BRITISH STANDARD

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Lightning Protection Components (LPC) —

Part 4: Requirements for conductor fasteners

ICS 91.120.40

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 50164-4:2008.

The UK participation in its preparation was entrusted to Technical Committee GEL/81, Protection against lightning.

A list of organizations represented on this committee can be obtained on request to its secretary.

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CENELEC

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 81X, Lightning protection.

The text of the draft was submitted to the Unique Acceptance procedure and was approved by CENELEC as EN 50164-4 on 2008-04-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2009-04-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2011-04-01

EN 50164 is a family standard and consists of the following parts under the generic title *"Lightning Protection Components (LPC)":*

Part 1	Requirements for connection components
Part 2	Requirements for conductors and earth electrodes
Part 3	Requirements for isolating spark gaps
Part 4	Requirements for conductor fasteners
Part 5 [1)]	Requirements for earth electrode inspection housings and earth electrode seals
Part 6 [1)]	Requirements for lightning strike counters
Part 7	Requirements for earthing enhancing compounds

[1)] In preparation.

Contents

1 Scope

This European standard specifies requirements and tests for:

– metallic and non-metallic conductor fasteners that are used in conjunction with the air termination system and down conductors;

– fixing of fasteners to the fabric / membrane / gravel roofing of structures is not covered by this standard due to the vast number and types used in modern day construction.

LPC may also be suitable for use in hazardous atmospheres. Regard should then be taken of the extra requirements necessary for the components to be installed in such conditions.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60068-2-52	1996	Environmental testing – Part 2: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution) (IEC 60068-2-52:1996)
EN 62305-3	2006	Protection against lightning – Part 3: Physical damage to structures and life hazard (IEC 62305-3:2006, mod.)
EN ISO 4892-2	2006	Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps (ISO 4892-2:2006)
EN ISO 6988	1994	Metallic and other non-organic coatings – Sulfur dioxide test with general condensation of moisture (ISO 6988:1985)
ISO 4892-4	2004	Plastics – Methods of Exposure to laboratory light sources – Part 4: Open-flame carbon-arc lamps
ISO 6957	1988	Copper alloys – Ammonia test for stress corrosion resistance

3 Definitions

For the purpose of this European Standard, the following definitions apply.

3.1
conductor fastener
a metallic, non-metallic or composite component designed to retain and support the air termination and down conductor, installed at intervals along the length of the conductors

NOTE The conductor fastener may be provided with a means of attachment to a mounting surface.

4 Classification

Conductor fasteners are classified:

4.1 According to the material composition

4.1.1 Metallic (e.g. hot dip galvanized steel, copper, aluminium, stainless steel)

4.1.2 Non-metallic (e.g. PVC, plastics)

4.1.3 Composite (combination of metal and plastic)

4.2 According to fixing arrangement of the conductor within the fastener

4.2.1 With screws

4.2.2 Without screws (e.g. clips, springs)

4.3 According to conductor clamping arrangement

4.3.1 Fasteners that are designed to clamp the conductor

4.3.2 Fasteners that are designed to allow axial movement of the conductor

5 Requirements

5.1 General

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

Conductor fasteners shall be so designed and constructed that safe handling is ensured and that retention and support for the conductor is provided and that in normal use their performance is reliable and without danger to persons and the surrounding.

The material of the conductor fastener shall be compatible with the conductor it is fastening, and the surface material it is fastening on and comply with the tests given in Clause 6.

5.2 Environmental requirements

5.2.1 Corrosion resistance

Metallic or composite fasteners shall withstand corrosion effects.

Compliance is checked following the manufacturer's declaration for the classification of the fastener in accordance with Clause 4 and by test according to 6.3.1 and 6.3.3.

5.2.2 UV resistance

Non-metallic and composite fasteners shall withstand UV effects.

Compliance is checked following the manufacturer's declaration for the classification of the fastener in accordance with Clause 4 and by test according to 6.3.2 and 6.3.3.

5.3 Mechanical strength

5.3.1 Perpendicular and axial loads

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

Compliance is checked following the manufacturer's declaration for the classification of the fastener in accordance with Clause 4 and by test according to 6.4.1 and 6.4.2.

5.3.2 Impact tests

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

Compliance is checked by test according to 6.4.3.

5.4 Installation instructions

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

Compliance is checked by inspection in accordance with 6.5.

5.5 Marking

Each conductor fastener shall be marked with:

– the manufacturer's or responsible vendor's name or logo or trademark;

– the product identification or type.

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

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

Compliance is checked in accordance with 6.6.

6 Tests

6.1 General test conditions

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

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

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

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

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

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

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

Unless otherwise specified, the tests shall be carried out in a room whose ambient temperature ranges between +15 °C and +40 °C.

Unless otherwise specified, the tests shall be carried out in a room whose relative humidity ranges between 25 % and 75 %.

A torque meter shall be used for all tightening operations. It shall have a resolution at least of 0,5 Nm and an accuracy not above ± 4 %.

The applicable tolerance for any applied mechanical load shall be within ± 5 %.

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

6.2 Test preparation

6.2.1 Arrangement of the specimen

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

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

Any fastener accommodating conductors with differences in size equal to or less than 2 mm shall be tested on the minimum conductor size recommended. If the range is greater than 2 mm it shall be tested on the minimum and maximum of conductor size recommended.

If a fastener as recommended by the manufacturer's installation instructions, is classified in more than one classification as per Clause 4, then it shall be tested for each one of those.

When by the manufacturer's installation instructions a fastener is used for fastening conductors made of aluminium and/or copper, tests shall be carried out using aluminium and/or copper conductors selected from Table 2 of EN 50164-2.

For testing purposes all fasteners shall be mounted rigidly as shown in Figures 1, 2, 3 and 4. It is permitted to test more than one arrangement of the specimen in series simultaneously.

6.3 Environmental influence test

In order that a fastener meets the requirements of this standard, environmental tests shall be carried out as per Annex A and/or Annex B. The selection of the test to be performed is defined in 6.3.1, 6.3.2 or 6.3.3 and depends on the fasteners as classified in Clause 4, see flow chart in Annex C.

6.3.1 Metallic

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

The arrangements of specimens shall be subjected to environmental influence tests consisting of a salt mist test as specified in A.1 followed by a humid sulphurous atmosphere test as specified in A.2. An additional test by an ammonia atmosphere shall be carried out for fasteners having parts made of copper alloy with a copper content less than 80 % as specified in A.3.

The specimens are deemed to have passed the tests if the base metal does not exhibit any corrosive deterioration visible to normal or corrected vision.

NOTE White rust is not considered as corrosive deterioration.

6.3.2 Non-metallic

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

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

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

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

6.3.3 Composite

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

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

– test as per 6.3.2 and

– test as per 6.3.1.

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

NOTE 1 Ensure that the surface of the mounting plate is suitable to resist UV radiation.

NOTE 2 White rust is not considered as corrosive deterioration.

6.4 Resistance to mechanical effects

6.4.1 Lateral load test

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

For metallic fasteners, the full test load is applied for period of 5 min to 6 min and for composite and non-metallic fasteners, the full test load is applied for a minimum period of 60 min to 61 min.

All tests are carried out at the temperature of –10 °C (± 1 °C) and repeated at the temperature of +40 °C (± 4 °C).

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

6.4.2 Axial load test

This test is applied only for fasteners classified according to 4.3.1.

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

For metallic fasteners, the full test load is applied for period of 5 min to 6 min and for composite and non-metallic fasteners, the full test load is applied for a minimum period of 60 min to 61 min.

All tests are carried out at the temperature of –10°C (± 1 °C) and repeated at the temperature of +40 °C (± 4 °C).

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

6.4.3 Impact test

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

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

Each arrangement of specimens is mounted on an impact test apparatus according to Clause 4 of EN 60068-2-75:1997 as shown in Figure 4. The impact test apparatus is mounted on a solid wall or structure providing sufficient support.

The arrangement of specimens is placed in a cabinet at a temperature –5 °C. After 2 h, the arrangement is, in turn, removed from the cabinet and immediately placed in position in the impact test apparatus.

At 12 s ± 2 s after the removal of the arrangement from the cabinet the hammer is allowed to fall (2 J, 0,5 kg, 400 mm) so that three impacts are applied as far as possible perpendicular to the length of the arrangement.

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

Instead of placing the arrangements in a cabinet and applying the impact at 12 s ± 2 s after the removal of the sample from the cabinet, it is allowed to apply the impact in a climatic chamber at a temperature of –5 °C (± 1 °C) on samples placed at this temperature at least for 2 h. Compliance in the climatic chamber is sufficient.

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

6.5 Installation instructions

The manufacturer or responsible vendor shall provide in his literature:

- the classifications according to Clause 4,
- the maximum and minimum conductor diameter,
- materials of conductors to be used,
- the type of mounting surface to be fixed,
- the recommended method of assembly, installation and fixing to the mounting surface,
- the lateral load,
- the axial movement load.

Compliance is checked by inspection.

6.6 Marking test

Marking on the product shall be durable and easily legible.

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

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

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

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

6.7 Construction

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

Compliance is checked by visual and manual inspection.

7 Electromagnetic compatibility (EMC)

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

8 Structure and content of the test report

The purpose of this instruction is to provide general requirements for laboratory test reports. This document 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 herein.

The structure of each report shall include at least information according to 8.1 to 8.9.

8.1 Report identification

8.1.1 A title or subject of the report

8.1.2 Name, address and telephone number of the test laboratory

8.1.3 Name, address and telephone number of the sub test laboratory where the test was carried out if different from company which has been assigned to perform the test

8.1.4 Unique identification number (or serial number) of the test report

8.1.5 Name and address of the vendor

8.1.6 Report shall be paginated and the total number of pages indicated on each page including appendices or annexes

8.1.7 Date of issue of report

8.1.8 Date(s) of performance of test(s)

8.1.9 Signature and title, or an equivalent identification of the person(s) authorized to sign for the testing laboratory for the content of the report

8.1.10 Signature and title of person(s) conducting the test

8.1.11 Declaration to avoid misuse

The following declaration shall be included in the test report in order to avoid misuse.

This type test report may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. This type test report only covers the samples submitted for test and does not produce evidence of the quality for series production.

8.2 Specimen description

8.2.1 Sample description

8.2.2 Functional parts and accessories description (e.g. screws, nuts, washers, quantity, material etc)

8.2.3 Manufacturing method (e.g. cast, hot forged, cold deformed, pressing, die casting etc.)

8.2.4 Detailed description and unambiguous identification of the test sample and/or test assembly

8.3 Characterization and condition of the test sample and/or test assembly

8.3.1 Sampling procedure, where relevant

8.3.2 Date of receipt of test samples

8.3.3 Photographs, drawings or any other visual documentation, if available

8.4 Conductor

8.4.1 Conductor material

8.4.2 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

8.5.1 Identification of the test standard used and the date of issue of the standard

8.5.2 Reference to this standard may only be made if the full set of tests is performed and reported except where the deviations are clearly justified in 8.6.2

8.5.3 Other relevant documentation with the documentation date

8.6 Test procedure

8.6.1 Description of the test procedure

8.6.2 Justification for any deviations from, additions to or exclusions from the referenced standard

8.6.3 Any other information relevant to a specific test such as environmental conditions

8.6.4 Configuration of testing assembly

8.6.5 Location of the arrangement in the testing area and measuring techniques

8.7 Testing equipment, description

8.7.1 Description of equipment used for every test conducted i.e. generator, conditioning/ageing device

8.8 Measuring instruments description

8.8.1 Characteristics and calibration date of all instruments used for measuring the values specified in the standard i.e. shunts, oscilloscope, ohmmeter, torque meter

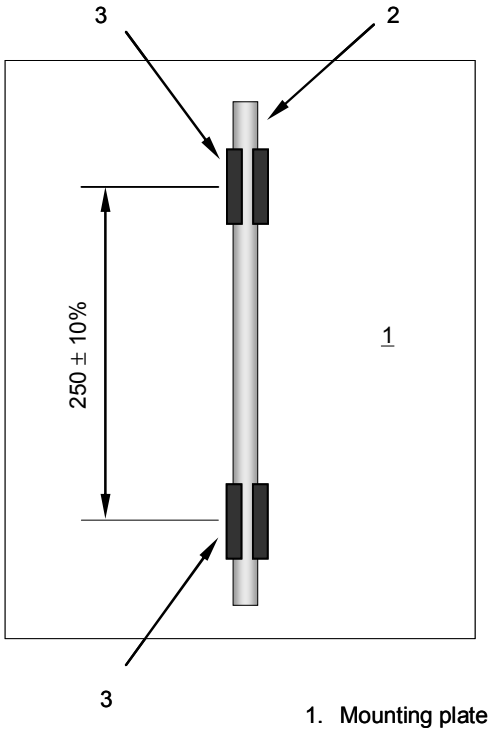
8.9 Results and parameters recorded

8.9.1 The required passing criteria for each test, defined by the standard

8.9.2 The relevant observed or derived results of the tests

8.9.3 All results shall be presented by tables, graphs, drawings, photographs or other documentation of visual observations as appropriate

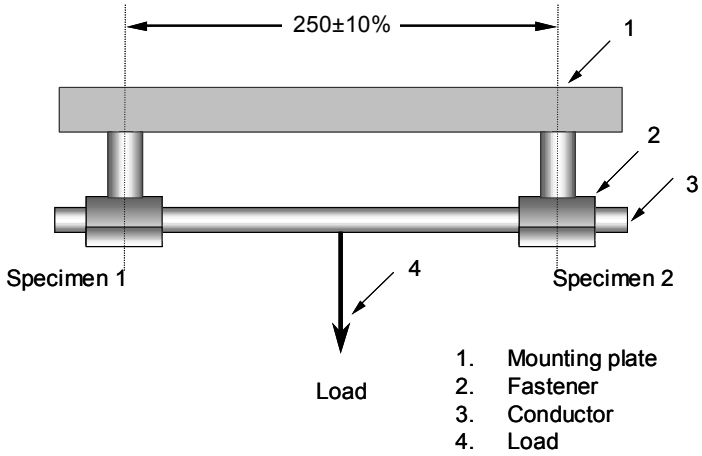
8.9.4 A statement of pass/fail identifying the part of the test for which the specimen has failed and also a description of the failure



1. Mounting plate
2. Conductor
3. Fastener

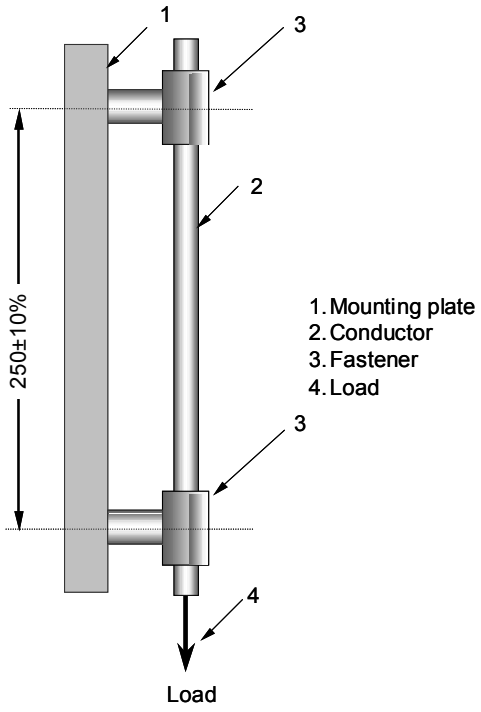
Dimensions in mm

Figure 1 – Basic arrangement of specimens



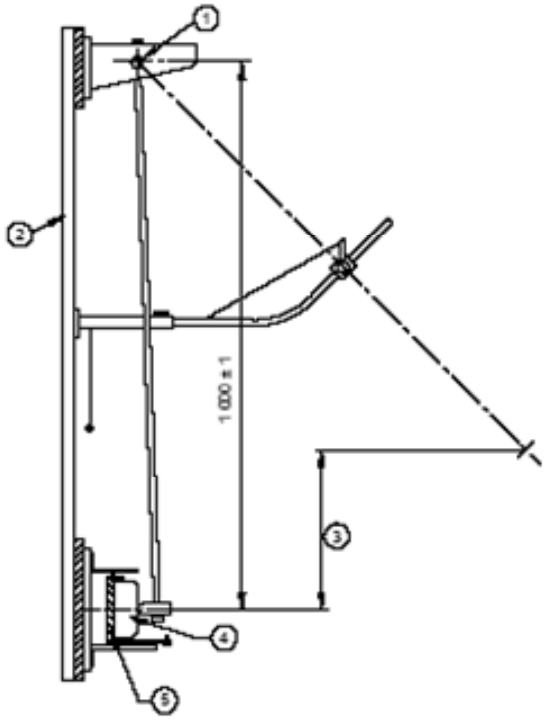
Dimensions in mm

Figure 2 – Basic arrangement of lateral load test



Dimensions in mm

Figure 3 – Typical arrangement for axial movement test



Key

1. Pendulum
2. Frame
3. Height of fall
4. Specimen
5. Mounting fixture

Figure 4 – Impact test apparatus

Annex A
(normative)

Environmental test for metallic fasteners

The test consists of a salt mist test according to A.1 followed by a humid sulphurous atmosphere test according to A.2. An additional ammonia atmosphere test according to A.3 for specimens made of copper alloy with a copper content less than 80 %.

A.1 Salt mist test

Salt mist treatment according to EN 60068-2-52:1996 except for Clauses 7, 10 and 11 which are not applicable.

The test is carried out using severity (2).

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

A.2 Humid sulphurous atmosphere test

Humid sulphurous atmosphere treatment according to EN ISO 6988:1994 with seven cycles with a concentration of sulphur dioxide of (667 ± 25) ppm (in volume) 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 °C ± 3 °C in the humid saturated atmosphere which is followed by a rest period of 16 h. After that, the humid sulphurous atmosphere is replaced.

NOTE If the test chamber maintains the temperature conditions as specified in 6.5.2 of EN ISO 6988:1995 then the specimen may remain in it for the rest period.

A.3 Ammonia atmosphere test

Ammonia atmosphere treatment according to ISO 6957:1988 for a moderate atmosphere with the pH value 10 except for 8.4 and Clause 9 which are not applicable.

Annex B
(normative)

Environmental test for non-metallic conductor fasteners - Resistance to ultraviolet light

For non-metallic fasteners a set of samples shall be subjected to ultraviolet light conditioning according to B.1 or B.2. All sets tested are considered representative of the material's entire colour range.

Samples shall be mounted on the inside of the cylinder in the ultraviolet light apparatus so that the samples do not touch each other and shall be positioned in such a way that the fixation surface for rod is perpendicular to the light source.

B.1 Passing criteria

After the test there shall be no sign of disintegration nor shall there be any crack visible to normal or corrected vision.

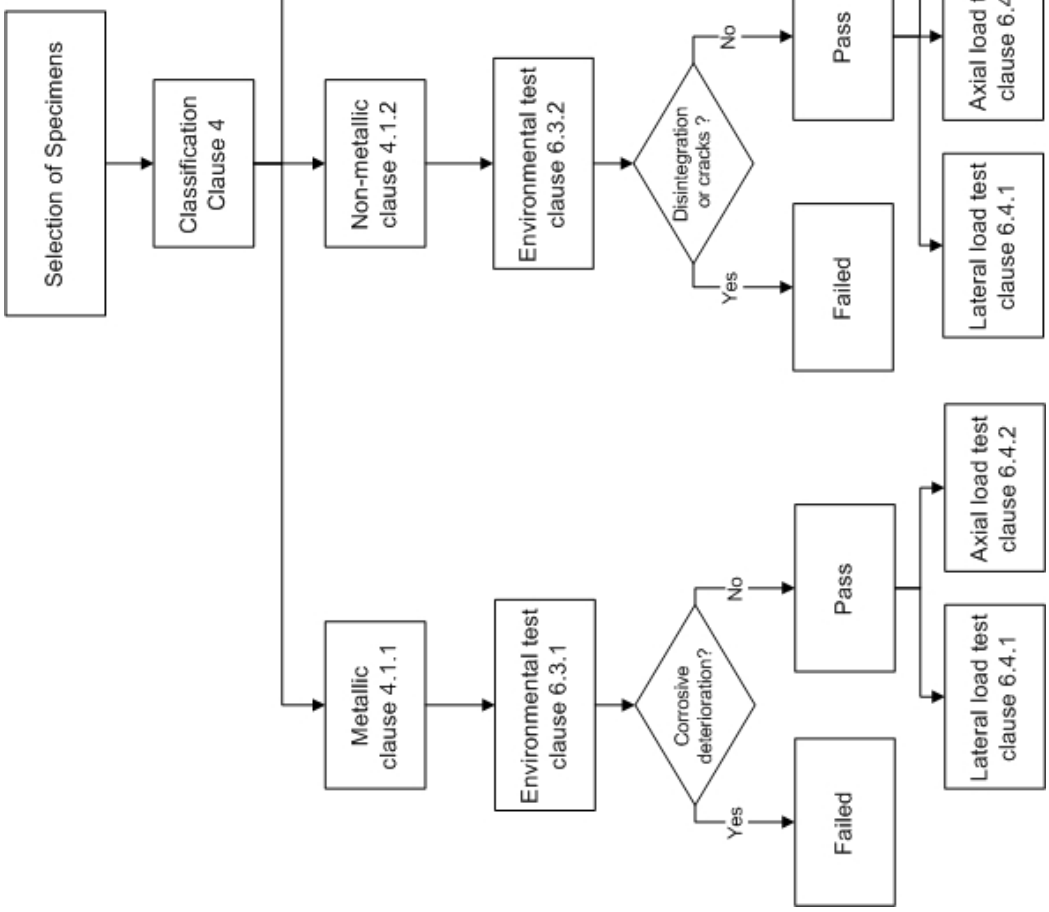
B.1.1 The specimens are to be exposed for (1 000 ± 1) h to Xenon-arc, Method A, in accordance with EN ISO 4892-2. Continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of (120 ± 1) % min consisting of a (102 ± 1) % min light exposure and a (18 ± 1) min exposure to water spray with light, shall be used. The apparatus shall operate with a water-cooled xenon-arc lamp, borosilicate glass inner and outer optical filters, a spectral irradiance of 0,35 W/m^2/nm at 340 nm and a black panel temperature of (65 ± 3) °C. The temperature of the chamber shall be (45 ± 5) °C. The relative humidity in the chamber shall be (50 ± 5) %.

B.2 Alternative test to B.1

B.2.2 The specimens are to be exposed for (720 ± 1) h to open-flame sunshine carbon-arc, in accordance with ISO 4892-4. Continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of (120 ± 1) min consisting of a (102 ± 1) min light exposure and an 18 min exposure to water spray with light, shall be used. The apparatus shall operate with an open-flame sunshine carbon-arc lamp, borosilicate glass Type 1 inner and outer optical filters, a spectral irradiance of 0,35 W/m^2/nm at 340 nm and a black panel temperature of (63 ± 3) °C. The temperature of the chamber shall be (45 ± 5) °C. The relative humidity in the chamber shall be (50 ± 5) %.

Annex C
(normative)

Flow chart of tests



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EN 62305-1:2006, Protection against lightning – Part 1: General Principles (IEC 62305-1:2006)

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