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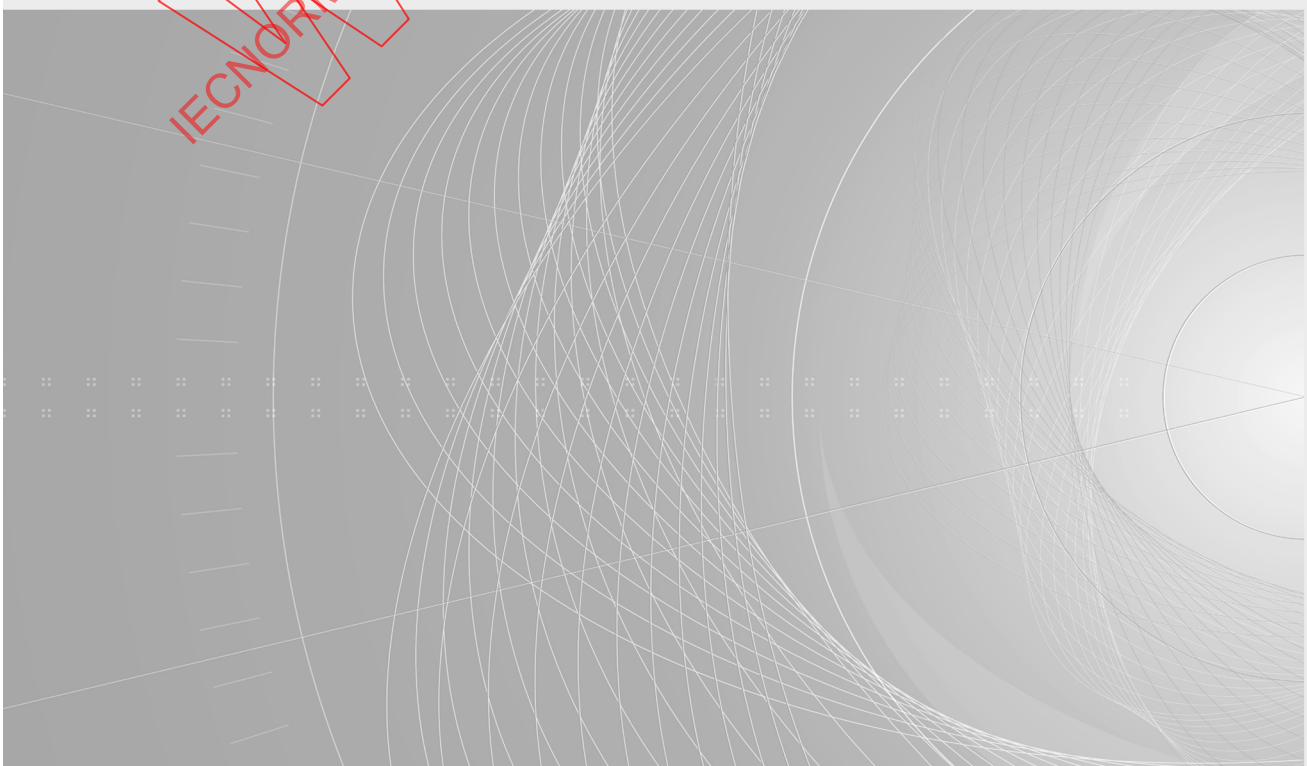
INTERNATIONAL STANDARD

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



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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.

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

FDIS	Report on voting
81/416/FDIS	81/422A/RVD

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

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

The content of this part of IEC 62561 is taken from European Standard EN 50164-1.

A list of all the 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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 of standards.

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, bonding and bridging components, expansion pieces and test joints.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 – Sulfur dioxide test with general condensation of moisture*

3 Terms and definitions

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

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 component includes connectors, clamps, bridging component and expansion piece.

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 this standard 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 carried out, 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.

4 Classification

4.1 Classification of components depends on the withstand lightning current as follows:

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:

a) embedded in concrete;

b) not embedded in concrete.

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 for 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:

– the classification of the component;
– the recommended tightening torque;
– the range of conductor sizes and materials;
– 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 6.3 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 6.4.

5.5 Screwed clamping 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 6.3.

5.6 Dismantling of test joints

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

Compliance is checked in accordance with 6.3.

5.7 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.

5.8 Safe connection

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

Compliance is checked in accordance with 6.3.

5.9 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.

5.10 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.

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 6.5.

6 Tests

6.1 General conditions for tests

The tests in accordance with this standard are type tests.

- 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. The tests which follow shall also 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 6.2.2.

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 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

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 demineralizing water and drying. They shall then be assembled in accordance with the manufacturer's instructions, e.g. with the recommended conductors and tightening torques.

The connection component shall be tested in all the connection configurations declared by the manufacturer 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 mm^2. The test is carried out using the smallest conductor size within the range of the terminal with a minimum of 16 mm^2 conductor. Typical arrangements for various LPSCs are shown in Annex B.

6.2.2 Conditioning/ageing

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.

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

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 as per this clause.

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

6.3 Electrical test

After 6.2.2 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 exponential decaying current in the range of 350 µs according to IEC 62305-1.				

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

a) 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) are of stainless steel, a value of 2,5 mΩ is allowed;

b) 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;

c) for screwed clamping connections 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;

d) 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;

e) 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);

f) the expansion conductor (E, see Figure 5) shall be tested according to IEC 62561-2[1] and shall fulfill the requirements for air termination conductors;

g) for screw-less components, such as compressed connection components, 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 or conductor.

6.4 Static mechanical test

A second set of three new specimens 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 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 or conductor.

[1] To be published.

6.5 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 standard 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 this clause 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 the following information contained in 8.2 to 8.10.

8.2 Report identification

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 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-section 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 caliper 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;

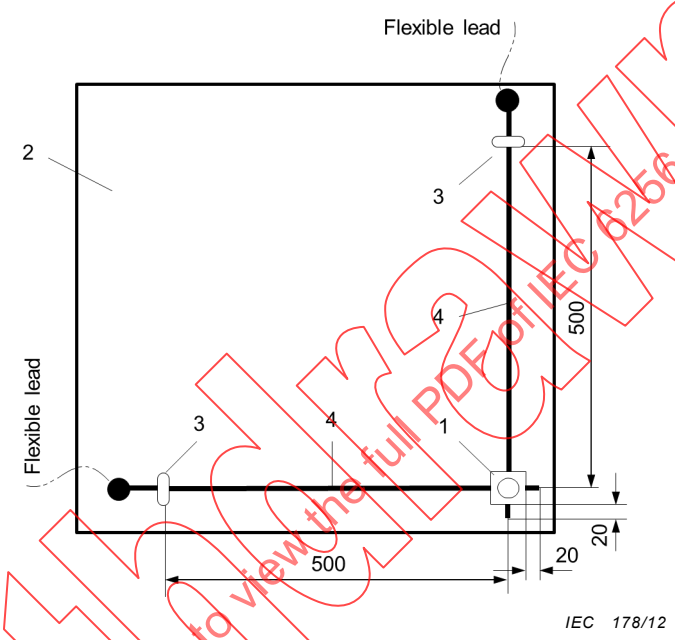
h) loosening torque.

The above shall be presented in 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.

Dimensions in millimetres

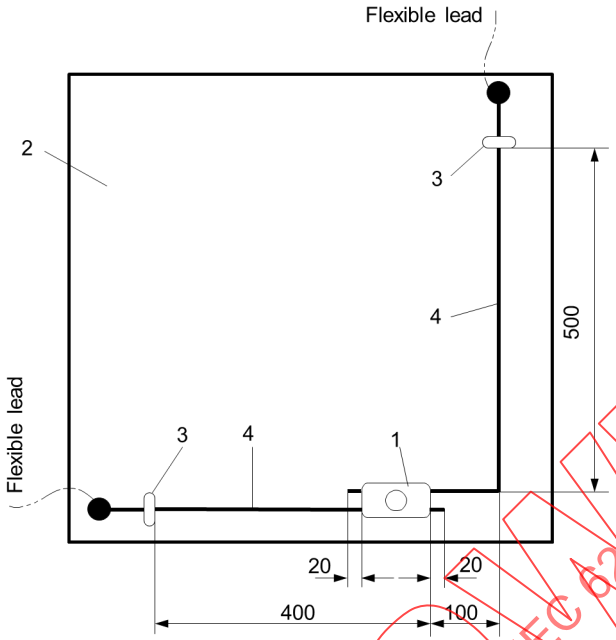


Key

1 cross connection component
2 plate made of insulating material
3 rigid fastener
4 conductor and/or metal installation as per Annex B

Figure 1 – Basic arrangement of specimen with cross connection component

Dimensions in millimetres

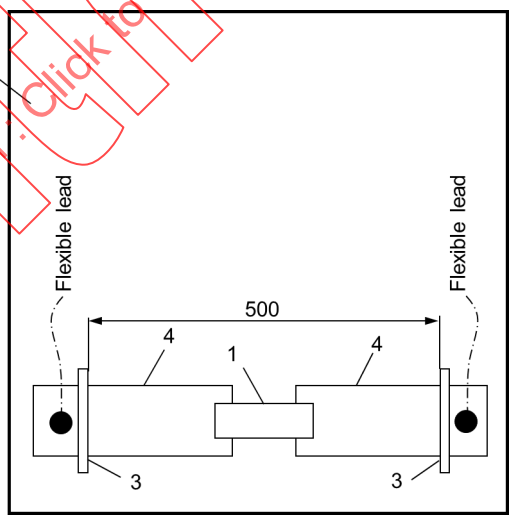


Key

1 parallel connection component
2 plate made of insulating material
3 rigid fastener
4 conductor and/or metal installation as per Annex B

Figure 2 – Basic arrangement of specimen with parallel connection component

Dimensions in millimetres



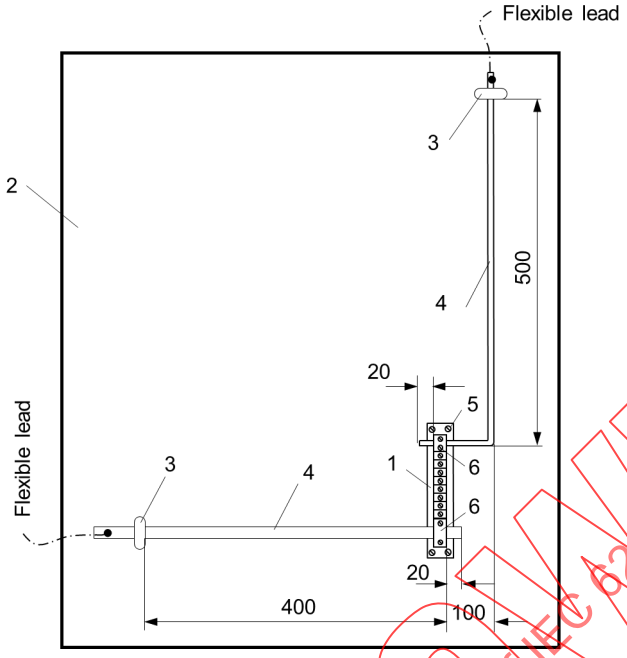
Key

1 bridging component
2 plate made of insulating material
3 rigid fastener
4 metal installation as per Annex B

IEC 180/12

Figure 3 – Basic arrangement of specimen with bridging component

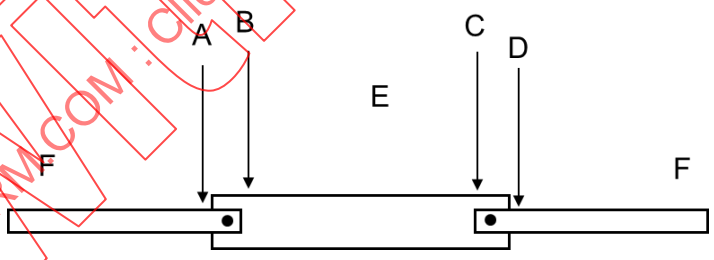
Dimensions in millimetres



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



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

Annex A
(informative)

Summary of the requirements and corresponding tests

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	5.3	6.3
3	Static mechanical test	5.4	6.4
4	Screwed clamping connection	5.5	Inspection and 6.3
5	Dismantling of test joints	5.6	6.3
6	Damage to conductors and metal installation	5.7	Inspection
7	Safe connection	5.8	6.3
8	Marking	5.10	Inspection and 6.5