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INTERNATIONAL STANDARD

Lightning protection system components (LPSC) – Part 3: Requirements for isolating spark gaps (ISG)

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IEC Central Office
3, rue de Varembé
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
ELECTROTECHNICAL
COMMISSION

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CONTENTS

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LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 3: Requirements for isolating spark gaps (ISG)

FOREWORD

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International Standard IEC 62561-3 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) a new classification has been added related to ISGs location installation;
b) an updated flow chart of tests has been developed.

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

FDIS	Report on voting
81/561/FDIS	81/566/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- withdrawn,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.

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), specifically isolating spark gaps (ISG) used for the installation of a lightning protection system (LPS) designed and implemented according to the IEC 62305 series.

LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 3: Requirements for isolating spark gaps (ISG)

1 Scope

This part of IEC 62561 specifies the requirements and tests for isolating spark gaps (ISG) for lightning protection systems.

ISGs can be used to indirectly bond a lightning protection system to other nearby metalwork where a direct bond is not permissible for functional reasons.

Typical applications include the connection to

- earth-termination systems of power installations,
- earth-termination systems of telecommunication systems,
- auxiliary earth electrodes of voltage-operated, earth fault circuit breakers,
- rail earth electrode of power and DC railways,
- measuring earth electrodes for laboratories,
- installations with cathodic protection and stray current systems,
- service entry masts for low-voltage overhead cables,
- bypassing insulated flanges and insulated couplings of pipelines.

This does not cover applications where follow currents occur.

NOTE Lightning protection system components (LPSC) can also be suitable for use in hazardous conditions such as fire and explosive atmosphere. Due regard will be taken of the extra requirements necessary for the components to be installed in such conditions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-52:1996, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*[1]

IEC 60068-2-75:1997, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*[2]

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1 2nd edition (1996). A 3rd edition IEC 60068-2-52: *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)* is under preparation. Stage at the time of publication: IEC PRVC 60068-2-52:2017.

2 1st edition (1997). This 1st edition was replaced in 2014 by a 2nd edition IEC 60068-2-75:2014, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests.*

ISO 4892-2:2006, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*[3]

IEC 62561-1, *Lightning protection system components (LPSC) – Part 1: Requirements for connection components*

ISO 4892-3:2006, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*[4]

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

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

ISO 6988:1985, *Metallic and other non-organic coatings – 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
isolating spark gap
ISG
component with discharge distance for isolating electrically conductive installation sections

Note 1 to entry: In the event of a lightning strike, the isolated sections are temporarily connected conductively as the result of response to the discharge.

3.2
sparkover voltage
maximum voltage value before disruptive discharge between the electrodes of the ISG

3.3
withstand voltage
value of the test voltage to be applied under specified conditions in a withstand test, during which a specified number of disruptive discharges is tolerated

3.4
power frequency withstand voltage
r.m.s value of a sinusoidal power frequency voltage that the ISG can withstand

3.5
DC withstand voltage
value of a DC voltage that the ISG can withstand

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3 2nd edition (2006). This 2nd edition was replaced in 2013 by a 3rd edition ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps.*

4 2nd edition (2006). This 2nd edition was replaced in 2016 by a 3rd edition: ISO 4892-3: 2016, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*.

3.6
rated withstand voltage
value of a withstand voltage declared by the manufacturer to characterize the isolating behavior of an ISG

3.7
rated power frequency withstand voltage
$U_{W\ AC}$
value of a power frequency withstand voltage declared by the manufacturer to characterize the isolating behavior of an ISG

3.8
rated DC withstand voltage
$U_{W\ DC}$
value of a DC withstand voltage declared by the manufacturer to characterize the isolating behavior of an ISG

3.9
impulse sparkover voltage
impulse voltage of the waveshape 1,2/50 to classify the sparkover behavior of the ISG

3.10
rated impulse sparkover voltage
U_{imp}
manufacturer's declaration of the ISG sparkover voltage

3.11
isolation resistance
ohmic resistance of the ISG between the active parts

3.12
lightning impulse current
I_{imp}
impulse current that classifies an ISG

Note 1 to entry: Five parameters are to be considered: the peak value, the charge, the duration, the specific energy and the rate of rise of the impulse current.

4 Classification

4.1 According to ISGs capability to withstand lightning current

The following classes apply, as per Table 1:

a) class H for heavy duty;
b) class N for normal duty;
c) class 1L for light duty;
d) class 2L for light duty;
e) class 3L for light duty.

4.2 According to ISGs location installation

The following classes apply:

a) indoor installation;
b) outdoor installation.

5 Requirements

5.1 General

ISGs 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.

5.2 Environmental requirements

ISGs shall be designed in such way that they operate satisfactorily under the environmental conditions given by the normal service conditions. Outdoor ISGs shall be contained in a weather shield of glass-glazed ceramic, or other acceptable material, that is resistant to UV (ultraviolet) light, corrosion and erosion.

Compliance is checked by testing. In accordance with 6.2 and 6.3.

5.3 Installation instructions

The manufacturer of the ISG shall provide adequate instructions in their literature to ensure that the installer of the ISG can select and install them in a suitable and safe manner.

Compliance is checked by review as per 6.6.

5.4 Lightning current carrying capability

ISGs shall have sufficient lightning current carrying capability.

Compliance is checked in accordance with Clause 6 following the manufacturer's declaration for the class of the ISG in accordance with Clause 4.

5.5 Rated impulse sparkover voltage

The ISG shall always spark over at this value during the tests.

The ISG may experience some variation of sparkover characteristics before and after the lightning current test. This shall be included in the rated impulse sparkover voltage defined by the manufacturer.

5.6 Rated withstand voltage

5.6.1 Rated DC withstand voltage

The ISG shall never spark over at this value during the tests even after performing the lightning current test.

5.6.2 Rated power frequency withstand voltage

The ISG shall never spark over at this value during the tests even after performing the lightning current test.

5.7 Isolation resistance

Before the lightning current test the isolation resistance shall be higher than 500 kΩ and after the lightning current test isolation resistance shall not be lower than 500 kΩ.

Compliance is checked in accordance with 6.5.1.

5.8 Marking

All products complying with this document shall be marked at least with the following:

a) manufacturer’s or responsible vendor’s name or trade mark or identifying symbol;

b) part number;

c) the classification in accordance with Clause 4.

If the marking in accordance with b) is not practical it may be given on the smallest packaging unit. The marking shall be durable and legible.

Compliance is checked in accordance with 6.7.

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

5.9 UV (ultraviolet) resistance

ISG housings for outdoor installation shall be made of UV resistant material.

Compliance is checked by tests as per 6.2.

6 Tests

6.1 General conditions for tests

The tests in accordance with this document are type tests and performed in a sequence according to Annex A.

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

a) 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.

b) Unless otherwise specified, three specimens are subjected to the tests and the requirements are satisfied if all the tests are met.

c) 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.

d) If the ISG has an integral connection component part with its design, it shall be subjected to the testing regime of IEC 62561-1 using the appropriate lightning current given in Table 1 of this document.

The applicant, when submitting a set of specimens, may also submit an additional set of specimens which may be necessary should one specimen fail. The testing laboratory will then, without further request, test the additional set of specimens and will reject the sets 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.

Prior to the testing of the ISG and clamp assembly, suitable protection measures should be employed to ensure that the housing is not exposed to the conditioning treatment.

6.2 UV (ultraviolet) light test

This test is necessary for ISGs designed to be installed outdoors or in specific environments.

ISG housings for outdoor application shall withstand UV light effects.

One set of three new specimens shall be assembled and mounted rigidly on an insulating plate (e.g. brick, polytetrafluoroethylene (PTFE)) in accordance with the manufacturer's installation instructions.

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

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

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

6.3 Resistance tests to corrosion

This test is necessary for ISGs having metallic parts designed to be installed outdoors or in specific environments.

The specimens used in and complying with the test in 6.2, shall be subjected to corrosion tests as per Annex B.

After the parts have been dried during 10 min in a drying oven at a temperature of 100 ºC ± 5 ºC, they shall not present any trace of rust on surfaces.

Traces of rust on the edges or a yellowish stain removed by rubbing are not taken into account. White rust, patina and other surface oxidations are not considered as corrosive deterioration.

6.4 Mechanical tests

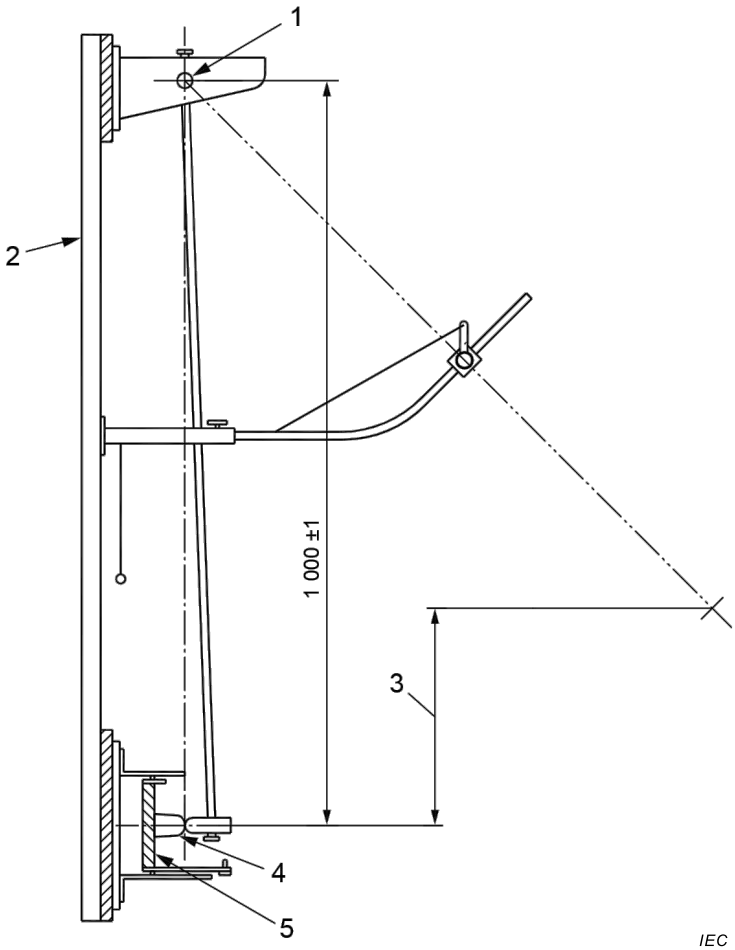
All specimens complying with 6.2 and 6.3 shall be stressed three times by mechanical impacts.

The impacts are carried out on the accessible parts of the ISG, which may be mechanically stressed accidentally.

The specimens are assembled under their normal operating conditions specified in the manufacturer's documentation.

The ISG is mounted on a pendulum hammer test apparatus according to IEC 60068-2-75:1997, Clause 4, as shown in Figure 1. The striking element material shall be polyamide as per IEC 60068-2-75:1997, Table 1, and its mass shall be 200 g as per IEC 60068-2-75:1997, Table 2.

Dimensions in millimetres



Key

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

Figure 1 – Pendulum hammer test apparatus

The hammer shall fall from a height of 200 mm so that one impact on each side is applied, as far as possible perpendicular to the length of the arrangement. The drop height is the vertical distance between the position of the point of control, when the pendulum is released, and the position of this point at the time of the impact.

The point of control is located on the surface of the striking part where the line passing through the point of intersection of the axes of the steel tube of the pendulum and the part of striking, perpendicular to the plane crossing the two axes, comes into contact with the surface.

The impacts are not applied to the connectors.

NOTE In theory, the centre of gravity of the striking part should be the point of control. As, in practice, it is difficult to determine the centre of gravity, the point of control has been chosen as described above.

After the test, the ISG shall show no cracks or similar damage visible to normal or corrected vision without magnification and shall not present damage which can potentially affect its later use.

6.5 Electrical tests

6.5.1 Isolation resistance

The test is conducted with a DC voltage of 0,5 times the rated withstand voltage up to a maximum of 500 V.

The resistance shall be measured after 30 s of applying the test voltage.

The specimen is deemed to have passed the test if the resistance is equal or greater than 500 kΩ.

6.5.2 Withstand voltage

6.5.2.1 General

The rated withstand voltages shall be tested according to the value declared by the manufacturer in accordance with 5.3.

6.5.2.2 Power frequency withstand voltage

6.5.2.2.1 General conditions for tests

The rated power frequency withstand voltage is tested by applying an AC voltage at the terminals of the ISG. The voltage is increased continuously at a rate of 100 V/s with a nominal frequency of 50 Hz or 60 Hz until the r.m.s. value as declared by the manufacturer is reached and this is maintained for a time of 60 s ± 1 s.

The prospective short-circuit current of the source may be limited to a minimum value of 5 mA.

6.5.2.2.2 Acceptance criteria

The specimens are deemed to have passed the test if during the application of the test voltage the ISG does not spark over, or conduct a leakage current exceeding 1 mA.

6.5.2.3 DC withstand voltage

6.5.2.3.1 General conditions for tests

The rated DC withstand voltage shall be tested by applying a DC voltage at the terminals of the ISG. The voltage shall be increased continuously at a rate of 100 V/s until the value as declared by the manufacturer is reached and this is maintained for a time of 60 s ± 1 s.

The prospective short circuit current of the source may be limited to a minimum value of 5 mA.

6.5.2.3.2 Acceptance criteria

The specimens are deemed to have passed the test if during the application of the test voltage the ISG does not spark over, or conduct a leakage current exceeding 1 mA.

6.5.3 Rated impulse sparkover voltage

6.5.3.1 General conditions for tests

An impulse voltage 1,2/50 µs with a peak value of the declared impulse sparkover voltage shall be applied at the terminals of the ISG. The test is performed with five surges of positive and negative polarity and the ISG has to spark over at each test impulse.

6.5.3.2 Acceptance criteria

The specimens are deemed to have passed the test if they have operated at each test impulse and no signs of cracks or punctures appear on the enclosures.

6.5.4 Lightning current

6.5.4.1 General conditions for tests

After 6.5.3 and the conditioning according to Annex B, the specimens shall be pre-stressed with a test current of 0,5 I_{imp}, followed by a second test current of I_{imp} after the ISG has cooled down close to ambient temperature.

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

All the parameters are given in Table 1.

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

ISG classification	I_{imp} kA ± 10 %	Q As $^{+20}_{-10}$ %	W/R kJ/Ω $^{+45}_{-10}$ %
H	100	50	2 500
N	50	25	625
1L	25	12,5	156
2L	10	5	25
3L	5	2.5	6,25

[a] The parameters are derived from the 3rd edition of IEC 62305-1 which is under preparation.

NOTE When a lightning current flows in an arc, a shock wave is produced. The severity of the shock is dependent upon the peak current and the rate of rise of the current. The shorter the rise time, the greater the severity. In general, the acoustic shock wave can cause damage to the surrounding components, such as the enclosure of the ISG.

6.5.4.2 Acceptance criteria

The specimens are deemed to have passed the test if no signs of cracks or punctures appear on the enclosures.

After the current test, the tests according to 6.5.1, 6.5.2 and 6.5.3 shall be carried out.

6.6 Installation instructions

6.6.1 General conditions for tests

The content of the installation instructions is checked as per its completeness by review.

6.6.2 Acceptance criteria

Installation instructions are deemed to have passed the test if they contain at least the following:

a) classification and lightning current capability (I_{imp});
b) rated withstand voltage;
c) rated power frequency withstand voltage ($U_{W\ AC}$);
d) rated DC withstand voltage ($U_{W\ DC}$);
e) assembly instructions with installation location (if crucial to the function);
f) appropriate connection components for the installation if not part of the ISG.

6.7 Marking test

6.7.1 General conditions for tests

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.

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

6.7.2 Acceptance criteria

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

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

The structure of each report shall include at least information specified in 8.2 to 8.9.

8.2 Report identification

The following information shall be included[5]:

a) A title or subject of the report.

b) Name and email address or telephone number of the testing laboratory.

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

d) Unique identification number (or serial number) of the test report.

e) Name and address of the vendor.

f) Report shall be paginated and the total number of pages indicated on each page, including appendices or annexes.

g) Date of issue of the report.

h) Date(s) test(s) was (were) performed.

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

j) Signature and title of person(s) conducting the test(s).

8.3 Specimen description

a) Sample description.

b) Detailed description and unambiguous identification of the test sample and/or test assembly, for example part number, type, classification, material, dimensions.

c) Characterization and condition of the test sample and/or test assembly.

d) Sampling procedure, where relevant.

e) Date of receipt of test samples.

f) Photographs, drawings or any other visual documentation, if available.

8.4 Standards and references

a) Identification of the test standard used and the date of issue of the standard.

b) Reference to this document may only be made if the full set of tests is performed and reported, except where the deviations are clearly justified in 8.5 b).

c) Other relevant documentation with the documentation date.

8.5 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 and measuring set up.

e) Location of the arrangement in the testing area and measuring techniques.

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

8.6 Testing equipment description

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

8.7 Measuring instruments description

Characteristics and calibration dates of all instruments used for measuring the values specified in this document, for example shunts, oscilloscopes, ohmmeters, torque meters.

8.8 Results and parameters recorded

a) The required passing criteria for each test, defined in the standard.

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

- isolation resistance,
- withstand voltage (power frequency withstand voltage, DC withstand voltage),
- rated spark over voltage,
- lightning current carrying capability (current, charge, specific energy, duration),
- connection component test results as per 6.1 d) (ohmic resistance, tightening and loosening torques),
- marking,
- statement of UV resistance.

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

8.9 Statement of pass/fail

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

Annex A
(normative)

Flow chart of tests

A flow chart of tests of ISGs is shown in Figure A.1. An ISG with an integral connection component part and its design shall be subjected to the testing regime of IEC 62561-1 using the appropriate lightning current given in Table 1.

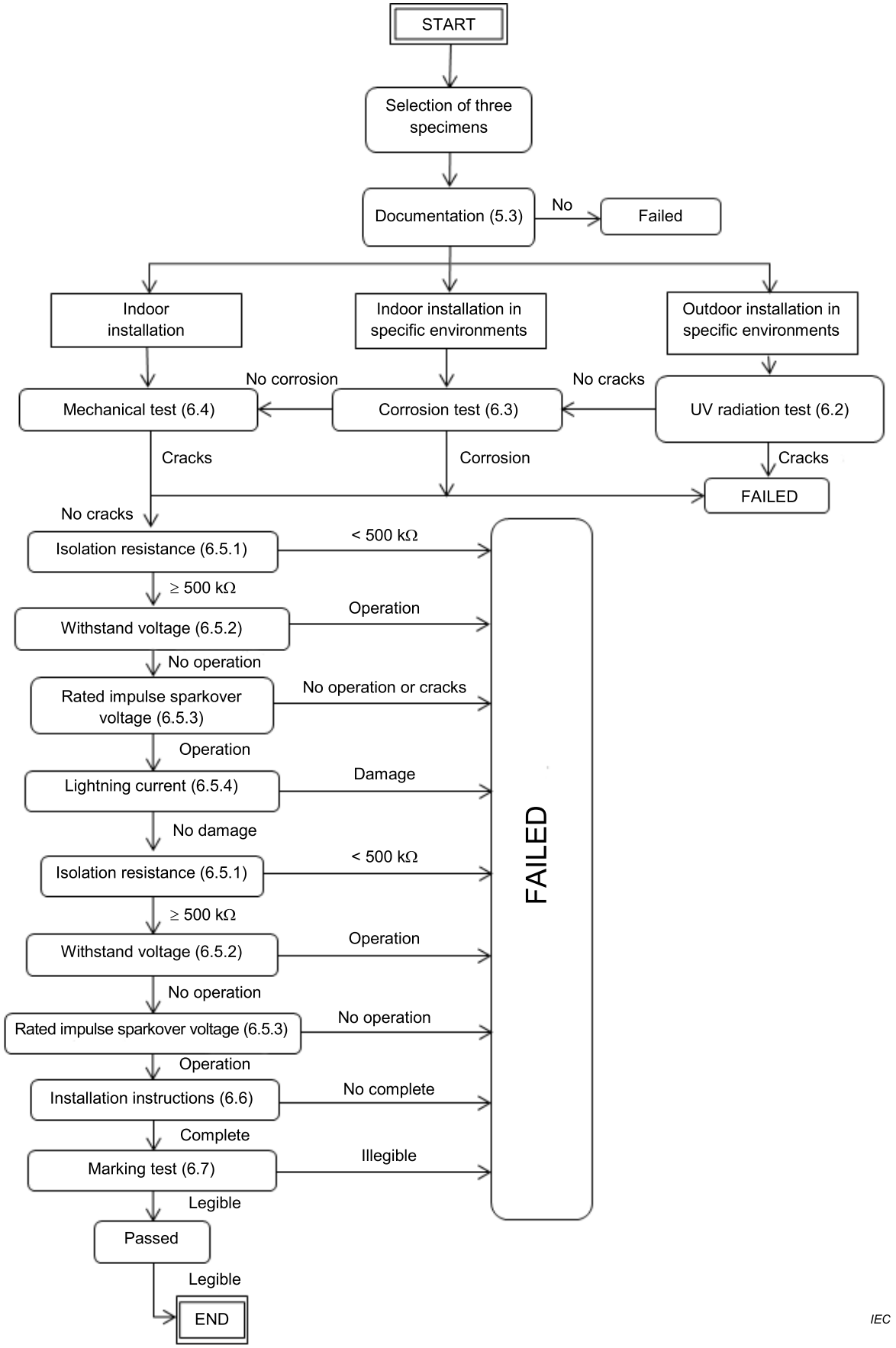

Figure A.1 – Flow chart of the sequence of tests for ISGs

Annex B
(normative)

Environmental test for isolating spark gaps

B.1 General

The conditioning ageing test consists of a salt mist treatment as specified in Clause B.2, followed by a humid sulphurous atmosphere treatment as specified in Clause B.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 B.4.

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

B.2 Salt mist treatment

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

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

B.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 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.

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

B.4 Ammonia atmosphere treatment

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

Annex C
(normative)

Environmental test for outdoor isolating spark gaps – Resistance to ultraviolet light

C.1 General

A set of samples shall be subjected to ultraviolet light conditioning specified in Clauses C.2, C.3, or C.4. 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 their surface is exposed perpendicularly to the light source.

C.2 The tests

The specimens shall be exposed for (1 000 ± 1) h to an xenon-arc, Method A, in accordance with ISO 4892-2:2006. 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 $W \times m^{-2} \times nm^{-1}$ 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) %.

C.3 First alternative test to C.2

The specimens shall 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 $W \times m^{-2} \times nm^{-1}$ at 340 nm and a black panel temperature of (63 ± 3) °C. The temperature of the chamber shall be (45 ± 5) °C with a relative humidity of (50 ± 5) %.

C.4 Second alternative test to C.2

The specimens shall be exposed for total irradiation energy equal to the values given in Clause C.2, to fluorescent UV light in accordance with ISO 4892-3:2006. The exposure conditions shall be by continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of (360 ± 1) min light exposure and (60 ± 1) min exposure to water spray with light as described in ISO 4892-3.2006, Table 4, Method A, cycle 3.

Bibliography

[1] IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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

[3] IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

[4] IEC 61643-11, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

[5] IEC 62305-1, *Protection against lightning – Part 1: General principles*

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

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