

INTERNATIONAL STANDARD



**Lightning protection system components (LPSC) –
Part 1: Requirements for connection components**

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL STANDARD



**Lightning protection system components (LPSC) –
Part 1: Requirements for connection components**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 1: Requirements for connection components

FOREWORD

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International Standard IEC 62561-1 has been prepared by IEC technical committee 81: Lightning protection.

This second edition cancels and replaces the first edition, published in 2012. This edition constitutes a technical revision.

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

- a) classification of connection components in permanent and non-permanent connection;
- b) requirements and corresponding tests for permanent connection components such as exothermic, brazing, welding, crimping, seaming;
- c) flow chart of tests for connection components.

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

FDIS	Report on voting
81/551/FDIS	81/559/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- withdrawn,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.

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INTRODUCTION

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

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LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 1: Requirements for connection components

1 Scope

This part of IEC 62561 specifies the requirements and tests for metallic connection components that form part of a lightning protection system (LPS). Typically, these can be connectors, clamps, bonding and bridging components, expansion pieces and test joints.

For the purposes of this document the following connection types are considered as connection components: exothermic, brazing, welding, clamping, crimping, seaming, screwing or bolting.

Testing of components for an explosive atmosphere is not covered by this document.

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 62305-1, *Protection against lightning – Part 1: General principles*~~

IEC 62561-2, *Lightning protection system components (LPSC) – Part 2: Requirements for conductors and earth electrodes*

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

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

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 at the following addresses:

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

3.1

connection component

part of an external LPS which is used for the connection of conductors to each other or to metallic installations

Note 1 to entry: Connection components include connectors, clamps, bridging components, expansion pieces and test joints.

3.2

metal installation

extended metal items in the structure to be protected which may form a path for lightning current, such as pipes, staircases, elevator guide rails, ventilation, heating and air conditioning ducts, and interconnected reinforcing steel

3.3

bridging component

connection component for the connection of metal installations

3.4

expansion piece

connection component designed to compensate for changes in length in conductors and/or metal installations caused by temperature changes

3.5

connector

connection component to interconnect two or more conductors

3.6

clamp

connection component for the connection of conductors to metal installations

3.7

pipe clamp

clamp for the connection of conductors to metal pipes

3.8

test joint

joint designed to facilitate electrical testing and measurement of LPS components

3.9

connection range

minimum to maximum range for which a specific connection component is designed to be used

3.10

bonding bar

metal bar on which metal installations, external conductive parts, electric power and telecommunication lines and other cables can be connected to an LPS

3.11

type test

test required to be made before supplying a type of material covered by IEC 62561-1 on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application

Note 1 to entry: These tests are of such a nature that, after they have been made, they need not be repeated unless changes are made to the accessory materials, design or type of manufacturing process which might change the performance characteristics.

3.12

permanent connection

connection that cannot or is not intended to be dismantled

3.13

non-permanent connection

connection that can or is intended to be dismantled

4 Classification

4.1 ~~Classification of components depends on the~~ According to the ability to withstand lightning current

- a) class H for heavy duty;
- b) class N for normal duty.

The selection of classes H and N should be performed by the manufacturer in accordance with the test parameters identified in Table 1.

4.2 ~~Classification is also made~~ According to the installation ~~of connection~~ components location

- a) general use;
- b) embedded in concrete.
- ~~b) not embedded in concrete.~~

4.3 According to the mechanical behaviour of connection components

- a) intended to withstand a static mechanical load;
- b) not intended to withstand a static mechanical load.

The manufacturer's declaration of ability to withstand a static load shall determine the need or otherwise to carry out the static mechanical test as identified in 6.5.

4.4 According to whether or not a connection is permanent

- a) permanent connection such as exothermic process, brazing, welding, crimping, seaming;
- b) non-permanent connection such as screwing or bolting.

5 Requirements

5.1 General

Connection components shall be designed in such a manner that when they are installed in accordance with the manufacturer's instructions their performance shall be reliable, stable and safe to persons and surrounding equipment.

NOTE A summary of the requirements and their corresponding tests is given in Annex A.

5.2 Installation instructions

The manufacturer of the connection components shall provide at least the following information:

- a) the classification of the component;
- b) the recommended tightening torque;
- c) the range of conductor sizes and materials;
- d) the connection configuration.

Compliance is checked by inspection.

5.3 Lightning current carrying capability

Connection components shall have sufficient lightning current carrying capability.

Compliance is checked in accordance with 6.4 following the manufacturer's declaration for the class (H or N) of the connection components in accordance with 4.1.

5.4 Static mechanical stress

Connection components shall have a sufficient withstand capability against static mechanical stresses.

Equipotential bonding bars are excluded from this requirement.

Compliance is checked in accordance with 6.5.

5.5 Permanent connection

Where exothermic process, brazing, welding, crimping or seaming are used as connection, the design shall be such that the conductor and/or the metal installation is always securely bonded.

Compliance is checked by inspection and in accordance with 6.4 a), b), e).

5.6 ~~Screwed clamping~~ Non-permanent connection

Where screws and/or nuts are used as the clamping connection, the design shall be such that the conductor and/or the metal installation is always securely fastened by the screw and/or nut application.

Compliance is checked by inspection and in accordance with 6.4, a), b), c), d).

5.7 Dismantling of test joints

It shall be possible to dismantle the test joints after lightning current stress.

Compliance is checked by inspection and in accordance with 6.4, a), b), c), d).

5.8 Damage to conductors and metal installations

Connection components shall be so designed that they connect the conductors and/or the metal installations without undue damage to the conductors, the metal installations and/or the connection components.

Compliance is checked by inspection.

5.9 ~~Safe~~ Reliable connection

Connection components shall guarantee safe connection within the connection range declared by the manufacturer.

Compliance is checked by inspection and in accordance with 6.4.

5.10 Terminals of bonding bars

The input terminals of bonding bars used for lightning protection installations shall have a diameter of connection equal to or greater than 6 mm.

Compliance is checked by inspection.

5.11 Marking

The connection components shall be marked at least with the following:

- a) manufacturer's or responsible vendor's name or trade mark;
- b) identifying symbol (picture, product number, etc.);
- c) classification, i.e. class N or H.

Where this proves to be impractical the marking in accordance with b) and c) may be given on the smallest packing unit **label or on the accompanying documentation**.

The marking shall be durable and legible.

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 condition ~~for~~ on tests

The tests in accordance with this document are type tests (see 3.11).

- Unless otherwise specified, tests are carried out with the specimens assembled and installed as in normal use according to the manufacturer's or supplier's installation instructions with the recommended conductor materials, sizes and tightening torques. If the connection component is suitable for various conductors' materials, then it shall be tested on each material combination.
- All tests are carried out on new specimens.
- Unless otherwise specified, three specimens are subjected to the tests and the requirements are satisfied if all the tests are met.
- If only one of the specimens does not satisfy a test due to an assembly or a manufacturing fault, 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 carried out in the required sequence on another full set of specimens, all of which shall comply with the requirements.
- The electrical test shall be carried out in the order given, after conditioning/ageing of the arrangement of the specimen in accordance with 6.3.

The applicant, when submitting the sets of specimens, may also submit an additional set of specimens which may be necessary, should one specimen fail. The testing station will then, without further request, test the additional set of specimens and will reject it only if a further failure occurs. If the additional set of specimens is not submitted at the same time, the failure of one specimen will entail rejection.

6.2 ~~Test~~ Preparation of the specimen

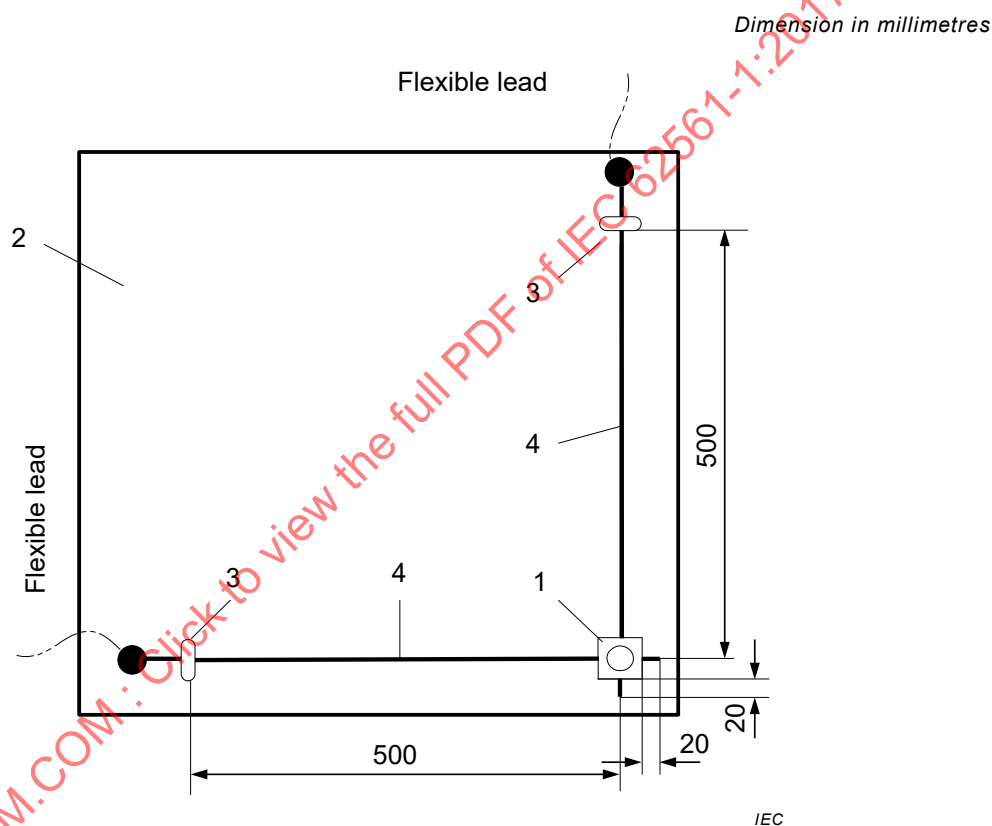
6.2.1 ~~Arrangement of the specimen~~

If not otherwise specified by the manufacturer, the conductors and the 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 instructions, for example with the recommended conductors and tightening torques.

The connection component shall be tested in all the connection configurations declared by the manufacturer. Typical connection configurations for various LPSCs are illustrated in Annex B.

Any connection components accommodating a range of conductors with a variation on any dimension equal to or less than 2 mm shall be tested using the minimum conductor size recommended. If the range of conductor sizes is greater than 2 mm, it shall be tested using the minimum and maximum size of conductors recommended.

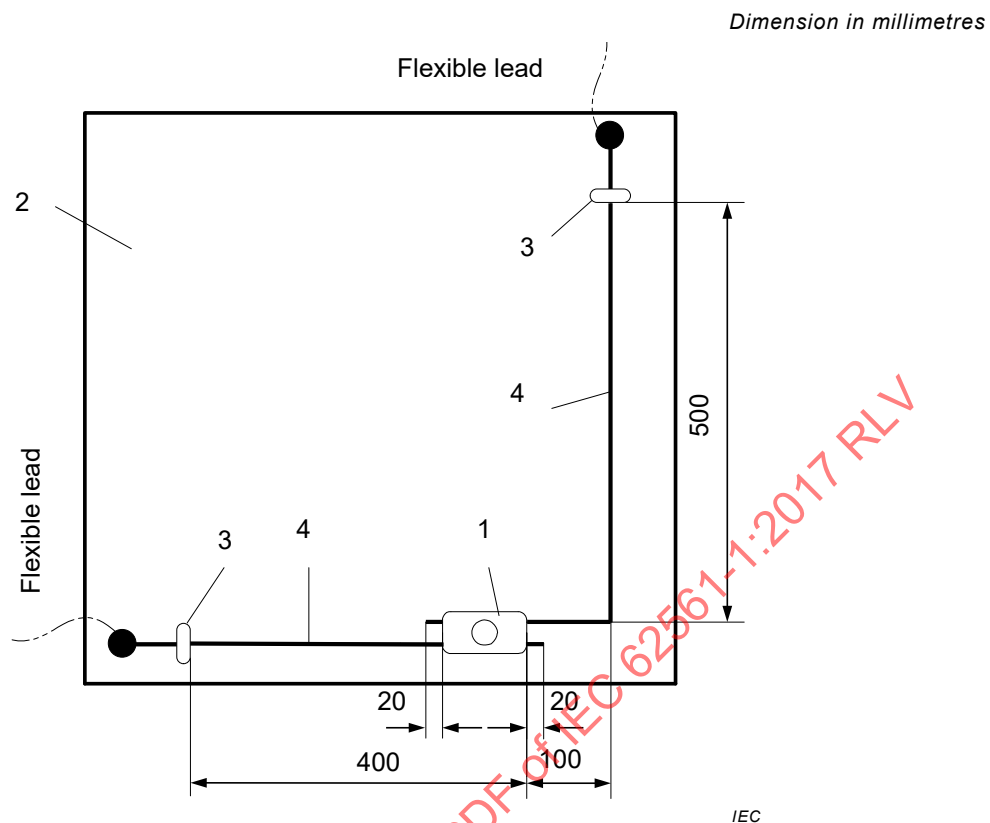
The basic arrangement of the specimen with cross-connection component, parallel connection component, bridging component and equipotential bonding bar is shown in Figures 1, 2, 3 and 4, respectively. Terminals of bonding bars are only tested if the connection size is equal to or greater than 16 mm². The test is carried out using the smallest conductor size within the range of the terminal with a minimum of 16 mm² conductor. Typical arrangements for various LPSCs are shown in Annex B.



Key

- 1 Cross-connection component
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Conductor and/or metal installation in accordance with Annex C

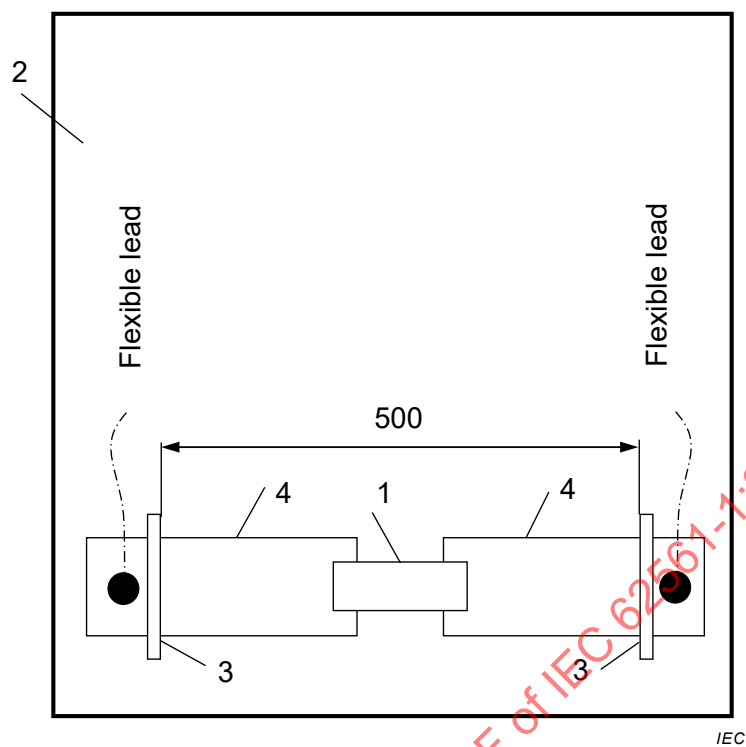
Figure 1 – Basic arrangement of specimen with cross-connection component

**Key**

- 1 Parallel connection component
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Conductor and/or metal installation in accordance with Annex C

Figure 2 – Basic arrangement of specimen with parallel connection component

Dimension in millimetres

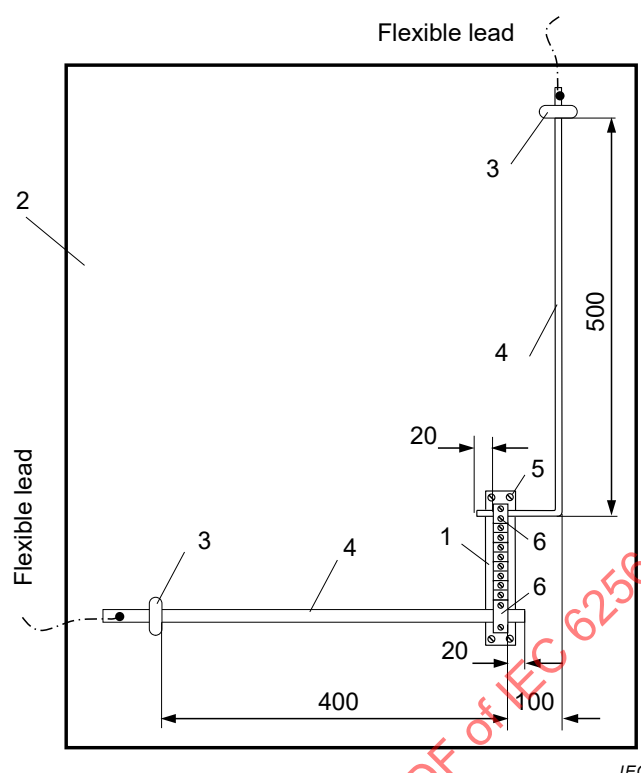


Key

- 1 Bridging component
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Metal installation in accordance with Annex C

Figure 3 – Basic arrangement of specimen with bridging component

Dimension in millimetres

**Key**

- 1 Equipotential bonding bar
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Conductor
- 5 Fixing points of equipotential bonding bar
- 6 Connection to be tested

Figure 4 – Basic arrangement of specimen with equipotential bonding bar**6.3 Conditioning/ageing****6.3.1 Connection components not embedded in concrete**

Following the manufacturer's declaration ~~for the location of the connection components~~ in accordance with 4.2, the arrangement of the specimen shall be subjected to a conditioning/ageing ~~as per Annex C, consisting of a salt mist treatment as specified in C.1 followed by a humid sulphurous atmosphere treatment as specified in C.2, and an additional ammonia atmosphere treatment for specimens made of copper alloy with copper content less than 80 % as specified in C.3~~ in accordance with Annex D.

The manufacturer shall provide proof of the copper content of any part of the assembly made from an alloy having a copper content $\geq 80\%$.

After the treatment, the arrangement is fixed on an insulated plate, taking care to avoid any damage to the specimen due to handling.

6.3.2 Connection components embedded in concrete

This treatment is not necessary for connection components designed to be completely embedded in concrete. Connection components designed to be partially embedded in concrete shall be subjected to the conditioning/ageing in accordance with 6.3.

Bonding bars ~~destined~~ **designed** for indoor applications only are tested without conditioning/ageing.

6.4 Electrical test

After 6.3 and without cleaning the arrangement, the specimen shall be stressed three times by a test current as given in Table 1. The time interval between individual shots shall allow the arrangement of the specimen to cool down to approximately ambient temperature.

The impulse discharge current passing through the device under test is defined by the crest value I_{imp} , and the specific energy W/R . The impulse current shall show no reversal and reach I_{imp} within 50 µs. The transfer of the specific energy W/R shall be dissipated within 5 ms.

Table 1 – Lightning impulse current (I_{imp}) parameters

Classification	I_{imp} kA ±10 %	W/R kJ/Ω ±35 %
H	100	2 500
N	50	625

NOTE The parameters specified in Table 1 can typically be achieved by an exponentially decaying lightning impulse current having a time to half value in the range of 350 µs according to IEC 62305-1.

The connection component is deemed to have passed the test if:

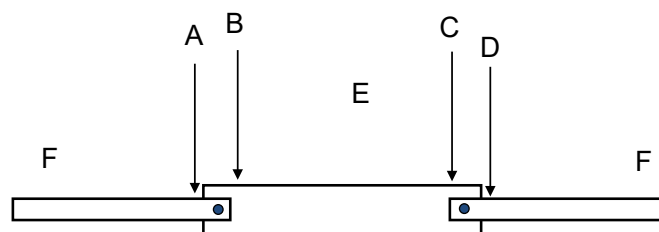
- the contact resistance, measured with a source of at least 10 A as close as possible to the connection component is equal to or less than 1 mΩ. In the case where the connection component or the conductor(s) is of stainless steel, a value of ~~2,5~~ 3 mΩ is allowed;
- it does not exhibit any crack to normal or corrected vision without magnification nor does it have any loose parts or deformation impairing its normal use;
- for ~~screwed clamping~~ **a non-permanent connections component**, in accordance with 4.4 b), utilizing screws, the loosening torque is greater than 0,25 and less than 1,5 times the tightening torque. In the case of connectors with more than one screw, only the loosening torque of the first screw is relevant to this test;
- ~~the 20 mm length of conductor from the connector (see Figures 1, 2 and 4), prior to the test is not less than 3 mm after completion of the test. For examples B3, B4, B6 and B8 as shown in Annex B, the requirement of not less than 3 mm is not applicable;~~
- ~~the measurement of the contact resistance of the expansion components (E) and the connected conductors (F) is performed between the clamped ends A-B and C-D, as close as possible to the expansion component (see Figure 5);~~
- ~~the expansion conductor (E, see Figure 5) shall be tested according to IEC 62561-2⁴ and shall fulfill the requirements for air termination conductors;~~
- for a non-permanent connection component, in accordance with 4.4 b), the 20 mm length of conductor from the connector (see Figures 1, 2 and 4), prior to the test, is not less than 3 mm after completion of the test;
- for screw-less or permanent connection components, ~~such as compressed connection components~~ in accordance with 4.4 a), each conductor of the specimen assemblies shall be subjected independently to a mechanical tensile force of 900 N ± 20 N, for 1 min. Each conductor shall be tested independently for multiple conductor connectors. The connection component is deemed to have passed the test if there is less than 1 mm movement of the conductor during the test and no damage on the ~~connector~~ **connection component** or conductor.

⁴ ~~To be published.~~

NOTE 1 For the examples B3 and B6 as shown in Figure B.1, the requirement of not less than 3 mm is not applicable.

NOTE 2 The measurement of the contact resistance of the expansion components (E) and the connected conductors (F) is performed between the clamped ends A-B and C-D, as close as possible to the expansion component (see Figure 5);

The expansion conductor (E, see Figure 5), shall be tested according to IEC 62561-2 and shall fulfill the requirements for air termination conductors.



Key

A-B, C-D Measuring points to verify the clamp contact resistances

E Solid material or stranded material according to IEC 62561-2

F Lightning protection system conductor according to IEC 62561-2

Figure 5 – Basic arrangement for contact measurement of expansion piece

6.5 Static mechanical test

6.5.1 General

The test shall be performed with all conductor materials permitted according to the manufacturer's declaration.

Alternatively, to minimize the number of tests, connection components that are used with several different conductor materials may be tested using stainless steel only.

Any connection components with a connection range equal to or less than 2 mm shall be tested on the minimum conductor size recommended. If the connection range is greater than 2 mm it shall be tested on the minimum and maximum size of conductor recommended.

6.5.2 Test procedure

A second set of 3 new ~~specimens~~ connection components shall be arranged according to the manufacturer's or supplier's installation instructions with the recommended conductor materials, sizes and tightening torques.

Each conductor of the specimen assemblies shall be subjected independently to a mechanical tensile force of $900\text{ N} \pm 20\text{ N}$ for 1 min. ~~Each conductor shall be tested independently for multiple conductor connectors.~~

The connection component is deemed to have passed the test if there is less than 1 mm movement of the conductor during the test and no damage to the ~~connector~~ connection component or conductor.

6.6 Marking test

The marking is checked by inspection and by rubbing it 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/mineral spirit.

NOTE Markings made by moulding, pressing or engraving are not subjected to this test.

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

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 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 information according to 8.2 to 8.10.

8.2 Report identification

The following information shall be included.

- a) A title or subject of the report.
- b) Name, address and email or telephone number of the test laboratory.
- c) Name, address and email or telephone number of the sub test 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~~ Page numbers, including the total number of pages indicated.
- g) Date of issue of report.
- h) Date(s) of performance of test(s).
- i) Signature and title, or an equivalent identification of the person(s) authorized to sign for the testing laboratory for the content of the report.
- j) Signature and title of person(s) conducting the test.

8.3 Specimen description

- a) Sample description.
- b) Detailed description and unambiguous identification of the test sample and/or test assembly.
- c) Characterization and condition of the test sample and/or test assembly.
- d) Sampling procedure, where relevant.

- e) Date of receipt of test items.
- f) Photographs, drawings or any other visual documentation, if available.

8.4 Conductor

- a) Conductor material.
- b) Nominal cross-sectional area, dimensions and shape. It is recommended that 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) Other relevant documentation with the documentation date.

8.6 Test procedure

- a) Description of the test procedure.
- 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.
- 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. generator, conditioning/ageing device.

8.8 Measuring instruments description

Characteristics and calibration date of all instruments used for measuring the values specified in the standard i.e. radius gauge, shunts, tensile testing machine, extensometer, ohmmeter, torque meter, thickness calliper gauge, etc.

8.9 Results and parameters recorded

The measured, observed or derived results shall be clearly identified at least for:

- a) current;
- b) charge;
- c) specific energy;
- d) front time of the impulse;
- e) duration of the impulse;
- f) ohmic resistance;
- g) tightening torque;
- h) loosening torque.

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

8.10 Statement of pass/fail

A statement that the specimen passed or failed the tests shall be reported. If the specimen has failed, a description of failure is necessary.

Annex A
(~~informative~~ normative)

Summary of the requirements and corresponding tests

See Table A.1.

Table A.1 – Requirements and corresponding tests

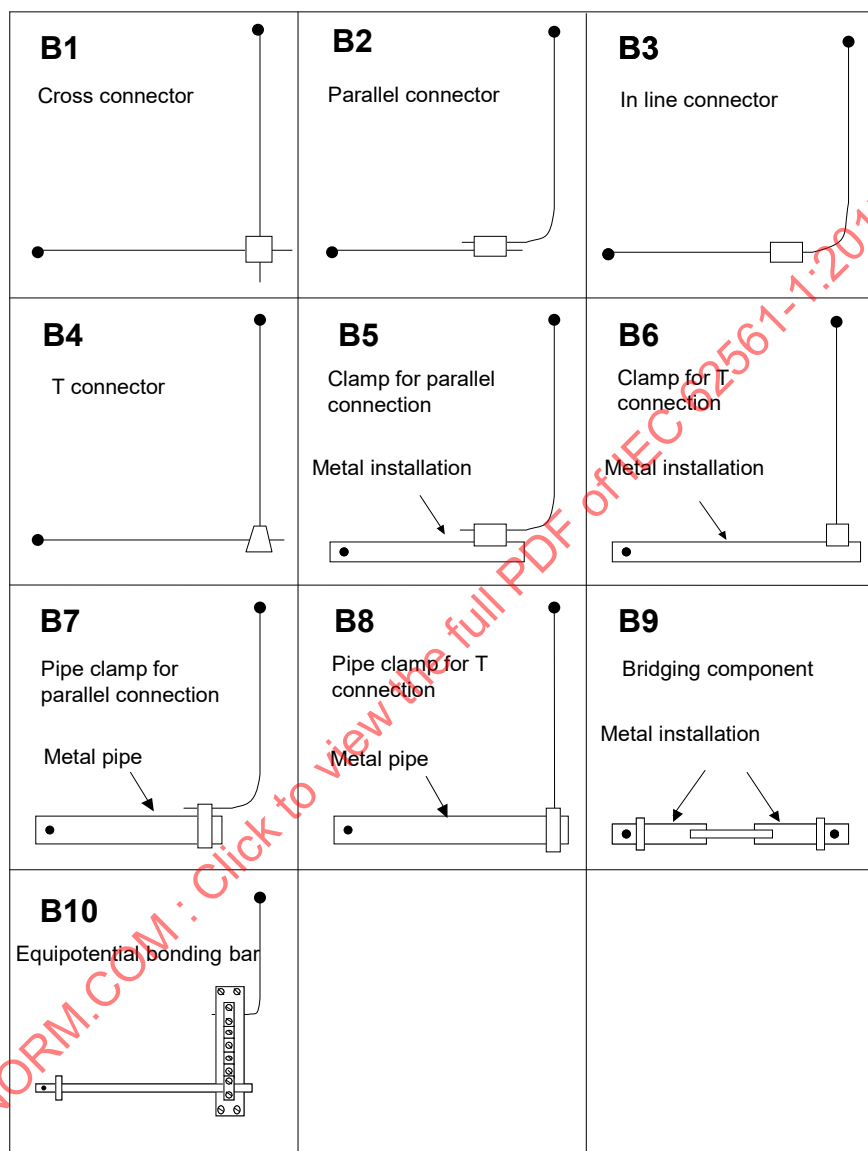
Test sequence	Requirements	Requirements in accordance with	Compliance is checked by
1	Installation instructions	5.2	Inspection
2	Lightning current carrying capability for non-permanent connection	5.3 and 5.6	6.4 a),b),c),d)
3	Lightning current carrying capability for permanent connection	5.3 and 5.5	6.4 a),b),e)
4	Screwed clamping connection	5.5	Inspection and 6.3
4	Dismantling of test joints	5.7	Inspection and 6.4 a),b),c),d)
5	Damage to conductors and metal installations	5.8	Inspection
6	Safe Reliable connection	5.9	Inspection and 6.4
7	Marking	5.11	Inspection and 6.6
8	Static mechanical test	5.4	6.5
9	Terminals of bonding bars	5.10	Inspection

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Annex B (informative)

Typical ~~arrangements~~ connection configurations for various LPSCs

See Figure B.1.



IEC

NOTE 1 B1, B4, B6 and B8 – for more information see Figure 1.

NOTE 2 B2, B3, B5 and B7 – for more information see Figure 2.

NOTE 3 B9 – for more information see Figure 3.

NOTE 4 B10 – for more information see Figure 4.

Figure B.1 – Typical arrangements for various LPSCs

Annex C
(normative)

Flow chart of tests for connection components

See Figure C.1.

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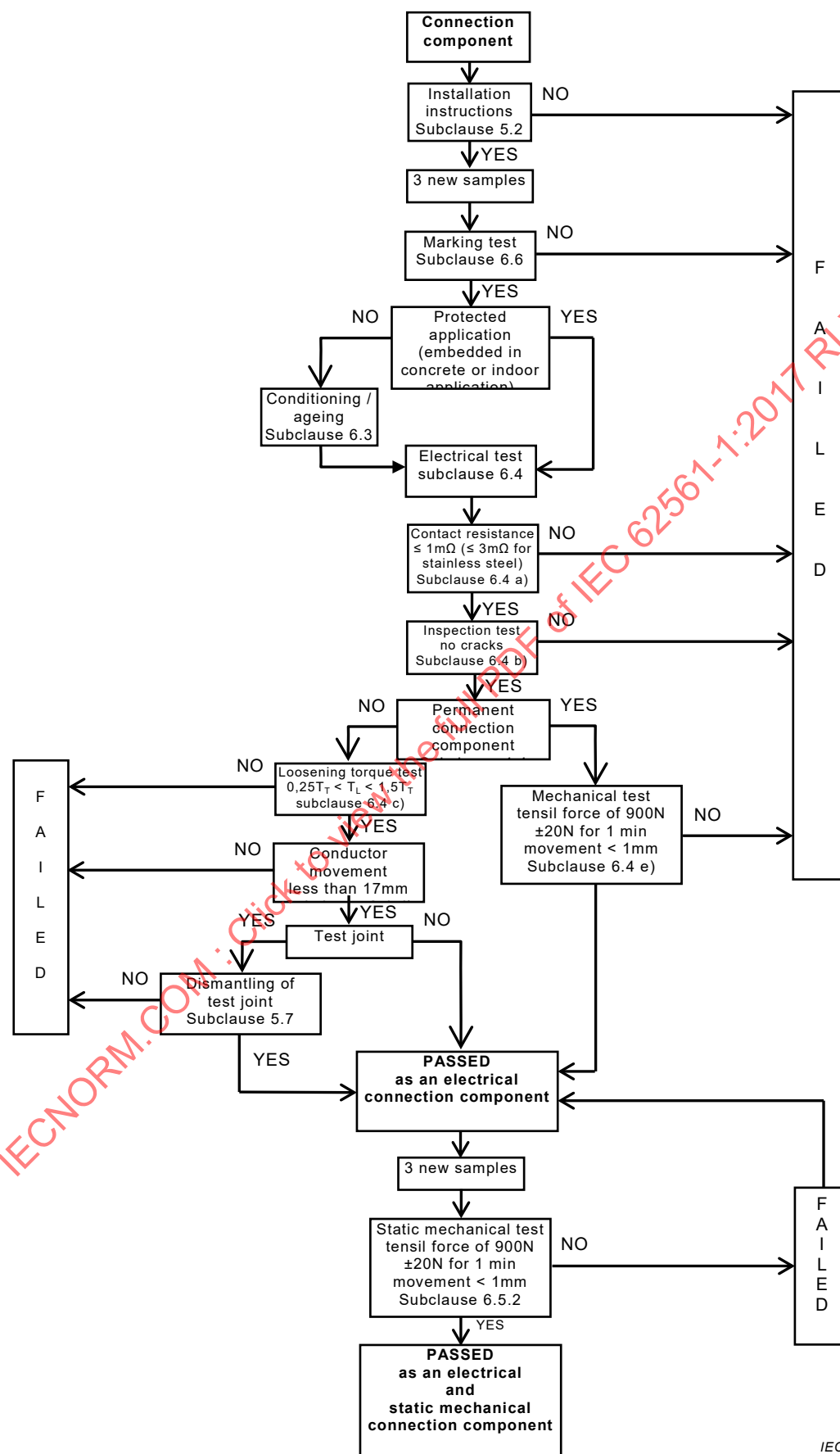


Figure C.1 – Flow chart of tests for connection components

Annex D (normative)

Conditioning/ageing for connection components

D.1 General

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

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

D.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~~ maintains the temperature conditions as specified in 9.3 of IEC 60068-2-52:1996 and a relative humidity of not less than 90 % then the specimen ~~may~~ **can** remain in the chamber for the humidity storage period.

D.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 $40 \text{ }^{\circ}\text{C} \pm 3 \text{ }^{\circ}\text{C}$ in the humid saturated atmosphere which is followed by a rest period of 16 h. After that, the humid sulphurous atmosphere is replaced.

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

D.4 Ammonia atmosphere treatment

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

Bibliography

- [1] IEC 62305 (all parts), *Protection against lightning*
- [2] IEC 62305-1, *Protection against lightning – Part 1: General principles*
- [3] ~~European Standard~~ EN 50164-1:2008², *Lightning Protection Components (LPC) – Part 1: Requirements for connection components*

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² Withdrawn.

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Lightning protection system components (LPSC) –
Part 1: Requirements for connection components**

**Composants des systèmes de protection contre la foudre (CSPF) –
Partie 1: Exigences pour les composants de connexion**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –**Part 1: Requirements for connection components****FOREWORD**

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International Standard IEC 62561-1 has been prepared by IEC technical committee 81: Lightning protection.

This second edition cancels and replaces the first edition, published in 2012. This edition constitutes a technical revision.

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

- a) classification of connection components in permanent and non-permanent connection;
- b) requirements and corresponding tests for permanent connection components such as exothermic, brazing, welding, crimping, seaming;
- c) flow chart of tests for connection components.

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

FDIS	Report on voting
81/551/FDIS	81/559/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.

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INTRODUCTION

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

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LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 1: Requirements for connection components

1 Scope

This part of IEC 62561 specifies the requirements and tests for metallic connection components that form part of a lightning protection system (LPS). Typically, these can be connectors, clamps, bonding and bridging components, expansion pieces and test joints.

For the purposes of this document the following connection types are considered as connection components: exothermic, brazing, welding, clamping, crimping, seaming, screwing or bolting.

Testing of components for an explosive atmosphere is not covered by this document.

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 62561-2, *Lightning protection system components (LPSC) – Part 2: Requirements for conductors and earth electrodes*

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

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

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 at the following addresses:

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

3.1

connection component

part of an external LPS which is used for the connection of conductors to each other or to metallic installations

Note 1 to entry: Connection components include connectors, clamps, bridging components, expansion pieces and test joints.

3.2

metal installation

extended metal items in the structure to be protected which may form a path for lightning current, such as pipes, staircases, elevator guide rails, ventilation, heating and air conditioning ducts, and interconnected reinforcing steel

3.3

bridging component

connection component for the connection of metal installations

3.4

expansion piece

connection component designed to compensate for changes in length in conductors and/or metal installations caused by temperature changes

3.5

connector

connection component to interconnect two or more conductors

3.6

clamp

connection component for the connection of conductors to metal installations

3.7

pipe clamp

clamp for the connection of conductors to metal pipes

3.8

test joint

joint designed to facilitate electrical testing and measurement of LPS components

3.9

connection range

minimum to maximum range for which a specific connection component is designed to be used

3.10

bonding bar

metal bar on which metal installations, external conductive parts, electric power and telecommunication lines and other cables can be connected to an LPS

3.11

type test

test required to be made before supplying a type of material covered by IEC 62561-1 on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application

Note 1 to entry: These tests are of such a nature that, after they have been made, they need not be repeated unless changes are made to the accessory materials, design or type of manufacturing process which might change the performance characteristics.

3.12

permanent connection

connection that cannot or is not intended to be dismantled

3.13

non-permanent connection

connection that can or is intended to be dismantled

4 Classification

4.1 According to the ability to withstand lightning current

- a) class H for heavy duty;
- b) class N for normal duty.

The selection of classes H and N should be performed by the manufacturer in accordance with the test parameters identified in Table 1.

4.2 According to the installation location

- a) general use;
- b) embedded in concrete.

4.3 According to the mechanical behaviour of connection components

- a) intended to withstand a static mechanical load;
- b) not intended to withstand a static mechanical load.

The manufacturer's declaration of ability to withstand a static load shall determine the need or otherwise to carry out the static mechanical test as identified in 6.5.

4.4 According to whether or not a connection is permanent

- a) permanent connection such as exothermic process, brazing, welding, crimping, seaming;
- b) non-permanent connection such as screwing or bolting.

5 Requirements

5.1 General

Connection components shall be designed in such a manner that when they are installed in accordance with the manufacturer's instructions their performance shall be reliable, stable and safe to persons and surrounding equipment.

NOTE A summary of the requirements and their corresponding tests is given in Annex A.

5.2 Installation instructions

The manufacturer of the connection components shall provide at least the following information:

- a) the classification of the component;
- b) the recommended tightening torque;
- c) the range of conductor sizes and materials;
- d) the connection configuration.

Compliance is checked by inspection.

5.3 Lightning current carrying capability

Connection components shall have sufficient lightning current carrying capability.

Compliance is checked in accordance with 6.4 following the manufacturer's declaration for the class (H or N) of the connection components in accordance with 4.1.

5.4 Static mechanical stress

Connection components shall have a sufficient withstand capability against static mechanical stresses.

Equipotential bonding bars are excluded from this requirement.

Compliance is checked in accordance with 6.5.

5.5 Permanent connection

Where exothermic process, brazing, welding, crimping or seaming are used as connection, the design shall be such that the conductor and/or the metal installation is always securely bonded.

Compliance is checked by inspection and in accordance with 6.4 a), b), e).

5.6 Non-permanent connection

Where screws and/or nuts are used as the clamping connection, the design shall be such that the conductor and/or the metal installation is always securely fastened by the screw and/or nut application.

Compliance is checked by inspection and in accordance with 6.4, a), b), c), d).

5.7 Dismantling of test joints

It shall be possible to dismantle the test joints after lightning current stress.

Compliance is checked by inspection and in accordance with 6.4, a), b), c), d).

5.8 Damage to conductors and metal installations

Connection components shall be so designed that they connect the conductors and/or the metal installations without undue damage to the conductors, the metal installations and/or the connection components.

Compliance is checked by inspection.

5.9 Reliable connection

Connection components shall guarantee safe connection within the connection range declared by the manufacturer.

Compliance is checked by inspection and in accordance with 6.4.

5.10 Terminals of bonding bars

The input terminals of bonding bars used for lightning protection installations shall have a diameter of connection equal to or greater than 6 mm.

Compliance is checked by inspection.

5.11 Marking

The connection components shall be marked at least with the following:

- a) manufacturer's or responsible vendor's name or trade mark;

- b) identifying symbol (picture, product number, etc.);
- c) classification, i.e. class N or H.

Where this proves to be impractical the marking in accordance with b) and c) may be given on the smallest packing unit label or on the accompanying documentation.

The marking shall be durable and legible.

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 condition on tests

The tests in accordance with this document are type tests (see 3.11).

- Unless otherwise specified, tests are carried out with the specimens assembled and installed as in normal use according to the manufacturer's or supplier's installation instructions with the recommended conductor materials, sizes and tightening torques. If the connection component is suitable for various conductors' materials, then it shall be tested on each material combination.
- All tests are carried out on new specimens.
- Unless otherwise specified, three specimens are subjected to the tests and the requirements are satisfied if all the tests are met.
- If only one of the specimens does not satisfy a test due to an assembly or a manufacturing fault, 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 carried out in the required sequence on another full set of specimens, all of which shall comply with the requirements.
- The electrical test shall be carried out in the order given, after conditioning/ageing of the arrangement of the specimen in accordance with 6.3.

The applicant, when submitting the sets of specimens, may also submit an additional set of specimens which may be necessary, should one specimen fail. The testing station will then, without further request, test the additional set of specimens and will reject it only if a further failure occurs. If the additional set of specimens is not submitted at the same time, the failure of one specimen will entail rejection.

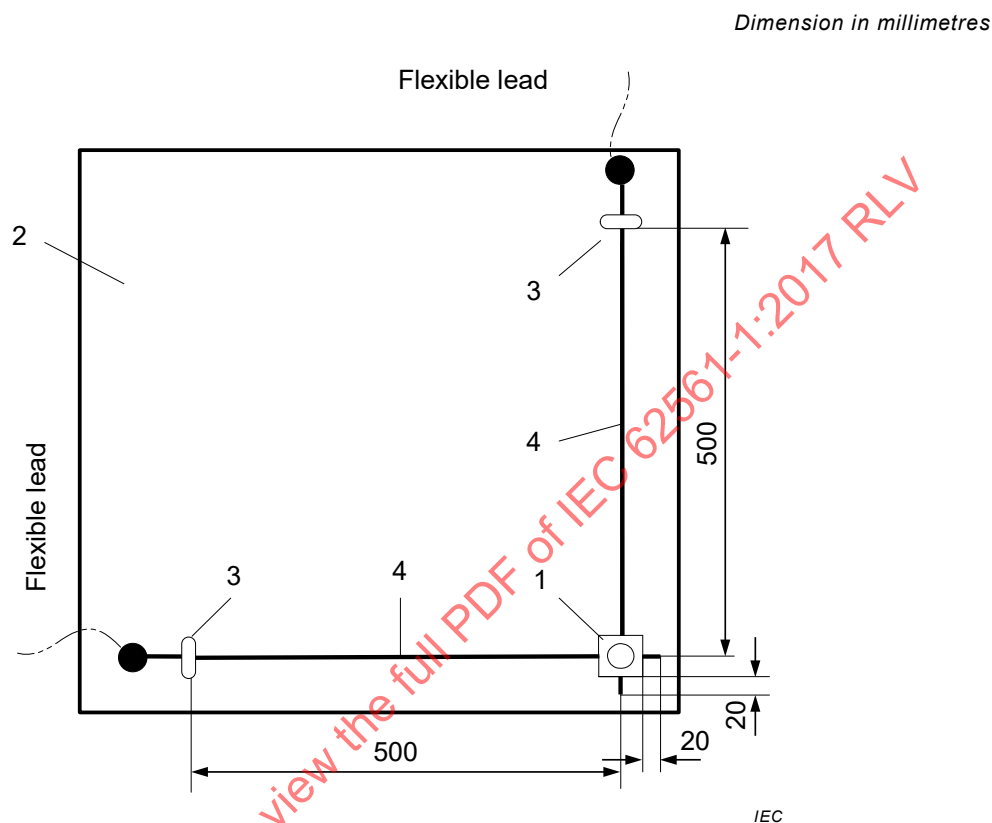
6.2 Preparation of the specimen

If not otherwise specified by the manufacturer, the conductors and the 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 instructions, for example with the recommended conductors and tightening torques.

The connection component shall be tested in all the connection configurations declared by the manufacturer. Typical connection configurations for various LPSCs are illustrated in Annex B.

Any connection components accommodating a range of conductors with a variation on any dimension equal to or less than 2 mm shall be tested using the minimum conductor size recommended. If the range of conductor sizes is greater than 2 mm, it shall be tested using the minimum and maximum size of conductors recommended.

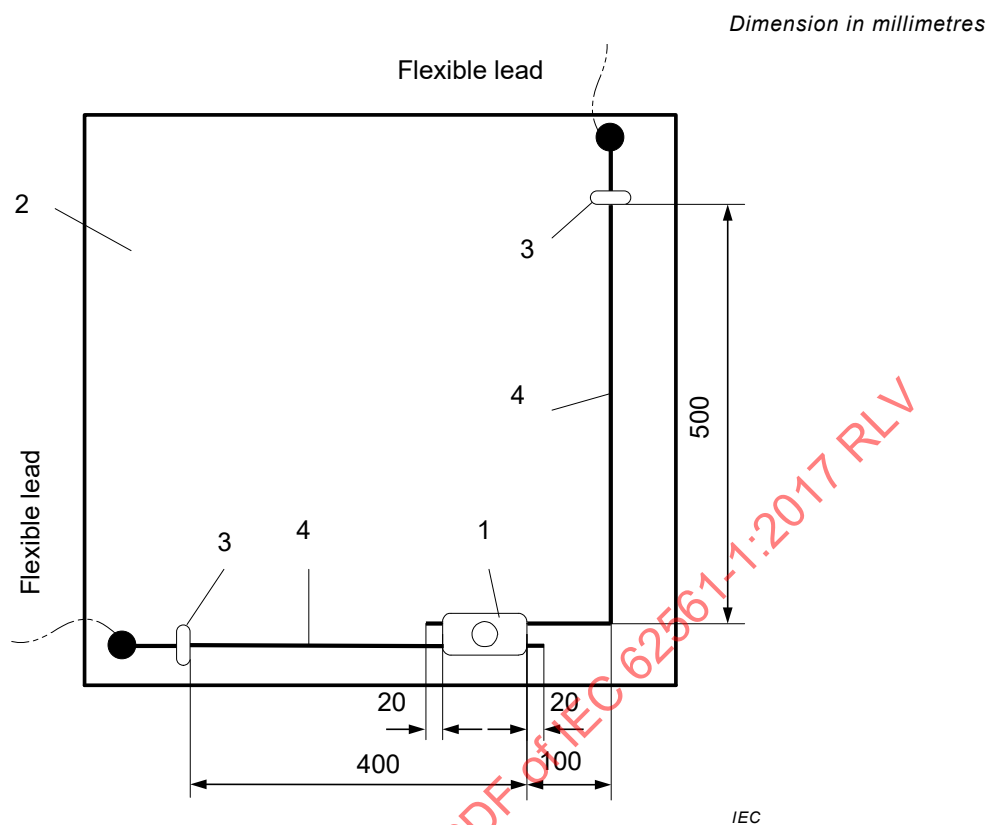
The basic arrangement of the specimen with cross-connection component, parallel connection component, bridging component and equipotential bonding bar is shown in Figures 1, 2, 3 and 4, respectively. Terminals of bonding bars are only tested if the connection size is equal to or greater than 16 mm². The test is carried out using the smallest conductor size within the range of the terminal with a minimum of 16 mm² conductor. Typical arrangements for various LPSCs are shown in Annex B.



Key

- 1 Cross-connection component
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Conductor and/or metal installation in accordance with Annex C

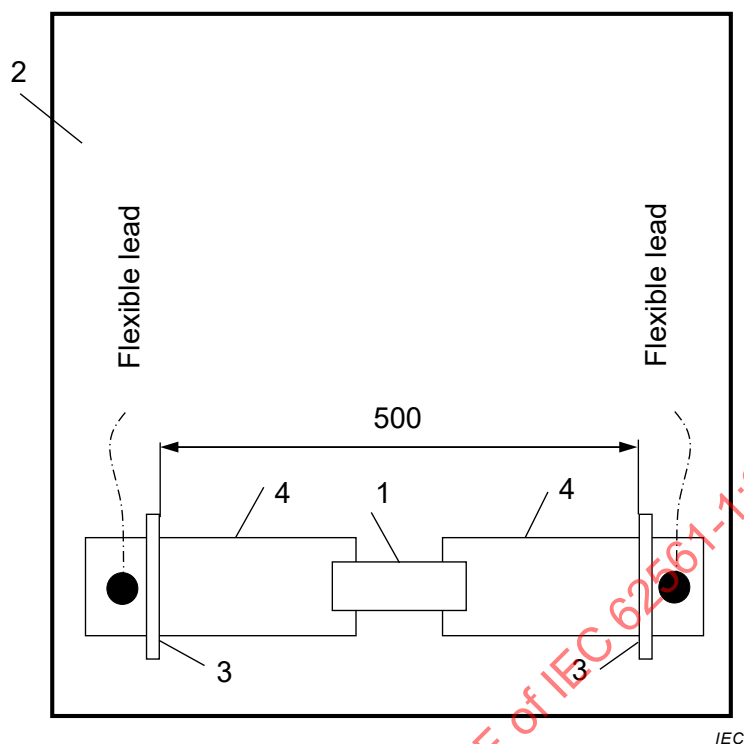
Figure 1 – Basic arrangement of specimen with cross-connection component

**Key**

- 1 Parallel connection component
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Conductor and/or metal installation in accordance with Annex C

Figure 2 – Basic arrangement of specimen with parallel connection component

Dimension in millimetres

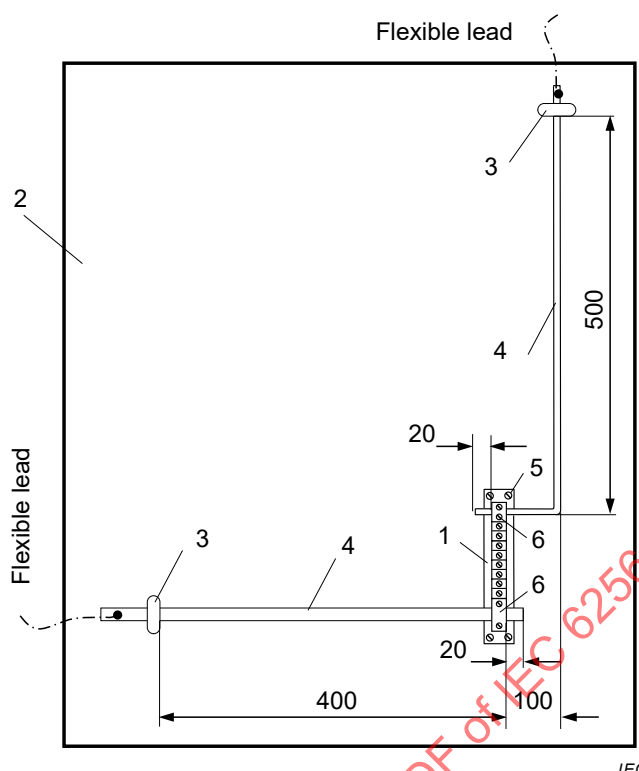


Key

- 1 Bridging component
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Metal installation in accordance with Annex C

Figure 3 – Basic arrangement of specimen with bridging component

Dimension in millimetres

**Key**

- 1 Equipotential bonding bar
- 2 Plate made of insulating material
- 3 Rigid fastener
- 4 Conductor
- 5 Fixing points of equipotential bonding bar
- 6 Connection to be tested

Figure 4 – Basic arrangement of specimen with equipotential bonding bar

6.3 Conditioning/ageing

6.3.1 Connection components not embedded in concrete

Following the manufacturer's declaration in accordance with 4.2, the arrangement of the specimen shall be subjected to a conditioning/ageing in accordance with Annex D.

The manufacturer shall provide proof of the copper content of any part of the assembly made from an alloy having a copper content $\geq 80\%$.

After the treatment, the arrangement is fixed on an insulated plate, taking care to avoid any damage to the specimen due to handling.

6.3.2 Connection components embedded in concrete

This treatment is not necessary for connection components designed to be completely embedded in concrete. Connection components designed to be partially embedded in concrete shall be subjected to the conditioning/ageing in accordance with 6.3.

Bonding bars designed for indoor applications only are tested without conditioning/ageing.

6.4 Electrical test

After 6.3 and without cleaning the arrangement, the specimen shall be stressed three times by a test current as given in Table 1. The time interval between individual shots shall allow the arrangement of the specimen to cool down to approximately ambient temperature.

The impulse discharge current passing through the device under test is defined by the crest value I_{imp} , and the specific energy W/R . The impulse current shall show no reversal and reach I_{imp} within 50 μ s. The transfer of the specific energy W/R shall be dissipated within 5 ms.

Table 1 – Lightning impulse current (I_{imp}) parameters

Classification	I_{imp} kA ± 10 %	W/R kJ/ Ω ± 35 %
H	100	2 500
N	50	625

NOTE The parameters specified in Table 1 can typically be achieved by an exponentially decaying lightning impulse current having a time to half value in the range of 350 μ s according to IEC 62305-1.

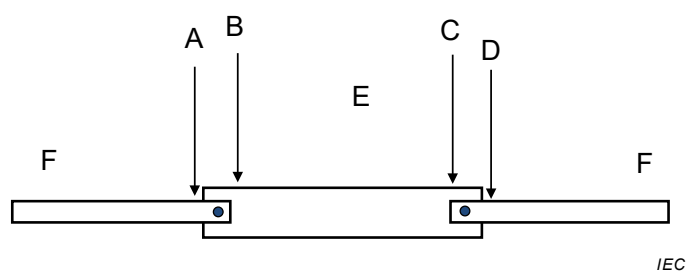
The connection component is deemed to have passed the test if:

- the contact resistance, measured with a source of at least 10 A as close as possible to the connection component is equal to or less than 1 m Ω . In the case where the connection component or the conductor(s) is of stainless steel, a value of 3 m Ω is allowed;
- it does not exhibit any crack to normal or corrected vision without magnification nor does it have any loose parts or deformation impairing its normal use;
- for a non-permanent connection component, in accordance with 4.4 b), utilizing screws, the loosening torque is greater than 0,25 and less than 1,5 times the tightening torque. In the case of connectors with more than one screw, only the loosening torque of the first screw is relevant to this test;
- for a non-permanent connection component, in accordance with 4.4 b), the 20 mm length of conductor from the connector (see Figures 1, 2 and 4), prior to the test, is not less than 3 mm after completion of the test;
- for screw-less or permanent connection components, in accordance with 4.4 a), each conductor of the specimen assemblies shall be subjected independently to a mechanical tensile force of 900 N $\pm$ 20 N, for 1 min. Each conductor shall be tested independently for multiple conductor connectors. The connection component is deemed to have passed the test if there is less than 1 mm movement of the conductor during the test and no damage on the connection component or conductor.

NOTE 1 For the examples B3 and B6 as shown in Figure B.1, the requirement of not less than 3 mm is not applicable.

NOTE 2 The measurement of the contact resistance of the expansion components (E) and the connected conductors (F) is performed between the clamped ends A-B and C-D, as close as possible to the expansion component (see Figure 5);

The expansion conductor (E, see Figure 5), shall be tested according to IEC 62561-2 and shall fulfill the requirements for air termination conductors.

**Key**

- A-B, C-D Measuring points to verify the clamp contact resistances
 E Solid material or stranded material according to IEC 62561-2
 F Lightning protection system conductor according to IEC 62561-2

Figure 5 – Basic arrangement for contact measurement of expansion piece

6.5 Static mechanical test

6.5.1 General

The test shall be performed with all conductor materials permitted according to the manufacturer's declaration.

Alternatively, to minimize the number of tests, connection components that are used with several different conductor materials may be tested using stainless steel only.

Any connection components with a connection range equal to or less than 2 mm shall be tested on the minimum conductor size recommended. If the connection range is greater than 2 mm it shall be tested on the minimum and maximum size of conductor recommended.

6.5.2 Test procedure

A second set of 3 new connection components shall be arranged according to the manufacturer's or supplier's installation instructions with the recommended conductor materials, sizes and tightening torques.

Each conductor of the specimen assemblies shall be subjected independently to a mechanical tensile force of $900\text{ N} \pm 20\text{ N}$ for 1 min.

The connection component is deemed to have passed the test if there is less than 1 mm movement of the conductor during the test and no damage to the connection component or conductor.

6.6 Marking test

The marking is checked by inspection and by rubbing it 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/mineral spirit.

Markings made by moulding, pressing or engraving are not subjected to this test.

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

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 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 information according to 8.2 to 8.10.

8.2 Report identification

The following information shall be included.

- a) A title or subject of the report.
- b) Name, address and email or telephone number of the test laboratory.
- c) Name, address and email or telephone number of the sub test 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) Page numbers, including the total number of pages.
- g) Date of issue of report.
- h) Date(s) of performance of test(s).
- i) Signature and title, or an equivalent identification of the person(s) authorized to sign for the testing laboratory for the content of the report.
- j) Signature and title of person(s) conducting the test.

8.3 Specimen description

- a) Sample description.
- b) Detailed description and unambiguous identification of the test sample and/or test assembly.
- c) Characterization and condition of the test sample and/or test assembly.
- d) Sampling procedure, where relevant.
- e) Date of receipt of test items.
- f) Photographs, drawings or any other visual documentation, if available.

8.4 Conductor

- a) Conductor material.
- b) Nominal cross-sectional area, dimensions and shape. It is recommended that 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) Other relevant documentation with the documentation date.

8.6 Test procedure

- a) Description of the test procedure.
- 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.
- 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. generator, conditioning/ageing device.

8.8 Measuring instruments description

Characteristics and calibration date of all instruments used for measuring the values specified in the standard i.e. radius gauge, shunts, tensile testing machine, extensometer, ohmmeter, torque meter, thickness calliper gauge, etc.

8.9 Results and parameters recorded

The measured, observed or derived results shall be clearly identified at least for:

- a) current;
- b) charge;
- c) specific energy;
- d) front time of the impulse;
- e) duration of the impulse;
- f) ohmic resistance;
- g) tightening torque;
- h) loosening torque.

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

8.10 Statement of pass/fail

A statement that the specimen passed or failed the tests shall be reported. If the specimen has failed, a description of failure is necessary.

Annex A (normative)

Summary of the requirements and corresponding tests

See Table A.1.

Table A.1 – Requirements and corresponding tests

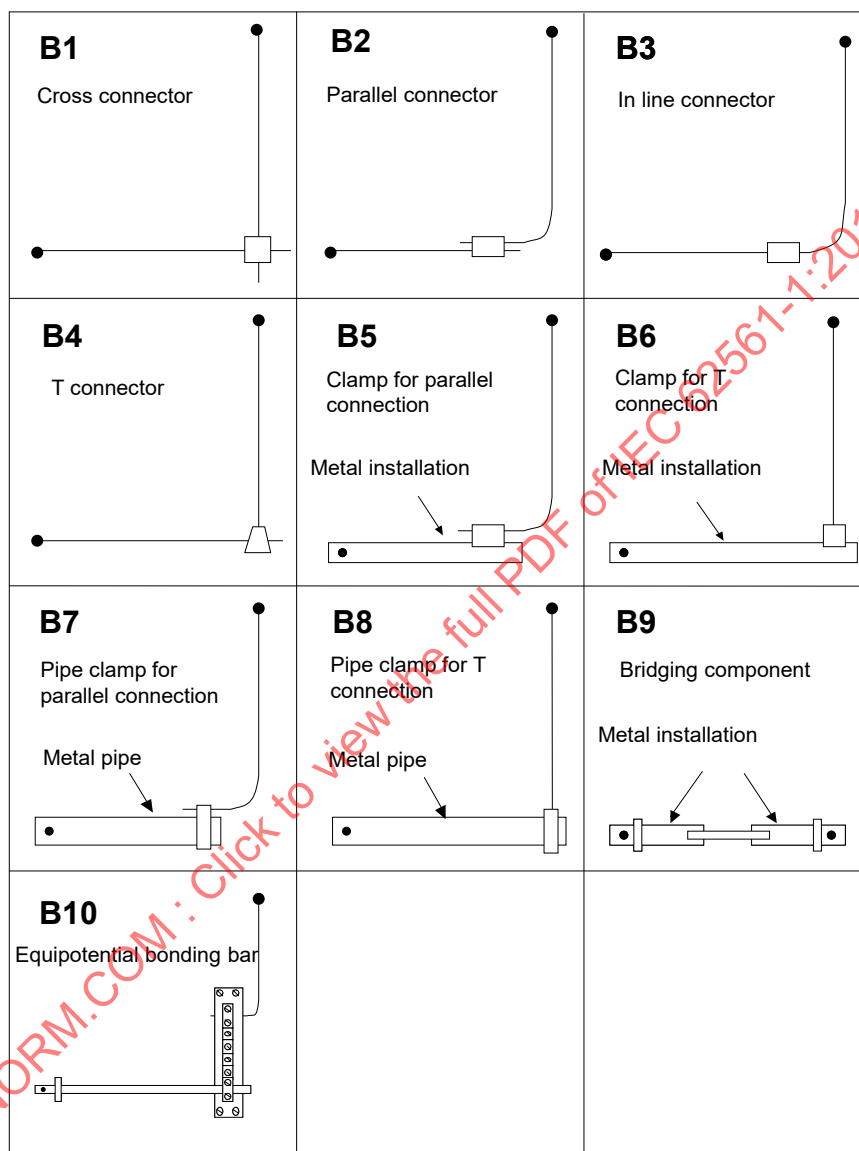
Test sequence	Requirements	Requirements in accordance with	Compliance is checked by
1	Installation instructions	5.2	Inspection
2	Lightning current carrying capability for non-permanent connection	5.3 and 5.6	6.4 a),b),c),d)
3	Lightning current carrying capability for permanent connection	5.3 and 5.5	6.4 a),b),e)
4	Dismantling of test joints	5.7	Inspection and 6.4 a),b),c),d)
5	Damage to conductors and metal installations	5.8	Inspection
6	Reliable connection	5.9	Inspection and 6.4
7	Marking	5.11	Inspection and 6.6
8	Static mechanical test	5.4	6.5
9	Terminals of bonding bars	5.10	Inspection

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Annex B (informative)

Typical connection configurations for various LPSCs

See Figure B.1.



IEC

NOTE 1 B1, B4, B6 and B8 – for more information see Figure 1.

NOTE 2 B2, B3, B5 and B7 – for more information see Figure 2.

NOTE 3 B9 – for more information see Figure 3.

NOTE 4 B10 – for more information see Figure 4.

Figure B.1 – Typical arrangements for various LPSCs

Annex C
(normative)

Flow chart of tests for connection components

See Figure C.1.

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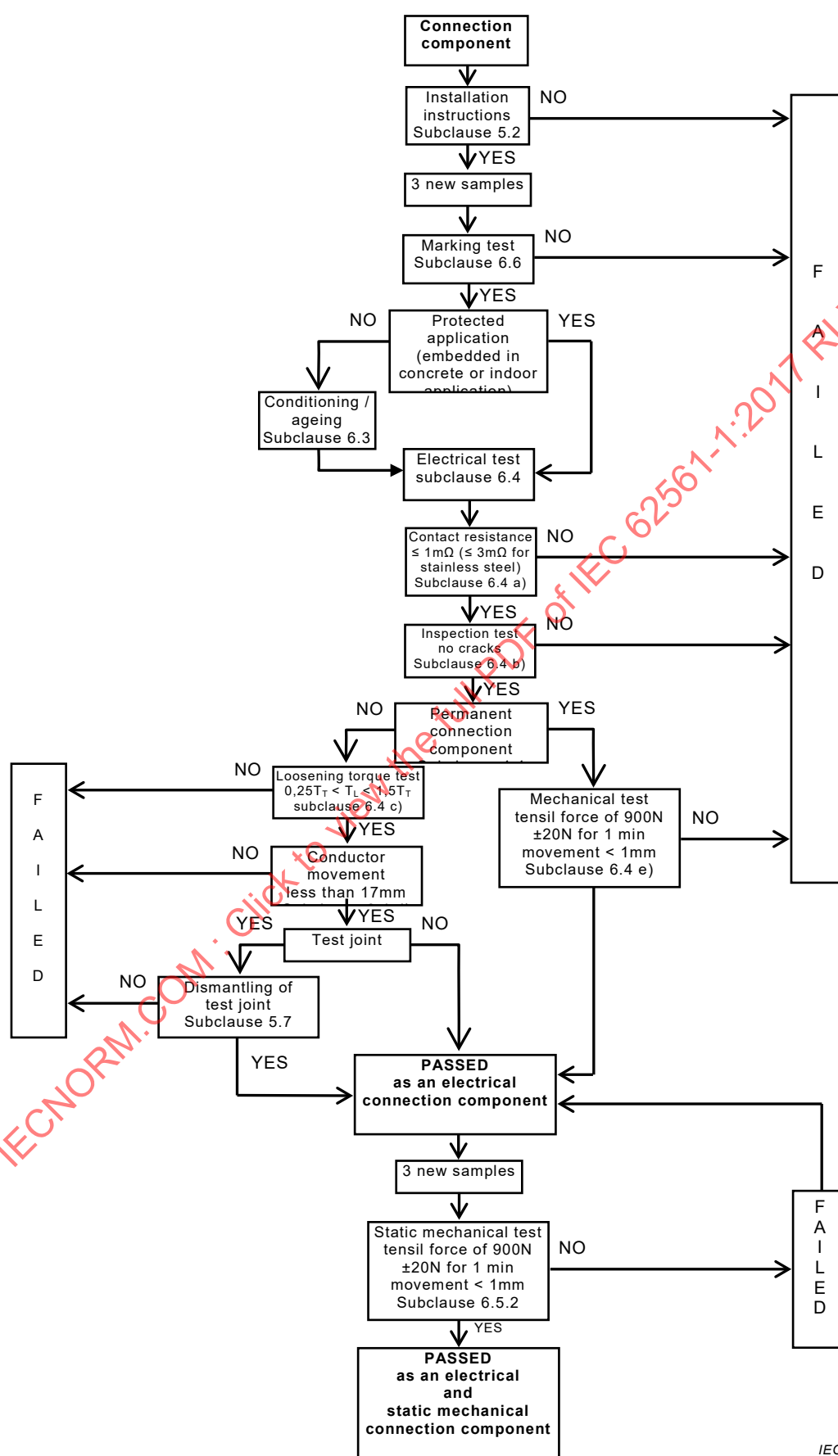


Figure C.1 – Flow chart of tests for connection components

Annex D (normative)

Conditioning/ageing for connection components

D.1 General

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

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

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

D.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 $40 \text{ }^{\circ}\text{C} \pm 3 \text{ }^{\circ}\text{C}$ in the humid saturated atmosphere which is followed by a rest period of 16 h. After that, the humid sulphurous atmosphere is replaced.

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

D.4 Ammonia atmosphere treatment

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

Bibliography

- [1] IEC 62305 (all parts), *Protection against lightning*
- [2] IEC 62305-1, *Protection against lightning – Part 1: General principles*
- [3] EN 50164-1:2008¹, *Lightning Protection Components (LPC) – Part 1: Requirements for connection components*

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¹ Withdrawn.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

COMPOSANTS DES SYSTEMES DE PROTECTION CONTRE LA FOUDRE (CSPF) –

Partie 1: Exigences pour les composants de connexion

AVANT-PROPOS

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La Norme internationale IEC 62561-1 a été établie par le comité d'études 81 de l'IEC: Protection contre la foudre.

Cette deuxième édition annule et remplace la première édition publiée en 2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) la classification des composants de connexion permanente et non permanente;
- b) les exigences et essais correspondants concernant les composants de connexion permanente, par exemple la soudure exothermique et d'autres procédés de soudage, le brasage, le sertissage ou l'agrafage;

c) un organigramme des essais destinés aux composants de connexion.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
81/551/FDIS	81/559/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62561, publiées sous le titre général *Composants des systèmes de protection contre la foudre (CSPF)*, peut être consultée sur le site web de l'IEC.

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- amendé.

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INTRODUCTION

La présente partie de l'IEC 62561 traite des exigences et des essais pour les composants des systèmes de protection contre la foudre (CSPF) utilisés pour l'installation d'un système de protection contre la foudre (SPF) conçu et mis en œuvre conformément à la série IEC 62305.

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COMPOSANTS DES SYSTEMES DE PROTECTION CONTRE LA Foudre (CSPF) –

Partie 1: Exigences pour les composants de connexion

1 Domaine d'application

La présente partie de l'IEC 62561 spécifie les exigences et les essais à appliquer aux composants métalliques de connexion faisant partie d'un système de protection contre la foudre (SPF). Il peut s'agir, typiquement, des connecteurs, des colliers de serrage, des composants de pontage, des pièces d'expansion et des joints de contrôle.

Pour les besoins du présent document, les types de connexions suivants sont considérés comme des composants de connexion: la soudure exothermique et autres procédés de soudage, le brasage, le serrage, le sertissage, l'agrafage, le vissage et le boulonnage.

Les essais de composants pour atmosphère explosive ne sont pas concernés par le présent document.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-52:1996, *Essais d'environnement – Partie 2-52: Essais – Essai Kb: Brouillard salin, essai cyclique (solution de chlorure de sodium)*

IEC 62561-2, *Composants des systèmes de protection contre la foudre (CSPF) – Partie 2: Exigences pour les conducteurs et les électrodes de terre*

ISO 6957:1988, *Alliages de cuivre – Essai à l'ammoniaque pour la résistance à la corrosion sous contrainte*

ISO 6988:1985, *Revêtements métalliques et autres revêtements non organiques – Essai au dioxyde de soufre avec condensation générale de l'humidité*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

3.1

composant de connexion

partie d'un SPF externe qui est utilisée pour la connexion des conducteurs entre eux ou aux installations métalliques

Note 1 à l'article: Le composant de connexion comprend les connecteurs, les colliers de serrage, les composants de pontage, les pièces d'expansion et les joints de contrôle.

3.2

installation métallique

ensemble des éléments métalliques de la structure à protéger pouvant constituer un chemin pour le courant de foudre, tels que les tuyaux, escaliers, guides d'ascenseurs, conduits de ventilation, de chauffage et de conditionnement d'air, ainsi que les armatures interconnectées en acier

3.3

composant de pontage

composant de connexion pour la liaison des installations métalliques

3.4

pièce d'expansion

composant de connexion destiné à compenser les variations de longueur des conducteurs et/ou des installations métalliques dues à des variations de température

3.5

connecteur

composant de connexion pour la liaison de deux conducteurs ou plus

3.6

collier de serrage

composant de connexion pour la liaison des conducteurs aux installations métalliques

3.7

collier de serrage pour tuyau

collier de serrage pour la liaison des conducteurs aux tuyaux métalliques

3.8

joint de contrôle

joint conçu pour faciliter les essais et mesures électriques des composants des SPF

3.9

plage de connexion

domaine minimal à maximal sur lequel un composant de connexion spécifique est conçu pour être utilisé

3.10

barre d'équipotentialité

barre métallique sur laquelle les installations métalliques, les parties conductrices externes, les réseaux de puissance et de communication et autres câbles peuvent être connectés à un SPF

3.11

essai de type

essai exigé, devant être effectué avant la livraison d'un type de matériau concerné par l'IEC 62561-1, sur une base commerciale générale, afin de démontrer que ses caractéristiques de performance satisfont à l'application prévue

Note 1 à l'article: Ces essais sont de telle nature qu'après avoir été effectués, il n'est pas nécessaire de les répéter, à moins que des modifications n'aient été introduites dans les matériaux des accessoires, dans la conception ou dans le type de procédé de fabrication, susceptibles d'en modifier les caractéristiques de performance.

3.12

connexion permanente

connexion qui ne peut pas ou n'est pas destinée à être démontée

3.13

connexion non permanente

connexion qui peut être ou est destinée à être démontée

4 Classification

4.1 En fonction de leur tenue aux courants de foudre

- a) classe H pour une tenue élevée;
- b) classe N pour une tenue normale.

Il convient que le choix de la classe H et de la classe N soit réalisé par le fabricant conformément aux paramètres d'essai identifiés dans le Tableau 1.

4.2 En fonction de leur emplacement d'installation

- a) utilisation générale;
- b) incorporés dans le béton.

4.3 En fonction de leur comportement mécanique

- a) prévu pour supporter une charge mécanique statique;
- b) pas prévu pour supporter une charge mécanique statique.

La déclaration d'aptitude à supporter une charge statique émise par le fabricant doit indiquer, le cas échéant, s'il est besoin d'effectuer l'essai mécanique statique indiqué en 6.5.

4.4 En fonction du caractère permanent ou non de la connexion

- a) connexion permanente, par exemple: soudure exothermique ou autres procédés de soudage, brasage, sertissage ou agrafage;
- b) connexion non permanente, par exemple: vissage ou boulonnage.

5 Exigences

5.1 Généralités

Les composants de connexion doivent être conçus de manière à ce que leurs performances soient fiables, stables et sûres pour les personnes et les matériels environnants lorsqu'ils sont installés conformément aux instructions du fabricant.

NOTE Un résumé des exigences et des essais correspondants est fourni à l'Annexe A.

5.2 Instructions d'installation

Le fabricant de composants de connexion doit fournir au minimum les informations suivantes:

- a) la classification du composant;
- b) le couple de serrage recommandé;
- c) la gamme de matériaux et de tailles de conducteurs;
- d) la configuration de connexion.

La conformité est vérifiée par examen.

5.3 Capacité de tenue au courant de foudre

Les composants de connexion doivent avoir une capacité suffisante de tenue au courant de foudre.

La conformité est vérifiée conformément au 6.4, selon les déclarations du fabricant concernant la classe (H ou N) des composants de connexion conformément au 4.1.

5.4 Contrainte mécanique statique

Les composants de connexion doivent avoir une capacité suffisante à résister aux contraintes mécaniques statiques.

Les barres d'équipotentialité sont exclues de cette exigence.

La conformité est vérifiée selon 6.5.

5.5 Connexion permanente

Lorsque des procédés de soudure exothermique ou d'autres procédés de soudage, de brasage, de sertissage ou d'agrafage sont utilisés pour réaliser la connexion, la conception doit être telle que le conducteur et/ou l'installation métallique soient toujours fixés de manière sûre.

La conformité est vérifiée par examen, conformément à 6.4 a), b), e).

5.6 Connexion non permanente

Lorsque des vis et/ou des écrous sont utilisés comme fixations à collier de serrage, leur conception doit être telle que le conducteur et/ou l'installation métallique soient toujours serrés de manière sûre par la vis et/ou l'écrou.

La conformité est vérifiée par examen, conformément à 6.4, a), b), c), d).

5.7 Démontage des joints de contrôle

Les joints de contrôle doivent pouvoir être démontés après le passage de la contrainte du courant de foudre.

La conformité est vérifiée par examen, conformément à 6.4, a), b), c), d).

5.8 Dommages subis par les conducteurs et les installations métalliques

Les composants de connexion doivent être conçus de manière à ce que les fixations des conducteurs et/ou des installations métalliques entre eux soient réalisées sans dommage pour les conducteurs, les installations métalliques et/ou les composants de connexion.

La conformité est vérifiée par examen.

5.9 Connexion fiable

Les composants de connexion doivent assurer une connexion sûre pour la plage de connexion déclarée par le fabricant.

La conformité est vérifiée par examen, conformément à 6.4.

5.10 Bornes des barres d'équipotentialité

Les bornes d'entrée des barres d'équipotentialité utilisées pour les installations de protection contre la foudre doivent présenter un diamètre de connexion supérieur ou égal à 6 mm.

La conformité est vérifiée par examen.

5.11 Marquage

Les composants de connexion doivent porter au moins les informations suivantes:

- a) le nom du fabricant ou du fournisseur responsable, ou marque commerciale,
- b) le symbole d'identification (photo, numéro de produit, etc.);
- c) la classification, c'est-à-dire classe N ou H.

Lorsque cela n'est pas possible, les marquages b) et c) peuvent être inscrits sur l'étiquette de l'emballage le plus petit ou sur la documentation jointe.

Le marquage doit se maintenir dans le temps et être lisible.

NOTE Le marquage peut être réalisé, par exemple, par moulage, emboutissage, gravure, impression adhésive ou décalcomanies.

La conformité est vérifiée selon 6.6.

6 Essais

6.1 Conditions générales d'essais

Les essais conformes au présent document sont des essais de type (voir 3.11).

- Sauf spécification contraire, les essais sont effectués sur des échantillons assemblés et installés comme en usage normal conformément aux instructions d'installation du fabricant ou du fournisseur, comportant les matériaux et tailles de conducteurs recommandés, ainsi que les couples de serrage recommandés. Si le composant de connexion est adapté à divers matériaux conducteurs, un essai doit être effectué pour chaque combinaison de matériaux.
- Tous les essais sont effectués sur des échantillons neufs.
- Sauf spécification contraire, les essais sont réalisés sur trois échantillons, et les exigences sont satisfaites si tous les essais sont réalisés avec succès.
- Si un seul des échantillons ne satisfait pas à un essai à cause d'un défaut d'assemblage ou de fabrication, cet essai et tout essai préalable qui peut avoir influencé les résultats de l'essai doivent être répétés, et les essais qui suivent doivent être effectués dans l'ordre requis sur un autre lot complet d'échantillons, qui doivent tous satisfaire aux exigences.
- L'essai électrique doit être effectué selon l'ordre donné après l'essai de conditionnement/vieillessement de l'ensemble d'échantillons conformément au 6.3.

Le demandeur, lorsqu'il soumet les jeux d'échantillons, peut aussi soumettre un jeu supplémentaire pouvant être nécessaire si un échantillon ne satisfait pas à l'essai. Le laboratoire d'essais soumettra alors aux essais, sans demande complémentaire, le lot supplémentaire d'échantillons, et ne le refusera que si une nouvelle défaillance se présente. Si le lot supplémentaire d'échantillons n'est pas soumis au même moment, la défaillance d'un échantillon entraînera un refus.

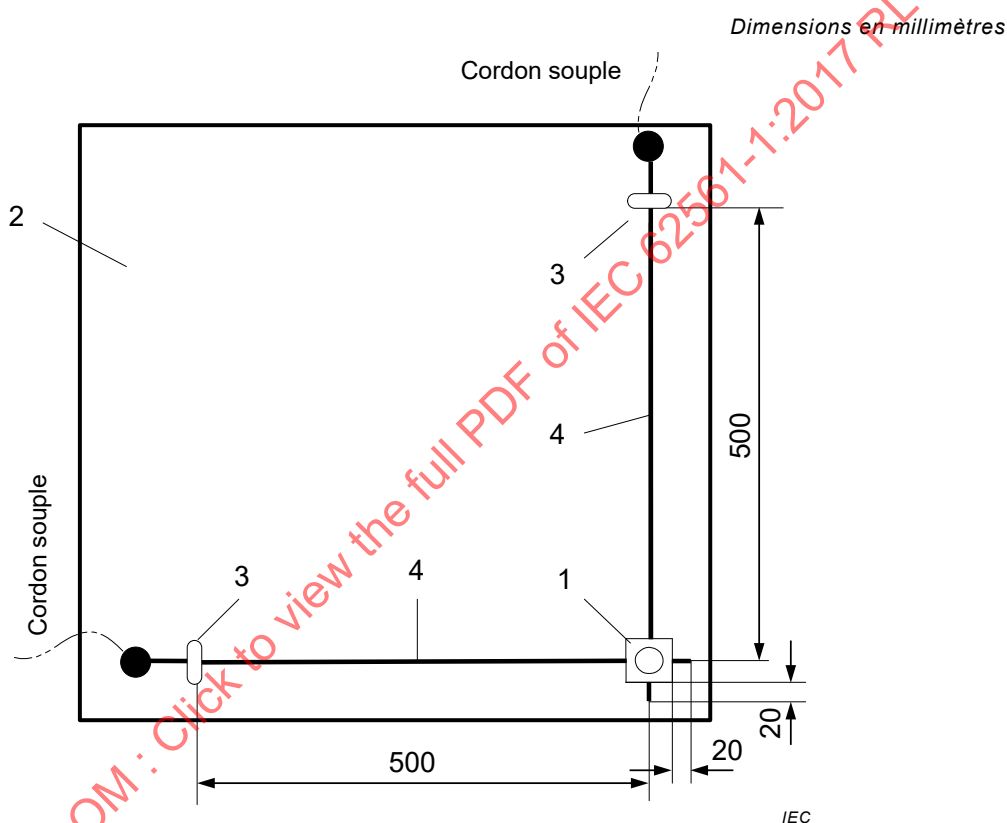
6.2 Préparation de l'échantillon

Sauf spécification contraire du fabricant, les conducteurs et les échantillons doivent être nettoyés en utilisant un dégraissant approprié, puis sont rincés dans une eau déminéralisée et séchés. Ils doivent alors être assemblés conformément aux instructions du fabricant, par exemple avec les conducteurs et les couples de serrage recommandés.

Les composants de connexion doivent être soumis à l'essai dans toutes les configurations de connexion déclarées par le fabricant. Les configurations de connexion typiques pour divers CSPF sont illustrées à l'Annexe B.

Tout domaine recevant les composants de connexion dont la plage de connexion est inférieure ou égale à 2 mm doit être soumis à l'essai sur la taille minimale de conducteur recommandée. Si la plage de connexion est supérieure à 2 mm, elle doit être soumise à l'essai sur la taille minimale et la taille maximale du conducteur recommandées.

Les dispositions de base des échantillons avec des composants à connexion croisée, des composants à connexion parallèle, des composants de pontage et une barre d'équipotentialité sont représentées respectivement dans les Figures 1, 2, 3 et 4. Les bornes des barres d'équipotentialité ne sont soumises à l'essai que si la dimension du raccordement est supérieure ou égale à 16 mm². L'essai est effectué en utilisant la plus petite dimension de conducteur comprise dans la plage de la borne, mais avec un minimum de 16 mm². Des dispositions typiques pour différents CSPF sont représentées à l'Annexe B.



Légende

- 1 Composant à connexion croisée
- 2 Plateau en matériau isolant
- 3 Pièce de fixation rigide
- 4 Conducteur et/ou installation métallique selon l'Annexe C

Figure 1 – Disposition de base des échantillons avec composant à connexion croisée