

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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

**Composants des systèmes de protection contre la foudre (CSPF) –  
Partie 3: Exigences pour les éclateurs d'isolement**

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## LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

### Part 3: Requirements for isolating spark gaps (ISGs)

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IEC 62561-3 has been prepared by IEC technical committee 81: Lightning protection. It is an International Standard.

This third edition cancels and replaces the second edition, published in 2017. This edition constitutes a technical revision.

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

- a) alignment with the latest edition of ISO 22479 relating to humid sulphurous atmosphere treatment;
- b) addition of a new normative Annex D for the applicability of previous tests.

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

Draft	Report on voting
81/727/FDIS	81/729/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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.

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## INTRODUCTION

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

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## LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

### Part 3: Requirements for isolating spark gaps (ISGs)

#### 1 Scope

This part of IEC 62561 specifies the requirements and tests for isolating spark gaps (ISGs) 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 electrodes 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.

Applications where follow currents occur are not included.

Extra requirements for the components can be necessary for LSCs intended for use in hazardous atmospheres.

NOTE 1 In CENELEC member countries, testing requirements of components for explosive atmospheres are specified in CLC/TS 50703-2.

NOTE 2 Testing of components for an explosive atmosphere (as defined in the IEC 60079-10 series) is not covered by this document.

#### 2 Normative references

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

IEC 60068-2-52:2017, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-75:2014, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 62305-1:2010, *Protection against lightning – Part 1: General principles*

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

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3:2016, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

ISO 4892-4:2013, *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 22479:2019, *Corrosion of metals and alloys – Sulphur dioxide test in a humid atmosphere (fixed gas method)*

### 3 Terms and definitions

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

ISO and IEC maintain terminology 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

##### **ISG**

##### **isolating spark gap**

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**

RMS 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

#### 3.6

##### **rated withstand voltage**

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

**3.7** $U_{W AC}$ **rated power frequency withstand voltage**

value of a power frequency withstand voltage declared by the manufacturer to characterize the isolating behaviour of an ISG

**3.8** $U_{W DC}$ **rated DC withstand voltage**

value of a DC withstand voltage declared by the manufacturer to characterize 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** $U_{imp}$ **rated impulse sparkover voltage**

manufacturer's declaration of the ISG sparkover voltage

**3.11****isolation resistance**

ohmic resistance of the ISG between the active parts

**3.12** $I_{imp}$ **lightning impulse current**

impulse current that classifies an ISG [IEC 62561-3:2023](https://standards.iteh.ai/catalog/standards/sist/42551ae5-44d2-4ce6-810b-6cae3cf509c7/iec-62561-3-2023)

Note 1 to entry: Five parameters shall 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 the capability of ISGs to withstand lightning current**

The following classes apply, in accordance with 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 installation location**

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 a 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 ultraviolet (UV) light, corrosion and erosion.

Compliance is checked by testing, in accordance with 6.2 and 6.3.

### 5.3 Documentation and 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 the ISG in a suitable and safe manner.

Compliance is checked by review, in accordance with 6.6.

### 5.4 Lightning current carrying capability

ISGs shall have sufficient lightning current carrying capability.

Compliance is checked in accordance with 6.5.4 following the manufacturer's declaration for the class of the ISG in accordance with Clause 4.

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### 5.5 Rated impulse sparkover voltage

The ISG shall always spark over at the rated impulse sparkover voltage during the tests.

ISGs can 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.

Compliance is checked in accordance with 6.5.3.

### 5.6 Rated withstand voltage

#### 5.6.1 Rated DC withstand voltage

The ISG shall never spark over at the rated DC withstand voltage or lower voltage during the tests even after performing the lightning current test.

Compliance is checked in accordance with 6.5.2.3.

#### 5.6.2 Rated power frequency withstand voltage

The ISG shall never spark over at the rated power frequency withstand voltage or lower voltage during the tests even after performing the lightning current test.

Compliance is checked in accordance with 6.5.2.2.

## 5.7 Isolation resistance

Before and after the lightning current test, the isolation resistance shall be equal to or greater than 500 k $\Omega$ .

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.

## 6 Tests

### 6.1 General test conditions

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, it is not necessary to repeat them unless changes are made to the materials, design or type of manufacturing process, which can change the performance characteristics of the product, see Annex D.

- a) The 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.
- b) Three specimens are subjected to the tests and the requirements are satisfied if all the tests are met, unless otherwise specified.
- 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 can 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 in 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, can also submit an additional set of specimens which can 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.

For products already tested according to this part of IEC 62561, the applicability of previous tests according to Annex D can be applied.

For new components, complete type tests and samples according to Clause 6 are required.

## 6.2 Ultraviolet (UV) light test

### 6.2.1 General test conditions

This test is necessary for ISGs designed to be installed outdoors.

The typical UV effects are covered by the test according to Annex C.

ISG housings for outdoor applications 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.

### 6.2.2 Acceptance criteria

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

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

## 6.3 Corrosion resistance test

### 6.3.1 General test conditions

This test is necessary for ISGs having metallic parts designed to be installed outdoors.

The typical corrosion outdoor environment is covered by the test specified in Annex B.7/iec-

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

### 6.3.2 Acceptance criteria

After the parts have been dried during 10 min in a drying oven at a temperature of  $100\text{ °C} \pm 5\text{ °C}$ , 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 Impact test

### 6.4.1 General test conditions

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 can be mechanically stressed accidentally.

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

Each arrangement of specimen shall be mounted on an impact test apparatus as described in IEC 60068-2-75:2014, Clause 4 and shown in IEC 60068-2-75:2014, Figure D.1. The impact test apparatus shall be mounted on a solid wall or structure providing sufficient support for the test apparatus.

The hammer shall deliver an impact of 0,35 J (see IEC 60068-2-75:2014, Table 2) perpendicular to the length of the arrangement.

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 is 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.

#### **6.4.2 Acceptance criteria**

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 DC withstand voltage but not more than 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 to or greater than 500 k $\Omega$ .

#### **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 test conditions**

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 RMS value as declared by the manufacturer is reached and this is maintained for a time of 60 s  $\pm$  1 s.

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

###### **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, and conducts a leakage current < 1 mA RMS.