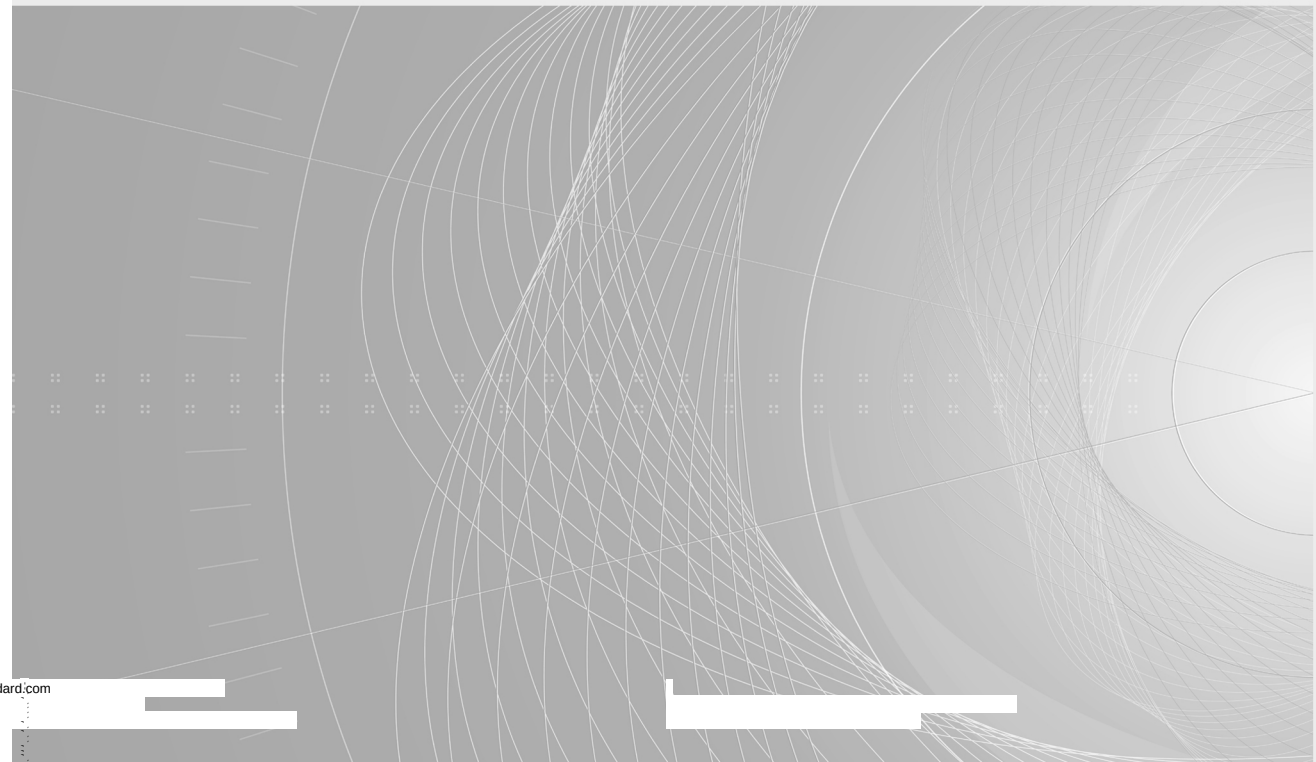
IEC 62561-3

Edition 1.0 2012-02

INTERNATIONAL STANDARD

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



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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,…).
It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 62561-3

Edition 1.0 2012-02

INTERNATIONAL STANDARD

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE R

ICS 29.020; 91.120.40

ISBN 978-2-88912-923-2

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 3: Requirements for isolating spark gaps (ISG)

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62561-3 has been prepared by IEC technical committee: Lightning protection.

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

FDIS	Report on voting
81/418/FDIS	81/424A/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 the European Standard EN 50164-3.

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

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 AC 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 standard 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, 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 61643-11, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

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

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

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

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 installation sections are temporarily connected conductively as the result of the response of 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 during tests made under specified conditions and for a specified time

3.5
DC withstand voltage
value of a DC voltage that the ISG can withstand during tests made under specified conditions and for a specified time

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

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

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

3.10
rated impulse sparkover voltage
$U_{r\ imp}$
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

According to the ISG's capability to withstand lightning current, as per Table 1, the following classes apply:

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.

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 for 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. Outdoors ISG shall be contained in a weather shield of glass-glazed ceramic, or other acceptable material, that is resistant to UV radiation, corrosion and erosion.

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.

These instructions shall contain at least the following information:

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

Compliance is checked by inspection.

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 AC 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 100 MΩ and after the lightning current test, isolation resistance shall not be lower than 500 kΩ.

Compliance is checked in accordance with 6.2.1.

5.8 Marking

The ISG shall be marked at least with the following:

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

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 6.3.

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

5.9 UV resistance

ISG housings shall be made of UV resistant material specified by the material's supplier.

Compliance is checked by inspection of the documentation.

6 Tests

6.1 General conditions for tests

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

- 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.
- 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 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.
- 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 standard.

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 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.

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 Electrical test

6.2.1 Isolation resistance

The test is conducted with a d.c. 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 100 MΩ.

6.2.2 Withstand voltage

6.2.2.1 General

The rated withstand voltage shall be tested according to the value declared by the manufacturer in accordance with 3.6.

6.2.2.2 Power frequency withstand voltage

6.2.2.2.1 General conditions for tests

The rated power frequency withstand voltage is tested by applying an a.c. 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. During the application of the test voltage the ISG shall not spark over, or conduct a leakage current exceeding 1 mA.

6.2.2.2.2 Acceptance criteria

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

6.2.2.3 DC withstand voltage

6.2.2.3.1 General conditions for tests

The rated d.c. withstand voltage shall be tested by applying a d.c. 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. During the application of the test voltage the ISG shall not spark over, or conduct a leakage current exceeding 1 mA.

6.2.2.3.2 Acceptance criteria

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

6.2.3 Rated impulse sparkover voltage

6.2.3.1 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.

6.2.3.2 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.

6.2.4 Lightning current

6.2.4.1 General conditions for tests

After 6.2.3 and the conditioning according to Annex A, 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%	*W/R* kJ/Ω ± 35 %
H	100	2 500
N	50	625
1L	25	156
2L	10	25
3L	5	6,25

[a] The parameters are derived from IEC 62305-1 and IEC 61643-11.

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.

6.2.4.2 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 6.2.5, 6.2.6 and 6.2.7 shall be carried out.

6.2.5 Isolation resistance

The isolation resistance shall be tested and recorded in accordance with 6.2.1. The specimens are deemed to have passed the test if the values are equal or greater than 500 kΩ.

6.2.6 Withstand voltage

Repeat the test per 6.2.2.

6.2.7 Rated impulse sparkover voltage

Repeat the test per 6.2.3.

6.3 Marking test

6.3.1 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.

6.3.2 Acceptance criteria

After the test the marking shall be 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 according to 8.2 to 8.9.

8.2 Report identification

a) A title or subject of the report.

b) Name, address and telephone number of the test laboratory.

c) 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.

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 the 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 identification.

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

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.

8.4 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.

8.5 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.

8.6 Testing equipment description

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

8.7 Measuring instruments description

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

8.8 Results and parameters recorded

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

a) isolation resistance;

b) withstand voltage (power frequency withstand voltage, DC withstand voltage);

c) rated sparkover voltage;

d) lightning current carrying capability (current, charge, specific energy, duration);

e) connection component test results (ohmic resistance, tightening and loosening torques);

f) marking;

g) statement of UV resistance.

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

8.9 Statement of pass/fail

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

Annex A
(normative)

Environmental test for isolating spark gaps

A.1 General

The test consists of a salt mist test according to A.2 followed by a humid sulphurous atmosphere test according to A.3 and followed by an ammonia atmosphere treatment according to A.4 for specimens made of copper alloy with a copper content less than 80 %.

A.2 Salt mist test

The salt mist test 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) as stated in IEC 60068-2-52:1996.

If the salt mist chamber can maintain 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 remain in it for the humidity storage period.

A.3 Humid sulphurous atmosphere test

Humid sulphurous atmosphere treatment shall be in accordance with ISO 6988:1985 with seven cycles with a concentration of sulphur dioxide of 667 x 10^{-6} (in volume) $\pm 25 \times 10^{-6}$, 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.

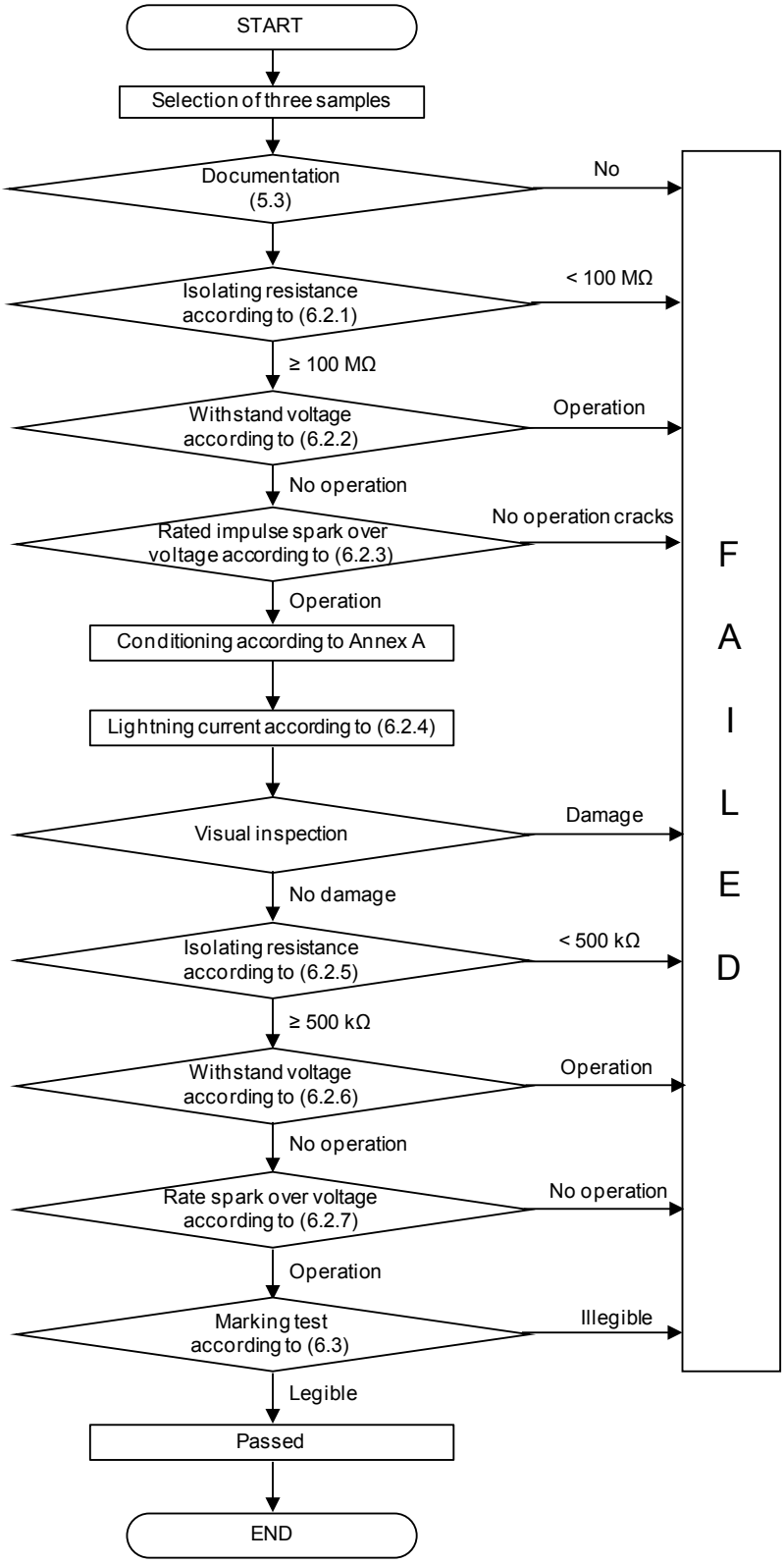
If the test chamber maintains the temperature conditions as specified in 6.5.2 of ISO 6988:1985 then the specimen may remain in it for the storage period.

A.4 Ammonia atmosphere treatment

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 B
(normative)

Flow chart of tests



IEC 191/12

Bibliography

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

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

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

_____

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