non-metallic conductor fasteners that are used to retain and support the air-termination, down-conductor and earth-termination systems.

This document does not cover the fixing of conductor fasteners to the fabric of structures due to the vast number and types used in modern day construction.

LPSC can also be suitable for use in hazardous atmospheres. There are therefore additional requirements when installing the components in such conditions.

#### 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 60068-2-52:1996, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-75:2014, *Environmental testing – Part 2: Tests – Test Eh: Hammer tests*

IEC 62305-3, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62561-1:2017, *Lightning Protection System Components (LPSC) – Part 1: Requirements for connection components*

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3:2016, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

ISO 4892-4, *Plastics – Methods of exposure to laboratory light sources – Part 4: Open-flame, carbon-arc lamps*

ISO 6988:1985, *Metallic and other non-organic coatings – Sulphur dioxide test with general condensation of moisture*

ISO 6957:1988, *Copper alloys – Ammonia test for stress corrosion resistance*

#### 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization, which can be consulted at the following addresses:

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

### 3.1

#### **conductor fastener**

metallic, non-metallic or composite component designed to retain and support the air-termination, down-conductor and earth-termination systems, installed at intervals along the length of the conductors

## 4 Classification

### 4.1 According to material of conductor fastener

- a) metallic (e.g. hot dip galvanized steel, copper, aluminium, stainless steel);
- b) non-metallic (e.g. PVC, plastics);
- c) composite (combination of metal and plastic).

If a metallic conductor fastener is used for bonding of two metallic parts of the external LPS it becomes a connection component and shall comply with testing requirements according to IEC 62561-1.

### 4.2 According to fixing arrangement of the conductor within the conductor fastener

- a) with screws;
- b) without screws (e.g. clips, springs).

### 4.3 According to conductor clamping arrangement

- a) conductor fasteners that are designed to clamp the conductor;
- b) conductor fasteners that are designed to clamp but allow axial movement of the conductor.

## 5 Requirements

### 5.1 General

The conductor fastener shall carry out its function of clamping the conductor in an acceptable and safe manner when subjected to mechanical influences, lightning discharge stress and environmental influences.

Conductor fasteners shall comply with the tests given in Clause 6. The material of the conductor fastener shall be compatible with the conductor it is fastening and the surface material onto which it is mounted.

NOTE 1 Certain extreme environmental conditions make the choice of non-metallic conductor fasteners unsuitable. Specific recommendations are provided by manufacturers as to their suitability in varying environments.

NOTE 2 Conductor fasteners are so designed and constructed that safe handling is ensured, that retention and support for the conductor is provided, and that in normal use their performance is reliable and without danger to persons and the surroundings.

### 5.2 Environmental requirements

#### 5.2.1 Corrosion resistance

Metallic or composite conductor fasteners shall withstand corrosion effects.

Compliance is checked for metallic fasteners by the test specified in 6.3.2 or for composite fasteners by the tests described in 6.3.4.

### **5.2.2 Ultraviolet (UV) light resistance**

Non-metallic and composite conductor fasteners shall withstand UV light effects.

Compliance is checked for non-metallic fasteners by the test specified in 6.3.3 or for composite fasteners by tests specified in 6.3.4.

## **5.3 Mechanical strength**

### **5.3.1 Perpendicular and axial loads**

The design of the conductor fastener shall be such that it carries the perpendicular loads caused by the weight of the conductor, snow, ice and wind and axial loads caused by the thermal expansion–contraction of the conductor and its weight.

Compliance is checked following the manufacturer's declaration for the classification of the conductor fastener in accordance with Clause 4 and by the tests specified in 6.4.1 and 6.4.2.

### **5.3.2 Impact tests**

Conductor fasteners shall be so designed and constructed to withstand impact stresses caused accidentally.

Compliance is checked by the tests specified in 6.4.3.

## **5.4 Installation instructions**

The manufacturer or supplier of the conductor fastener shall provide adequate information in his literature to ensure that the installer can select and install the component in a suitable and safe manner, in accordance with IEC 62305-3.

Compliance is checked by inspection in accordance with 6.5.

## **5.5 Marking**

Each conductor fastener shall be marked with:

- the manufacturer's or responsible vendor's name or logo or trademark,
- product identification or type.

Where it is not possible to make these marks directly onto the product, they shall be made on the smallest supplied packaging.

NOTE Marking can be applied for example by moulding, pressing, engraving, printing adhesive labels or water slide transfers.

Compliance is checked in accordance with 6.6.

# **6 Tests**

## **6.1 General test conditions**

Tests specified in this document are type tests. These tests are of such a nature that, after they have been performed, they need not be repeated unless changes are made to the materials, design or type of manufacturing process, which might change the performance characteristics of the product.

The present document cannot cover all possible types of conductor fasteners and the way of fixing them on various surfaces of different materials. When required, for these applications, agreement should be obtained between the test engineer and manufacturer on the specific testing regime.

Unless otherwise specified, tests are carried out with the specimens assembled and installed as in normal use specified in the manufacturer's or supplier's instructions, with the recommended conductor materials, sizes and the tightening torques.

The tests shall be carried out in the sequence given after environmental tests of the specimen in accordance with 6.3.

Unless otherwise specified, 12 metallic or 18 composite/non-metallic specimens are subjected to the tests and the requirements are satisfied if all the tests are met.

If only one of the specimens fails to satisfy a test due to a manufacturing fault, that test and any preceding one which may have influenced the results of the test shall be repeated. 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.

Tests for non-metallic conductor fasteners shall not commence earlier than 168 h from the time of their manufacturing.

A torque meter shall be used for all tightening operations. It shall have a resolution of at least 0,5 Nm with an accuracy of  $\pm 4$  % or less. The applicable tolerance for any applied mechanical load shall be within  $\pm 5$  %.

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

## **6.2 Preparation of the specimen**

If not otherwise specified by the manufacturer, the conductors and specimens shall be cleaned by using a suitable degreasing agent followed by cleaning in demineralized water and drying. They shall then be assembled in accordance with the manufacturer's installation instructions, for example with the recommended conductors and the tightening torques.

The tightening torque should be applied in a steady and uniform manner.

Any conductor fastener accommodating conductors with differences in size (diameter, thickness and width) equal to or less than 2 mm shall be tested using the minimum conductor size recommended. If the range is greater than 2 mm, the conductor fastener shall be tested using the minimum and maximum of conductor sizes.

## **6.3 Environmental influence test**

### **6.3.1 General**

In order that a conductor fastener meets the requirements of this document, environmental tests shall be carried out according to Annex A and/or Annex B.

The selection of the tests to be performed depends upon the conductor fastener material.

Annex C provides a flow chart relating to the tests identified in 6.3.2, 6.3.3 and 6.3.4 to the conductor fastener material.

NOTE The sequence of performing the UV test prior to the salt mist test for composite fasteners is because during the salt mist test the specimen is covered by a salt layer. This would inhibit the UV exposure test.

### 6.3.2 Metallic

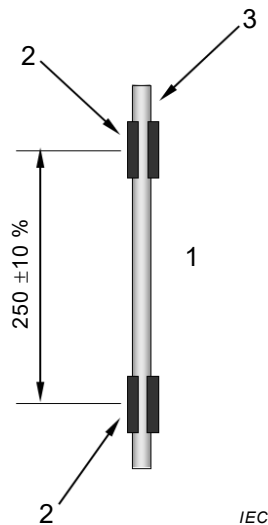
Two sets, each one consisting of three arrangements, shall be assembled and mounted rigidly on an insulating plate (e.g. brick, polytetrafluoroethylene (PTFE)) as shown in Figure 1 in accordance with the manufacturer's installation instructions, for example with the recommended conductors and the tightening torques for screwed fastening conductor fasteners.

The arrangements of specimens shall be subjected to environmental influence tests consisting of a salt mist test as specified in Clause A.2 followed by a humid sulphurous atmosphere test as specified in Clause A.3. An additional test by an ammonia atmosphere as specified in Clause A.4, shall be carried out for conductor fasteners made of copper alloys with a copper content of less than 80 %. This is also valid for conductor fasteners having parts made of copper alloys with a copper content of less than 80 %.

The specimens are deemed to have passed the tests if there are no signs of corrosive deterioration of the conductor or conductor fastener visible to normal or corrected vision.

NOTE White rust, patina and surface oxidation are not considered as corrosive deterioration.

Dimensions in millimetres



#### Key

- 1 mounting plate
- 2 fastener
- 3 conductor

**Figure 1 – Basic arrangement of specimens**

### 6.3.3 Non-metallic

Three sets, each one consisting of three arrangements, shall be assembled and mounted rigidly on an insulating plate (e.g. brick, polytetrafluoroethylene (PTFE)) as shown in Figure 1 in accordance with the manufacturer's installation instructions, for example with the recommended conductors and the tightening torques for screwed fastening conductor fasteners.

The arrangements of specimens shall be subjected to an environmental test consisting of an ultraviolet light test as specified in Annex B.

The specimens are deemed to have passed this part of the test if there are no signs of disintegration and no cracks visible to normal or corrected vision.

Ensure that the surface of the mounting plate is suitable to resist UV radiation.

#### **6.3.4 Composite**

Three sets, each one consisting of three arrangements, shall be assembled and mounted on a rigid surface (e.g., brick, polytetrafluoroethylene (PTFE)) as shown in Figure 1 in accordance with the manufacturer's installation instructions, for example with the recommended conductors and the tightening torques for screwed fastening conductor fasteners.

The arrangement of specimens shall be subjected to the environmental tests in the following sequence:

- test as per 6.3.3 and
- test as per 6.3.2.

The specimens are deemed to have passed this part of the test if the base metal of their metal parts does not exhibit any corrosive deterioration and if their plastic parts show no sign of disintegration and no cracks visible to normal or corrected vision.

Ensure that the surface of the mounting plate is suitable to resist UV radiation.

NOTE White rust, patina and surface oxidation are not considered as corrosive deterioration.

### **6.4 Resistance to mechanical effects**

#### **6.4.1 Lateral load test**

After the test of 6.3 a first set of three arrangements of specimens are subjected to a load test of 200 N applied in the mid distance between the conductor fasteners as illustrated in Figure 2.

The test shall be performed using a stainless steel conductor with the appropriate dimensions.

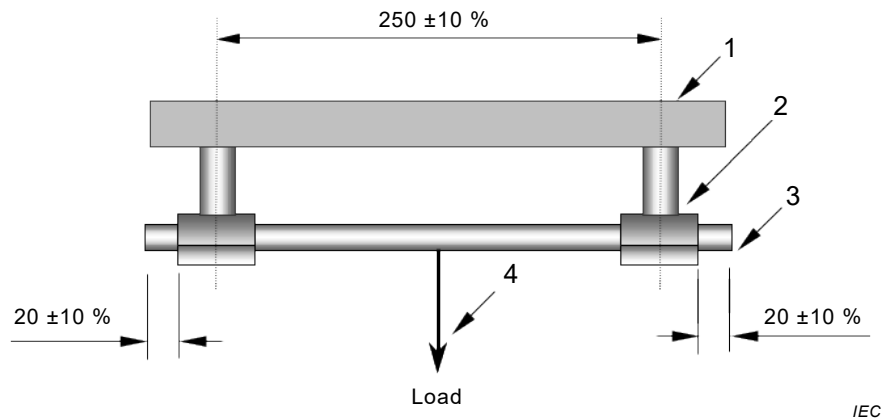
For metallic conductor fasteners, the full test load is applied for a minimum of 5 min and for composite and non-metallic conductor fasteners, the full test load is applied for a minimum period of 60 min.

All tests are carried out at a temperature of  $-10\text{ °C}$  ( $\pm 1\text{ °C}$ ) and repeated at a temperature of  $+40\text{ °C}$  ( $\pm 4\text{ °C}$ ).

The specimens are deemed to have passed the tests provided that the conductor fasteners remain intact and the conductor is still located within the conductor fasteners.



Dimensions in millimetres



IEC

**Key**

- 1 mounting plate
- 2 fastener
- 3 conductor
- 4 load

**Figure 2 – Basic arrangement of lateral load test****6.4.2 Axial load test**

This test is only applicable to conductor fasteners classified according to 4.3 a).

After the test of 6.3 the second set of three arrangements are subjected to a load test of 50 N applied as shown in Figure 3.

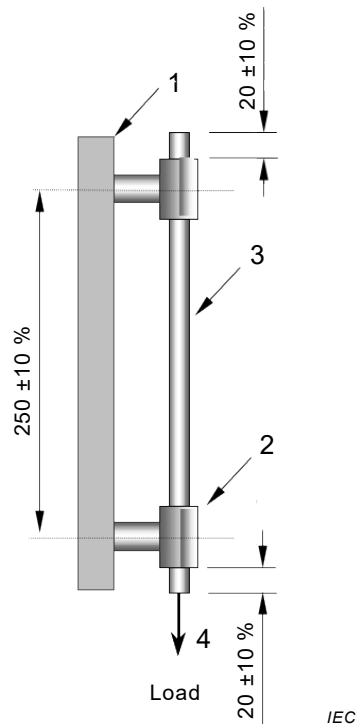
The test shall be performed using the conductors designated by the manufacturer for the conductor fastener.

For metallic conductor fasteners, the full test load is applied for a minimum of 5 min and for composite and non-metallic conductor fasteners, the full test load is applied for a minimum period of 60 min.

All tests are carried out at a temperature of  $-10\text{ °C}$  ( $\pm 1\text{ °C}$ ) and repeated at a temperature of  $+40\text{ °C}$  ( $\pm 4\text{ °C}$ ).

The specimens are deemed to have passed the tests provided the conductor fasteners remain intact and the displacement of the conductor with respect to the conductor fasteners is not more than 3 mm.

Dimensions in millimetres



**Key**

- 1 mounting plate
- 2 fastener
- 3 conductor
- 4 load

**Figure 3 – Typical arrangement for axial movement test**

**6.4.3 Impact test**

This test is carried out on non-metallic and composite conductor fasteners.

After the test of 6.3 the third set of three arrangements is subjected to an impact test.

Each arrangement of specimens shall be mounted on an impact test apparatus as described in IEC 60068-2-75:2014, Clause 5 and shown in Figure 4. The impact test apparatus shall be mounted on a solid wall or structure providing sufficient support for the test apparatus.

The arrangement of specimens is placed in a cabinet at a temperature  $-5\text{ }^{\circ}\text{C}$ . After 2 h, the arrangement is removed from the cabinet and immediately placed in position in the impact test apparatus.

After removal of the arrangement from the cabinet, and after a period of  $12\text{ s} \pm 2\text{ s}$ , the hammer is allowed to fall (2 J, 0,5 kg, 400 mm as illustrated in IEC 60068-2-75:2014, Table 2) so that three impacts are applied as far as possible perpendicular to the length of the arrangement.

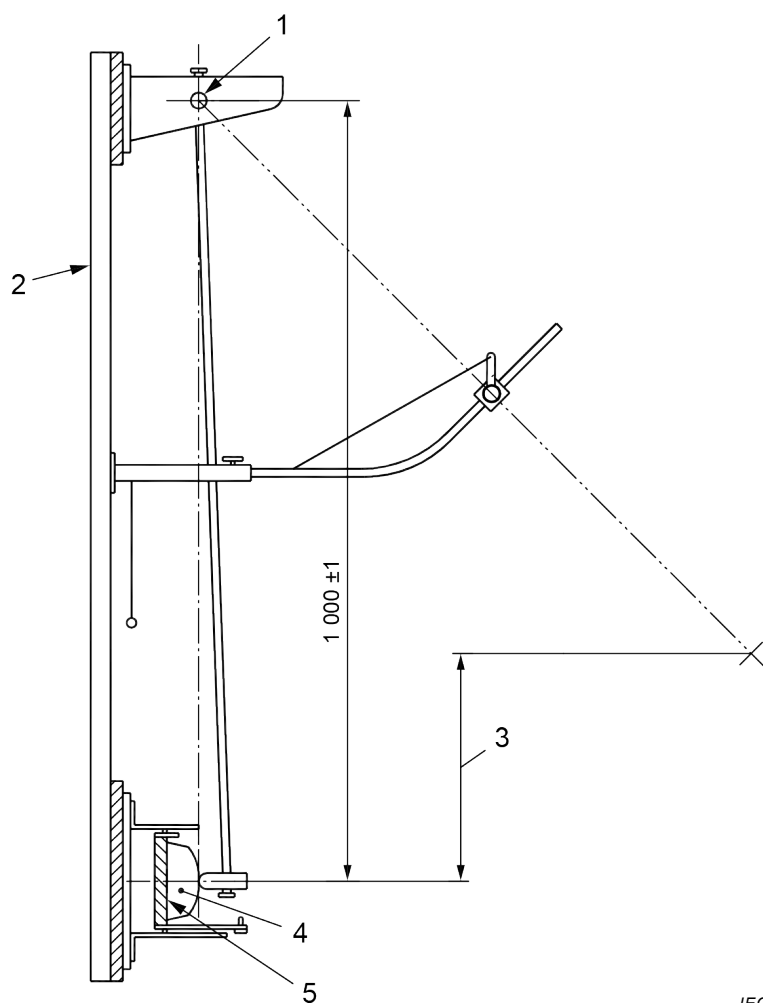
The first impact should be to the left conductor fastener, the second to the other conductor fastener and the third to the middle length of the arrangement.

Instead of placing the arrangements in a cabinet and applying the impact at  $12\text{ s} \pm 2\text{ s}$  after the removal of the sample from the cabinet, it is allowed to apply the impact in a climatic

chamber at a temperature of  $-5\text{ °C}$  ( $\pm 1\text{ °C}$ ) on samples placed at this temperature for at least 2 h prior to testing. Compliance in the climatic chamber is sufficient.

After the test, the specimens shall show no cracks or similar damage visible to normal or corrected vision without magnification and the conductor shall remain located within the conductor fasteners.

Dimensions in millimetres



#### Key

- 1 pendulum
- 2 frame
- 3 height of fall
- 4 specimen
- 5 mounting fixture

**Figure 4 – Impact test apparatus**

### 6.5 Installation instructions

The manufacturer or responsible vendor shall provide in his literature:

- the classifications according to Clause 4;
- the maximum and minimum conductor diameter;
- the materials of conductors to be used;

- the type of mounting surface to be used;
- the recommended method of assembly, installation and fixing to the mounting surface;
- the lateral load;
- the axial movement load.

Compliance is checked by inspection.

## **6.6 Marking test**

### **6.6.1 General conditions for tests**

Marking on the conductor fastener shall be durable and easily legible.

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 white spirit.

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

### **6.6.2 Acceptance criteria**

The specimen is deemed to have passed the test if the marking remains legible.

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

## **6.7 Construction**

The surface of the conductor fastener shall be free from burrs from any cutting process, flash, moulding joint deformation and similar inconsistencies which are likely to damage the conductors or inflict injury to the installer or user.

Compliance is checked by visual and manual inspection.

## **7 Electromagnetic compatibility (EMC)**

Products covered by this document are, in normal use, passive in respect of electromagnetic influences (emission and immunity).

## **8 Structure and content of the test report**

### **8.1 General**

The purpose of Clause 8 is to provide general requirements for laboratory test reports. It is intended to promote clear, complete reporting procedures for laboratories submitting test reports.

The results of each test carried out by the testing laboratory shall be reported accurately, clearly, unambiguously and objectively, in accordance with any instructions in the test methods. The results shall be reported in a test report and shall include all the information necessary for the interpretation of the test results and all information required by the method used.

Particular care and attention shall be paid to the arrangement of the report, especially with regard to presentation of the test data and ease of assimilation by the reader. The format shall be carefully and specifically designed for each type of test carried out, but the headings shall be standardized as indicated below.

The structure of each report shall include at least the information specified in 8.2 to 8.10.

## 8.2 Report identification

The following information shall be included<sup>1</sup>:

- a) A title or subject of the report.
- b) Name and e-mail address or telephone number of the testing laboratory.
- c) Name, address and telephone number of the sub-testing laboratory where the test was carried out if different from the company which has been assigned to perform the test.
- d) Unique identification number (or serial number) of the test report.
- e) Name and address of the vendor.
- f) Report shall be paginated and the total number of pages indicated on each page, including appendices or annexes.
- g) Date of issue of the report.
- h) Date(s) test(s) was (were) performed.
- i) Signature and title, or an equivalent identification of the person(s) authorized by the testing laboratory to attest the content of the report.
- j) Signature and title of person(s) conducting the test(s).

## 8.3 Specimen description

- a) Sample description.
- b) Detailed description and unambiguous identification of the test sample and/or test assembly, for example part number, type, classification, material, dimensions.
- c) Functional parts and accessories description (e.g. screws, nuts, washers, quantity, material).
- d) Manufacturing method (e.g. cast, hot forged, cold deformed, pressing, die casting).
- e) Characterization and condition of the test sample and/or test assembly.
- f) Sampling procedure, where relevant.
- g) Date of receipt of test samples.
- h) Photographs, drawings or any other visual documentation, if available.

## 8.4 Conductor

- a) Conductor material.
- b) Nominal cross-sectional area, dimensions and shape. The actual cross-sectional area should also be given.

## 8.5 Standards and references

- a) Identification of the test standard used and the date of issue of the standard.
- b) Reference to this document may only be made if the full set of tests is performed and reported, except where the deviations are clearly justified in 8.6 b).
- c) Other relevant documentation with the documentation date.

## 8.6 Test procedure

- a) Description of the test procedure.

---

<sup>1</sup> It is suggested to insert in the test report a specific declaration to avoid its misuse. A declaration example is: "This type test report may not be reproduced other than in full, except with the prior written approval of the issuing testing laboratory. This type test report only covers the samples submitted for test and does not produce evidence of the quality for series production."

- b) Justification for any deviations from, additions to or exclusions from the referenced standard.
- c) Any other information relevant to a specific test such as environmental conditions.
- d) Configuration of testing assembly and measuring set up.
- e) Location of the arrangement in the testing area and measuring techniques.

### **8.7 Testing equipment description**

Description of equipment used for every test conducted, i.e. generators, conditioning/ageing devices.

### **8.8 Measuring instruments description**

Characteristics and calibration date of all instruments used for measuring the values specified in this document, i.e. ohmmeters, torque meters.

### **8.9 Results and parameters recorded**

- a) The required passing criteria for each test, defined in the standard.
- b) The relevant measured, observed or derived results of the tests.
- c) Test results of fasteners operating as connection components, as per 4.1 (ohmic resistance, tightening and loosening torques).

The above shall be presented by tables, graphs, drawings, photographs or other documentation of visual observations as appropriate.

### **8.10 Statement of pass/fail**

A statement of pass/fail is necessary, identifying the part of the test for which the specimen has failed and also a description of the failure.

## **Annex A** (normative)

### **Environmental test for metallic and composite conductor fasteners**

#### **A.1 General**

The conditioning/ageing test consists of a salt mist treatment as specified in Clause A.2, followed by a humid sulphurous atmosphere treatment as specified in Clause A.3 and an additional ammonia atmosphere treatment as specified in Clause A.4 for specimens where any component part is made of copper alloy with a copper content less than 80 %.

The manufacturer or supplier shall provide proof of the copper content of any part of the assembly made from an alloy of copper.

#### **A.2 Salt mist treatment**

The salt mist treatment shall be in accordance with IEC 60068-2-52:1996 except for Clauses 7, 10 and 11 which are not applicable. The test is carried out using severity (2).

If the salt mist chamber can maintain the temperature conditions as specified in IEC 60068-2-52:1996, 9.3 and a relative humidity of not less than 90 % then the specimen may remain in the chamber for the humidity storage period.

#### **A.3 Humid sulphurous atmosphere treatment**

The humid sulphurous atmosphere treatment shall be in accordance with ISO 6988:1985 with seven cycles with a volume concentration of sulphur dioxide of  $667 \times 10^{-6} \pm 25 \times 10^{-6}$ , except for Clauses 9 and 10 which are not applicable.

Each cycle which has a duration of 24 h is composed of a heating period of 8 h at a temperature of  $+40 \text{ °C} \pm 3 \text{ °C}$  in the humid saturated atmosphere which is followed by a rest period of 16 h. After that, the humid sulphurous atmosphere is replaced and the next cycle is getting started.

If the test chamber maintains the temperature conditions as specified in ISO 6988:1985, 6.5.2 then the specimen may remain in the chamber for the storage period.

#### **A.4 Ammonia atmosphere treatment**

The ammonia atmosphere treatment shall be in accordance with ISO 6957:1988 for a moderate atmosphere with the pH value 10 except for 8.4 and Clause 9, which are not applicable.