

INTERNATIONAL STANDARD



Radio interference test on high-voltage insulators

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IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

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

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INTERNATIONAL STANDARD



Radio interference test on high-voltage insulators

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RADIO INTERFERENCE TEST ON HIGH-VOLTAGE INSULATORS

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This commented version (CMV) of the official standard IEC 60437:2023 edition 3.0 allows the user to identify the changes made to the previous IEC 60437:1997 edition 2.0. Furthermore, comments from IEC TC 36 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 60437 has been prepared by IEC technical committee 36: Insulators. It is an International Standard.

This third edition cancels and replaces the second edition published in 1997. This edition constitutes a technical revision.

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

- a) Composite station post and composite hollow core station post insulators have been included;
- b) All paragraphs of Samples test were actualized;
- c) Sample test fast procedure was introduced.

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

Draft	Report on voting
36/585/FDIS	36/591/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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- revised.

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INTRODUCTION

The first edition of IEC 60437 presented the available information on a radio interference test on high-voltage insulators as a technical report. This allowed further experience in conducting the test and the interpretation of results to be gained.

The second edition incorporated that experience in the form of an International Standard, which gave the recommended procedures for a radio interference test on high-voltage insulators.

This third edition incorporates clarification of test arrangements and the number of insulators to be tested for composite station posts, composite hollow core station posts and hybrid insulators. This edition also incorporates clarification on the fast method for the sample test.

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RADIO INTERFERENCE TEST ON HIGH-VOLTAGE INSULATORS

1 Scope

This International Standard specifies the procedure for a radio interference (RI) test carried out in a laboratory on clean and dry insulators at a frequency of 0,5 MHz or 1 MHz or, alternatively, at other frequencies between 0,5 MHz and 2 MHz.

This document applies to insulators for use on AC or DC overhead power lines and overhead traction lines with a nominal voltage greater than 1 000 V. **1**

In service the RI characteristics of an insulator may be modified by the ambient conditions, particularly rainfall and other moisture, and by pollution. It is not considered feasible to specify reproducible test conditions to simulate a range of ambient conditions. Hence only tests on clean and dry insulators are specified in this document.

NOTE The effects of insulator surface conditions, including pollution, are presented in ~~Amendment 1 of~~ CISPR 18-2:2017, clause 6.3.

2 Normative references **2**

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 60050(471):1984, International Electrotechnical Vocabulary (IEV) – Chapter 471: Insulators~~

IEC 60060-1:1989 ~~2010~~, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60137:1995 ~~2017~~, *Insulated bushings for alternating voltages above 1 000 V*

IEC 60168:1994, *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V*

IEC 60168:1994/AMD1:1997

IEC 60168:1994/AMD2:2000

IEC 60383-1:1993 ~~2023~~, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 60383-2:1993, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 2: Insulator strings and insulator sets for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 61109:2008, *Insulators for overhead lines – Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 61462:2007, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods, acceptance criteria and design recommendations*

IEC 61952:2008, *Insulators for overhead lines – Composite line post insulators for A.C. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 62231:2006, *Composite station post insulators for substations with a.c. voltages greater than 1 000 V up to 245 kV – Definitions, test methods and acceptance criteria*

~~CISPR 16-1:1993, Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus~~

CISPR 16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 18-2:1986/2017, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*
~~Amendment 1 (1993)~~

3 Terms and definitions

~~For the purpose of this International Standard, the definitions given in IEC 60050(471) and IEC 60383-1 are applicable.~~

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Measurement frequency

~~Measurements of RI characteristics shall be made at a frequency of $(0,5 \pm 0,05)$ MHz or $(1,0 \pm 0,1)$ MHz or alternatively by agreement between purchaser and manufacturer at other frequencies between 0,5 MHz and 2 MHz.~~

The reference measurement frequency is 0,5 MHz. It is recommended that measurements are made at a frequency of $0,5 \text{ MHz} \pm 10 \%$ 3. Alternatively, by agreement between purchaser and manufacturer, other frequencies between 0,5 MHz and 2 MHz may be used.

NOTE Although CISPR 18-2 gives the reference measurement frequency for the measurement of RI characteristics as 0,5 MHz, the existing standard practice in some countries is to use 1 MHz or 2 MHz when measuring radio interference characteristics of insulators.

The frequencies of 0,5 MHz or alternatively 1 MHz are preferred because, usually, the level of radio noise at this part of the spectrum is representative of the higher levels and also because 0,5 MHz lies between the low and medium frequency radio broadcast bands.

The RI characteristics of insulators do not normally affect television broadcasts.

5 Radio noise limits and test voltage

This document does not specify a limiting value for the radio interference characteristic of insulators or the test voltage.

When RI tests are required, the relevant values, ~~depending on product or national regulations or specifications,~~ shall be found in the relevant IEC standard or shall be agreed between the purchaser and manufacturer.

NOTE Guidance for establishing limit values is given in CISPR 18-2:2017, ~~Amendment 1.~~

6 Measuring instruments

6.1 Standard CISPR measuring apparatus

Unless otherwise agreed, the standard CISPR measuring apparatus, as specified in CISPR 16-1-1, shall be used for all measurements of RI characteristics of insulators.

6.2 Other measuring apparatus

By agreement between the purchaser and manufacturer measuring apparatus differing from the CISPR standard measuring apparatus may be used provided that conversion of the measurements to quasi peak values is possible.

7 Measuring circuit

Laboratory measurements of radio noise shall be made by measuring the conducted quantities, either current or voltage.

The relevant measuring circuits are specified in CISPR 18-2.

The basic test circuit is shown in Figure 4 of CISPR 18-2:2017, and a practical form of standard test circuit in Figure 5. For DC insulators tests, H.V. transformer mentioned on both figures shall be a DC voltage generator **4**. Depending on the distance between the measuring set and the test circuit, the arrangements shown in Figure 6 or Figure 7 of CISPR 18-2:2017 may be incorporated into the test circuit of Figure 5.

The test circuit shall be arranged so as to permit an accurate measurement of the radio noise level generated by the object under test. Any interference from outside the test circuit, including the supply, or from other parts of the circuit, shall be at a low level and, preferably, at least 10 dB below the level specified for the test object. Also, with the specified test voltage applied to the circuit, the level of background noise shall be at least 6 dB below the lowest level to be measured (see 4.5.11 – CISPR 18-2:2017). **5**

8 Requirements for test voltage

RI measurements shall be made with a power-frequency voltage (for AC insulators) or direct voltage (for DC insulators) applied to the test object. The test voltage and its method of measurement shall comply with the requirements of IEC 60060-1. ~~The radio noise level produced by the connections between the transformer and test insulator shall be insignificant compared with the levels to be measured from the test object at the test voltage.~~

9 Atmospheric conditions

The standard reference atmospheric conditions in accordance with IEC 60060-1 are not applicable to radio interference tests.

Tests made in accordance with this document shall be performed under atmospheric conditions complying with the following requirements:

- temperature between 10 °C and 35 °C
- pressure between 87 kPa and 107 kPa (870 mbar and 1 070 mbar)
- relative humidity between 45 % and 75 %.

NOTE 1 — The absolute humidity and the atmospheric pressure can influence the test results.

NOTE 2 — By agreement between the purchaser and manufacturer, e.g. to simulate service conditions, tests may be carried out under other atmospheric conditions. Examples of these include:

- temperature between 5 °C and 40 °C
- relative humidity between 20 % and 80 %.

Correction to standard atmospheric conditions shall not be applied to either the test voltage or the radio interference measurements.

The atmospheric conditions shall be recorded.

10 Test area

Tests on smaller insulators and insulator sets preferably shall be performed inside a screened room which is large enough to prevent the walls and floor having any significant effect on the distribution of the electric field at the surface of the test object. Circuits, for example power and lighting, entering the screened test area shall, ideally, be filtered so as to avoid the introduction of radio noise present in the general environment.

When, for testing larger insulators and insulator sets, a suitable screened room is not available, the tests may be carried out at any place where the background noise level is sufficiently low compared with the levels to be measured (see Clause 7).

11 Arrangements of insulators for test

11.1 Mounting of insulators

Insulators, including bushings, shall, when mounted for radio interference tests, be complete with ~~any~~ all stress control devices and fittings specified by the manufacturer or the purchaser. They shall be mounted either in a standard method of mounting for electrical tests or in a manner simulating service conditions.

Test results are influenced not only by the insulators, but also by the method of mounting and the presence of arcing horns, grading rings, conductor bundles and their position relative to the insulators. Hence a test configuration simulating service conditions shall be as representative as possible.

NOTE 1 Although measurements of the RI characteristics of an insulator are related to its service voltage, the standard methods of mounting are referenced to the requirements or otherwise, to switching impulse tests, since RI measurements are usually made on insulators and insulator sets when they are mounted for other electrical tests, and service voltage is not normally a specified characteristic of an insulator.

Pin insulators, line post insulators and string insulator units shall be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 60383-1.

NOTE — For pin and line post insulators, care should be taken to ensure that the high-voltage connection is sufficiently secure to make a good contact with the ~~porcelain~~ ceramic or glass or with the metal end fittings, thus ensuring freedom from local discharges.

Insulator sets for which switching impulse tests are not required shall be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 60383-2. The mounting arrangement for string insulator units may be applied for short suspension or tension composite insulators (Length $\leq 0,6\text{m}$). In case of tests in screened rooms the conductor can be omitted. **6**

Post insulators for which switching impulse tests are not required shall be mounted in accordance with the standard method of mounting given in 4.4.1 of IEC 60168:1994.

Bushings for which switching impulse tests are not required shall be mounted in accordance with the standard method of mounting given in 7.3 of IEC 60137:2017.

Insulator sets, post insulators and bushings for which switching impulse tests are required shall:

- either be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 60383-2, IEC 60168 or IEC 60137.
- or be mounted in a manner simulating the service conditions. In this case 12.3 of IEC 60383-2:1993 or 4.4.3 of IEC 60168:1994 shall apply, as appropriate.

For both methods of mounting care shall be taken to avoid discharges from the high-voltage conductor assembly.

The ends of the assembly shall be protected by suitable corona-free terminations.

Composite station post and composite hollow core station post insulators shall be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 62231.

Hybrid insulators shall be mounted, depending on type and application, in accordance with IEC 606168, IEC 60383-1, IEC 60383-2 or IEC 62155 for the respective kind of products. **7**

11.2 Conditions of insulators before test

Before commencing the radio interference tests the insulators shall be in thermal equilibrium with the test area to avoid any condensation on their surfaces. The surface of the insulation part shall be clean and dry before starting high-voltage tests. ~~When the insulators to be tested are in a clean and dry state,~~ They may be wiped with a dry cloth to remove dust and fibres which might affect the surfaces.

11.3 Checking and calibration of test circuit

Before commencing the RI tests the test circuit shall, if necessary, be checked and calibrated in accordance with 4.5.11 and 4.5.12 of CISPR 18-2:2017.

12 ~~Insulators for~~ Type test

12.1 Number of insulators **8**

Unless otherwise agreed between the purchaser and manufacturer, the number of insulators, ~~excluding string insulator units,~~ subjected to a radio interference test shall be that mentioned in the relevant IEC standard. If no mention is made, then the number of insulators shall be the same as the number specified for the electrical type test in the relevant IEC standard. This requirement is summarized as follows:

- ~~— bushings — 1~~
- ~~— composite insulators — 1~~
- ~~— line post insulators $H \leq 600\text{ mm}$ 3~~
- ~~— line post insulators $H > 600\text{ mm}$ 1~~

- ~~— pin insulators 3~~
 - ~~— insulator sets 1~~
 - ~~— post insulators $H \leq 600$ mm 3~~
 - ~~— post insulators $H > 600$ mm 1~~
- ~~where H is the height of the insulator.~~

~~NOTE — When three insulators of the same design are tested, the RI characteristic should be given as the mean value of the three test results at the specified test voltage.~~

- | | |
|--|--|
| – bushings | 1 |
| – Suspension and tension composite insulators $L \leq 600$ mm | 3 (see NOTE 2,3) |
| – Suspension and tension composite insulators $L > 600$ mm | 1 (see NOTE 2,3) |
| – line post insulators $H \leq 600$ mm | 3 (see NOTE 3) |
| – line post insulators $H > 600$ mm | 1 (see NOTE 3) |
| – pin insulators | 5 |
| – insulator sets | 1 (see NOTE 1) |
| – ceramic or glass insulator units | 3 |
| – ceramic or glass post insulators / composite station post / composite hollow core station post | |
| $H \leq 600$ mm | 3 (see NOTE 3) |
| $H > 600$ mm | 1 (see NOTE 3) |
| – hybrid insulators | depending on type and application, in accordance with IEC 60168, IEC 60383 or IEC 62155 for the respective kind of products. |

where

H is the height of the insulator and

L is the distance between metal fittings of the insulator

The requirement and the number of insulators gives priority to product standard.

When more than one insulator of the same design is tested, the RI characteristic should be given as the mean value of all test results at the specified test voltage.

NOTE 1 Insulator sets completed with their fittings obtain the most representative measurements.

NOTE 2 Not applicable to test insulator alone without all associated fittings or reference conductor bundle etc.

NOTE 3 600 mm length limit on line post insulators are established in order to aligned to IEC 60383-1.

NOTE 4 RIV test on insulator set according to customer design if required by customer specification.

12.2 String insulator units

~~Tests on string insulator units either as single units or as short standard strings are not specified as a type test requirement of this standard. The object of this standard is to specify a method of evaluating the RI performance of insulator sets complete with their fittings in order to obtain the most representative measurements.~~

~~Agreement may however be reached between the purchaser and manufacturer to carry out sample RI tests on single string insulator units, notably of the cap and pin type, to provide information on single unit characteristics.~~

~~13 Procedure for type tests~~

12.2 Voltage application and RI characteristics

The radio noise level generated by a test insulator is not entirely determined by a particular value of the test voltage. A hysteresis effect often occurs, with the result that the noise may or may not be present at a given test voltage, since it depends on whether this voltage was reached by increasing or decreasing values.

Preconditioning of the test insulator, by subjecting it to a voltage which is equal to or greater than the specified test voltage for a specific period of time, can also have an effect on the measured level of radio noise.

The following standard procedure shall be adopted.

A voltage 10 % higher than the specified test voltage shall be applied to the insulator under test and maintained for at least 5 min. The voltage shall then be decreased in steps to 30 % of the specified test voltage, raised in steps to the initial value, maintained there for 1 min and finally decreased in steps to the 30 % value. Each voltage step shall be approximately 10 % of the specified test voltage.

NOTE With an agreement between the manufacturer and the customer, maintaining times in voltage for each level greater than 5 min can be defined.

At each step, when the value is stable, a radio interference measurement shall be made, and the results obtained during the last decreasing run shall be plotted against the applied voltage. The curve so obtained is the RI characteristic of the insulator. Figure 1 shows a schematic representation of the test procedure.

12.3 Acceptance criterion

The insulator passes the test provided that the RI level at the specified test voltage, as read from the RI characteristic, does not exceed the specified value or the value previously agreed between the purchaser and manufacturer.

13 Procedure for Sample tests

13.1 General

If the purchaser and manufacturer agree to perform RI test on a sample test, this paragraph specifies selection of samples, an appropriate number of insulators to be tested, the test method and acceptance criteria.

13.2 Insulators subjected to sample tests 8

~~For some designs of insulators, particularly string insulator units of the cap and pin type, it may be agreed between the purchaser and manufacturer that~~ RI tests shall be carried out on samples taken at random from each lot of insulators offered for acceptance.

~~In this case, the test voltage and the acceptance RI level shall be agreed and the following procedures shall apply.~~

13.3 Number of samples

~~The number of samples used for the test shall be E_1 plus E_2 as defined in 8.2 of IEC 60383-1.~~

Unless otherwise agreed between the purchaser and manufacturer, the number of insulators subjected to a radio interference test shall be that mentioned in the relevant IEC standard. If no mention is done, the number of insulators subjected to a radio interference sample test shall be as follows:

- Sample size as defined in 3.4.1 (Table 1) of IEC 60168:1994.
- E_2 as defined in 8.2 of IEC 60383-1:2023.
- E_2 as defined in 12.1 (Table 4) of IEC 61109:2008.
- Sample size as defined in 9.1 (Table 4) of IEC 61462:2007.
- E_2 as defined in 12.1 (Table 4) of IEC 61952:2008.
- E_2 as defined in 10.1 (Table 2) of IEC 62231:2006.

For hybrid insulators, number of samples shall be in accordance with IEC 60168, IEC 60383-1 or IEC 62155 for the respective kind of products.

The requirement and the number of insulators gives priority to product standard.

14.3 Mounting arrangement

~~The mounting arrangement shall be agreed between the purchaser and manufacturer.~~

~~NOTE — For string insulator units of the cap and pin type one suitable mounting arrangement is to suspend them below a rigid high voltage conductor by means of a good electrical connection and to earth the cap.~~

13.4 Test procedure

The test procedure shall be in accordance with 12.2 and 12.3.

As alternative, the following fast procedure can be applied. **9**

A voltage 10 % higher than the specified test voltage shall be applied to the insulator under test and maintained for at least 1 min. The voltage shall then be decreased to the specified test voltage where the result shall be obtained.

NOTE With an agreement between the manufacturer and the customer, maintaining times in voltage greater than 1 min can be defined.

13.5 Acceptance criterion

~~The insulator passes the test if the RI level on all the samples at the specified test voltage does not exceed the value previously agreed between the manufacturer and the purchaser. If one or more of the sample insulators exhibit an RI level above the specified value, then a re-test in accordance with 8.3 of IEC 60383-1 shall be carried out.~~

The insulator batch passes the test provided that RI level on all the samples at the specified test voltage does not exceed the specified value in the relevant IEC standard (if this value is specified) or the value previously agreed between the purchaser and manufacturer.

13.6 Re-test procedure

The following re-test procedure applies for the sample test:

If one or more of the sample insulators exhibit an RI level above the specified value, then a retest in accordance with the appropriate paragraph of the insulator standard shall be performed.

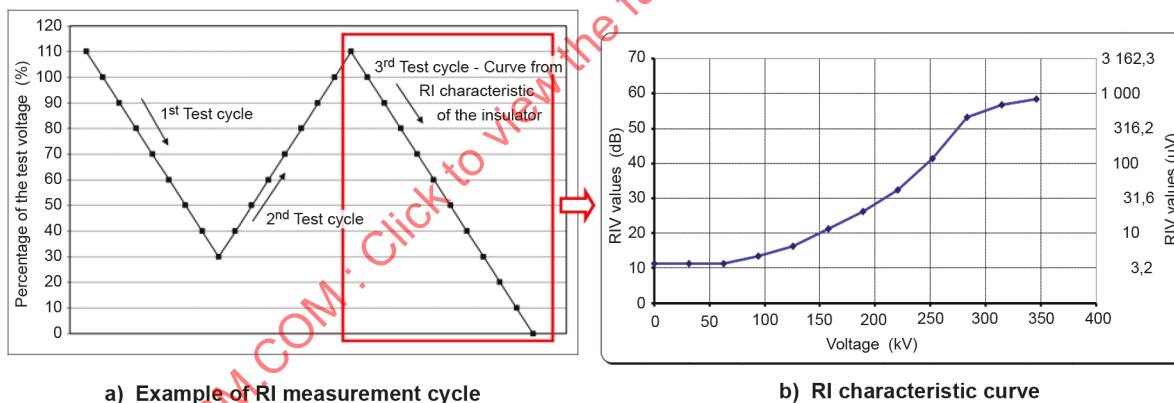
If it is not mentioned in the standard, then the following procedures shall be applied.

- If only one insulator fails to comply with the sample test, a new sample equal to twice the quantity originally submitted to that test shall be subjected to re-testing.
- If two or more insulators parts fail to comply with any of the sample tests, or if any failure occurs during the re-testing, the complete lot is considered as not complying with this test.

14 Test report

The test report shall contain the following details:

- name of manufacturer;
- type designation or description of insulator(s) tested;
- details of test arrangements including dimensions;
- atmospheric conditions prevailing during the test (temperature, pressure and relative humidity);
- background noise;
- RI characteristics of insulator tested.



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Figure 1 – Schematic representation of the type test procedure:
(a) measurement cycle / (b) example of characteristic curve

List of comments

- 1 This version clarifies the scope of the standard to AC and DC overhead lines.
 - 2 New standards are included to cover all types of insulators in case the purchaser agrees to perform RI test.
 - 3 The frequency of 0,5 MHz has been set as preferred, although, if necessary, other frequencies can be used.
 - 4 The standard includes specific transformer for DC test.
 - 5 Outside interferences and background noise have been clarify referring to CISPR 18-2.
 - 6 In order to expedite the assembly and change of the insulator, according to experience, the conductor can be omitted due to its low influence on the result in the tests carried out in screened room.
 - 7 These types of insulators are added in case the purchaser and manufacturer agree to perform RI test.
 - 8 As it is mentioned, the number of insulators gives priority to product standard. The objective of this paragraph is only to summarize and establish the number of insulators only in case that no mention is done on the product standard and the purchaser and manufacturer agree to perform RI test.
 - 9 The experience of various laboratories indicates that this method, more practical for sample testing, has similar accuracy.
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NORME INTERNATIONALE



Radio interference test on high-voltage insulators

Essai de perturbations radioélectriques des isolateurs pour haute tension

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIO INTERFERENCE TEST ON HIGH-VOLTAGE INSULATORS

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.
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IEC 60437 has been prepared by IEC technical committee 36: Insulators. It is an International Standard.

This third edition cancels and replaces the second edition published in 1997. This edition constitutes a technical revision.

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

- a) Composite station post and composite hollow core station post insulators have been included;
- b) All paragraphs of Samples test were actualized;
- c) Sample test fast procedure was introduced.

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

Draft	Report on voting
36/585/FDIS	36/591/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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The first edition of IEC 60437 presented the available information on a radio interference test on high-voltage insulators as a technical report. This allowed further experience in conducting the test and the interpretation of results to be gained.

The second edition incorporated that experience in the form of an International Standard, which gave the recommended procedures for a radio interference test on high-voltage insulators.

This third edition incorporates clarification of test arrangements and the number of insulators to be tested for composite station posts, composite hollow core station posts and hybrid insulators. This edition also incorporates clarification on the fast method for the sample test.

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RADIO INTERFERENCE TEST ON HIGH-VOLTAGE INSULATORS

1 Scope

This International Standard specifies the procedure for a radio interference (RI) test carried out in a laboratory on clean and dry insulators at a frequency of 0,5 MHz or 1 MHz or, alternatively, at other frequencies between 0,5 MHz and 2 MHz.

This document applies to insulators for use on AC or DC overhead power lines and overhead traction lines with a nominal voltage greater than 1 000 V.

In service the RI characteristics of an insulator may be modified by the ambient conditions, particularly rainfall and other moisture, and by pollution. It is not considered feasible to specify reproducible test conditions to simulate a range of ambient conditions. Hence only tests on clean and dry insulators are specified in this document.

NOTE The effects of insulator surface conditions, including pollution, are presented in CISPR 18-2:2017, clause 6.3.

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 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60137:2017, *Insulated bushings for alternating voltages above 1 000 V*

IEC 60168:1994, *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V*

IEC 60168:1994/AMD1:1997

IEC 60168:1994/AMD2:2000

IEC 60383-1:2023, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 60383-2:1993, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 2: Insulator strings and insulator sets for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 61109:2008, *Insulators for overhead lines – Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 61462:2007, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods, acceptance criteria and design recommendations*

IEC 61952:2008, *Insulators for overhead lines – Composite line post insulators for A.C. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 62231:2006, *Composite station post insulators for substations with a.c. voltages greater than 1 000 V up to 245 kV – Definitions, test methods and acceptance criteria*

CISPR 16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 18-2:2017, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Measurement frequency

The reference measurement frequency is 0,5 MHz. It is recommended that measurements are made at a frequency of 0,5 MHz $\pm$ 10 %. Alternatively, by agreement between purchaser and manufacturer, other frequencies between 0,5 MHz and 2 MHz may be used.

NOTE Although CISPR 18-2 gives the reference measurement frequency for the measurement of RI characteristics as 0,5 MHz, the existing standard practice in some countries is to use 1 MHz or 2 MHz when measuring radio interference characteristics of insulators.

The frequencies of 0,5 MHz or alternatively 1 MHz are preferred because, usually, the level of radio noise at this part of the spectrum is representative of the higher levels and also because 0,5 MHz lies between the low and medium frequency radio broadcast bands.

The RI characteristics of insulators do not normally affect television broadcasts.

5 Radio noise limits and test voltage

This document does not specify a limiting value for the radio interference characteristic of insulators or the test voltage.

When RI tests are required, the relevant values shall be found in the relevant IEC standard or shall be agreed between the purchaser and manufacturer.

NOTE Guidance for establishing limit values is given in CISPR 18-2:2017.

6 Measuring instruments

6.1 Standard CISPR measuring apparatus

Unless otherwise agreed, the standard CISPR measuring apparatus, as specified in CISPR 16-1-1, shall be used for all measurements of RI characteristics of insulators.

6.2 Other measuring apparatus

By agreement between the purchaser and manufacturer measuring apparatus differing from the CISPR standard measuring apparatus may be used provided that conversion of the measurements to quasi peak values is possible.

7 Measuring circuit

Laboratory measurements of radio noise shall be made by measuring the conducted quantities, either current or voltage.

The relevant measuring circuits are specified in CISPR 18-2.

The basic test circuit is shown in Figure 4 of CISPR 18-2:2017, and a practical form of standard test circuit in Figure 5. For DC insulators tests, H.V. transformer mentioned on both figures shall be a DC voltage generator. Depending on the distance between the measuring set and the test circuit, the arrangements shown in Figure 6 or Figure 7 of CISPR 18-2:2017 may be incorporated into the test circuit of Figure 5.

The test circuit shall be arranged so as to permit an accurate measurement of the radio noise level generated by the object under test. Any interference from outside the test circuit, including the supply, or from other parts of the circuit, shall be at a low level and, preferably, at least 10 dB below the level specified for the test object. Also, with the specified test voltage applied to the circuit, the level of background noise shall be at least 6 dB below the lowest level to be measured (see 4.5.11 – CISPR 18-2:2017).

8 Requirements for test voltage

RI measurements shall be made with a power-frequency voltage (for AC insulators) or direct voltage (for DC insulators) applied to the test object. The test voltage and its method of measurement shall comply with the requirements of IEC 60060-1.

9 Atmospheric conditions

The standard reference atmospheric conditions in accordance with IEC 60060-1 are not applicable to radio interference tests.

Tests made in accordance with this document shall be performed under atmospheric conditions complying with the following requirements:

- temperature between 10 °C and 35 °C
- pressure between 87 kPa and 107 kPa (870 mbar and 1 070 mbar)
- relative humidity between 45 % and 75 %.

NOTE The absolute humidity and the atmospheric pressure can influence the test results.

By agreement between the purchaser and manufacturer, e.g. to simulate service conditions, tests may be carried out under other atmospheric conditions. Examples of these include:

- temperature between 5 °C and 40 °C
- relative humidity between 20 % and 80 %.

Correction to standard atmospheric conditions shall not be applied to either the test voltage or the radio interference measurements.

The atmospheric conditions shall be recorded.

10 Test area

Tests on smaller insulators and insulator sets preferably shall be performed inside a screened room which is large enough to prevent the walls and floor having any significant effect on the distribution of the electric field at the surface of the test object. Circuits, for example power and lighting, entering the screened test area shall, ideally, be filtered so as to avoid the introduction of radio noise present in the general environment.

When, for testing larger insulators and insulator sets, a suitable screened room is not available, the tests may be carried out at any place where the background noise level is sufficiently low compared with the levels to be measured (see Clause 7).

11 Arrangements of insulators for test

11.1 Mounting of insulators

Insulators, including bushings, shall, when mounted for radio interference tests, be complete with all stress control devices and fittings specified by the manufacturer or the purchaser. They shall be mounted either in a standard method of mounting for electrical tests or in a manner simulating service conditions.

Test results are influenced not only by the insulators, but also by the method of mounting and the presence of arcing horns, grading rings, conductor bundles and their position relative to the insulators. Hence a test configuration simulating service conditions shall be as representative as possible.

NOTE 1 Although measurements of the RI characteristics of an insulator are related to its service voltage, the standard methods of mounting are referenced to the requirements or otherwise, to switching impulse tests, since RI measurements are usually made on insulators and insulator sets when they are mounted for other electrical tests, and service voltage is not normally a specified characteristic of an insulator.

Pin insulators, line post insulators and string insulator units shall be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 60383-1.

For pin and line post insulators, care should be taken to ensure that the high-voltage connection is sufficiently secure to make a good contact with the ceramic or glass or with the metal end fittings, thus ensuring freedom from local discharges.

Insulator sets for which switching impulse tests are not required shall be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 60383-2. The mounting arrangement for string insulator units may be applied for short suspension or tension composite insulators (Length $\leq 0,6\text{m}$). In case of tests in screened rooms the conductor can be omitted.

Post insulators for which switching impulse tests are not required shall be mounted in accordance with the standard method of mounting given in 4.4.1 of IEC 60168:1994.

Bushings for which switching impulse tests are not required shall be mounted in accordance with the standard method of mounting given in 7.3 of IEC 60137:2017.

Insulator sets, post insulators and bushings for which switching impulse tests are required shall:

- either be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 60383-2, IEC 60168 or IEC 60137.
- or be mounted in a manner simulating the service conditions. In this case 12.3 of IEC 60383-2:1993 or 4.4.3 of IEC 60168:1994 shall apply, as appropriate.

For both methods of mounting care shall be taken to avoid discharges from the high-voltage conductor assembly.

The ends of the assembly shall be protected by suitable corona-free terminations.

Composite station post and composite hollow core station post insulators shall be mounted in accordance with the standard method of mounting given in the relevant clauses of IEC 62231.

Hybrid insulators shall be mounted, depending on type and application, in accordance with IEC 606168, IEC 60383-1, IEC 60383-2 or IEC 62155 for the respective kind of products.

11.2 Conditions of insulators before test

Before commencing the radio interference tests the insulators shall be in thermal equilibrium with the test area to avoid any condensation on their surfaces. The surface of the insulation part shall be clean and dry before starting high-voltage tests. They may be wiped with a dry cloth to remove dust and fibres which might affect the surfaces.

11.3 Checking and calibration of test circuit

Before commencing the RI tests the test circuit shall, if necessary, be checked and calibrated in accordance with 4.5.11 and 4.5.12 of CISPR 18-2:2017.

12 Type test

12.1 Number of insulators

Unless otherwise agreed between the purchaser and manufacturer, the number of insulators subjected to a radio interference test shall be that mentioned in the relevant IEC standard. If no mention is made, then the number of insulators shall be the same as the number specified for the electrical type test in the relevant IEC standard. This requirement is summarized as follows:

– bushings	1
– Suspension and tension composite insulators $L \leq 600$ mm	3 (see NOTE 2,3)
– Suspension and tension composite insulators $L > 600$ mm	1 (see NOTE 2,3)
– line post insulators $H \leq 600$ mm	3 (see NOTE 3)
– line post insulators $H > 600$ mm	1 (see NOTE 3)
– pin insulators	5
– insulator sets	1 (see NOTE 1)
– ceramic or glass insulator units	3
– ceramic or glass post insulators / composite station post / composite hollow core station post	
$H \leq 600$ mm	3 (see NOTE 3)
$H > 600$ mm	1 (see NOTE 3)
– hybrid insulators	depending on type and application, in accordance with IEC 60168, IEC 60383 or IEC 62155 for the respective kind of products.

where

H is the height of the insulator and

L is the distance between metal fittings of the insulator

The requirement and the number of insulators gives priority to product standard.

When more than one insulator of the same design is tested, the RI characteristic should be given as the mean value of all test results at the specified test voltage.

NOTE 1 Insulator sets completed with their fittings obtain the most representative measurements.

NOTE 2 Not applicable to test insulator alone without all associated fittings or reference conductor bundle etc.

NOTE 3 600 mm length limit on line post insulators are established in order to aligned to IEC 60383-1.

NOTE 4 RIV test on insulator set according to customer design if required by customer specification.

12.2 Voltage application and RI characteristics

The radio noise level generated by a test insulator is not entirely determined by a particular value of the test voltage. A hysteresis effect often occurs, with the result that the noise may or may not be present at a given test voltage, since it depends on whether this voltage was reached by increasing or decreasing values.

Preconditioning of the test insulator, by subjecting it to a voltage which is equal to or greater than the specified test voltage for a specific period of time, can also have an effect on the measured level of radio noise.

The following standard procedure shall be adopted.

A voltage 10 % higher than the specified test voltage shall be applied to the insulator under test and maintained for at least 5 min. The voltage shall then be decreased in steps to 30 % of the specified test voltage, raised in steps to the initial value, maintained there for 1 min and finally decreased in steps to the 30 % value. Each voltage step shall be approximately 10 % of the specified test voltage.

NOTE With an agreement between the manufacturer and the customer, maintaining times in voltage for each level greater than 5 min can be defined.

At each step, when the value is stable, a radio interference measurement shall be made, and the results obtained during the last decreasing run shall be plotted against the applied voltage. The curve so obtained is the RI characteristic of the insulator. Figure 1 shows a schematic representation of the test procedure.

12.3 Acceptance criterion

The insulator passes the test provided that the RI level at the specified test voltage, as read from the RI characteristic, does not exceed the specified value or the value previously agreed between the purchaser and manufacturer.

13 Sample tests

13.1 General

If the purchaser and manufacturer agree to perform RI test on a sample test, this paragraph specifies selection of samples, an appropriate number of insulators to be tested, the test method and acceptance criteria.

13.2 Insulators subjected to sample tests

RI tests shall be carried out on samples taken at random from each lot of insulators offered for acceptance.

13.3 Number of samples

Unless otherwise agreed between the purchaser and manufacturer, the number of insulators subjected to a radio interference test shall be that mentioned in the relevant IEC standard. If no mention is done, the number of insulators subjected to a radio interference sample test shall be as follows:

- Sample size as defined in 3.4.1 (Table 1) of IEC 60168:1994.
- E2 as defined in 8.2 of IEC 60383-1:2023.
- E2 as defined in 12.1 (Table 4) of IEC 61109:2008.
- Sample size as defined in 9.1 (Table 4) of IEC 61462:2007.
- E2 as defined in 12.1 (Table 4) of IEC 61952:2008.
- E2 as defined in 10.1 (Table 2) of IEC 62231:2006.

For hybrid insulators, number of samples shall be in accordance with IEC 60168, IEC 60383-1 or IEC 62155 for the respective kind of products.

The requirement and the number of insulators gives priority to product standard.

13.4 Test procedure

The test procedure shall be in accordance with 12.2 and 12.3.

As alternative, the following fast procedure can be applied.

A voltage 10 % higher than the specified test voltage shall be applied to the insulator under test and maintained for at least 1 min. The voltage shall then be decreased to the specified test voltage where the result shall be obtained.

NOTE With an agreement between the manufacturer and the customer, maintaining times in voltage greater than 1 min can be defined.

13.5 Acceptance criterion

The insulator batch passes the test provided that RI level on all the samples at the specified test voltage does not exceed the specified value in the relevant IEC standard (if this value is specified) or the value previously agreed between the purchaser and manufacturer.

13.6 Re-test procedure

The following re-test procedure applies for the sample test:

If one or more of the sample insulators exhibit an RI level above the specified value, then a retest in accordance with the appropriate paragraph of the insulator standard shall be performed.

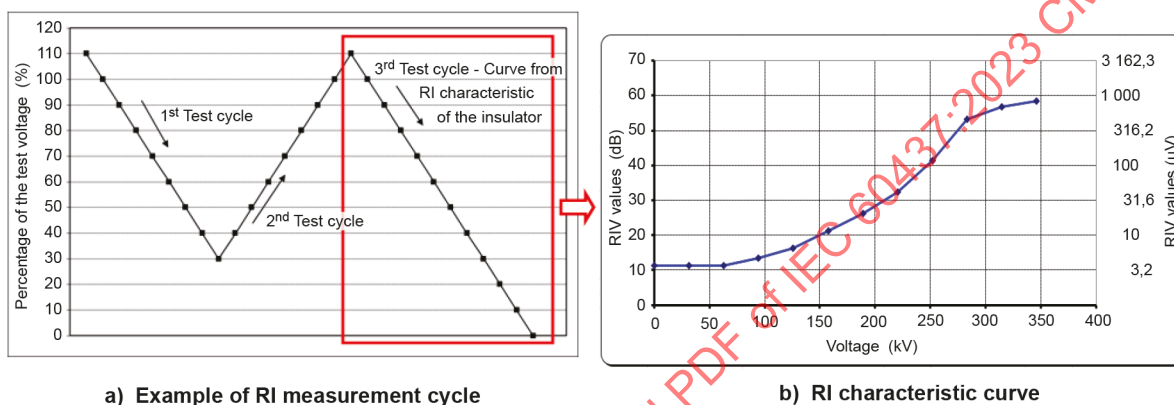
If it is not mentioned in the standard, then the following procedures shall be applied.

- If only one insulator fails to comply with the sample test, a new sample equal to twice the quantity originally submitted to that test shall be subjected to re-testing.
- If two or more insulators parts fail to comply with any of the sample tests, or if any failure occurs during the re-testing, the complete lot is considered as not complying with this test.

14 Test report

The test report shall contain the following details:

- name of manufacturer;
- type designation or description of insulator(s) tested;
- details of test arrangements including dimensions;
- atmospheric conditions prevailing during the test (temperature, pressure and relative humidity);
- background noise;
- RI characteristics of insulator tested.



IEC

**Figure 1 – Schematic representation of the type test procedure:
(a) measurement cycle / (b) example of characteristic curve**

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**ESSAI DE PERTURBATIONS RADIOÉLECTRIQUES
DES ISOLATEURS POUR HAUTE TENSION****AVANT-PROPOS**

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L'IEC 60437 a été établie par le comité d'études 36 de l'IEC: Isolateurs. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 1997. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) Introduction des supports isolants composites et des supports isolants composites creux;
- b) Actualisation de tous les alinéas portant sur les essais individuels;
- c) Introduction d'une procédure rapide d'essai individuel.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
36/585/FDIS	36/591/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

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INTRODUCTION

La première édition de l'IEC 60437 présentait les informations disponibles sur l'essai de perturbations radioélectriques des isolateurs pour haute tension sous la forme d'un rapport technique. Cela a permis d'acquérir plus d'expérience dans la conduite de l'essai et d'interpréter les résultats à obtenir.

La deuxième édition incorporait l'expérience acquise sous la forme d'une Norme internationale, qui a donné les procédures recommandées pour un essai de perturbations radioélectriques des isolateurs pour haute tension.

La présente troisième édition incorpore une clarification des dispositions et le nombre d'isolateurs à soumettre à l'essai pour les supports isolants composites, composites creux et hybrides. Cette édition incorpore aussi une clarification de la méthode rapide pour l'essai individuel.

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ESSAI DE PERTURBATIONS RADIOÉLECTRIQUES DES ISOLATEURS POUR HAUTE TENSION

1 Domaine d'application

La présente Norme internationale spécifie la procédure pour un essai de perturbations radioélectriques effectué en laboratoire sur des isolateurs propres et secs à une fréquence de 0,5 MHz ou 1 MHz ou, en variante, à d'autres fréquences comprises entre 0,5 MHz et 2 MHz.

Le présent document s'applique aux isolateurs destinés à des lignes aériennes en courant alternatif ou continu et des lignes aériennes de traction de tension nominale supérieure à 1 000 V.

En service, les caractéristiques des perturbations radioélectriques d'un isolateur peuvent être modifiées par les conditions ambiantes, particulièrement par la pluie, l'humidité due à d'autres influences et par la pollution. On considère qu'il est impossible de spécifier en pratique des conditions d'essai reproductibles afin de simuler une gamme de conditions ambiantes. En conséquence, seuls des essais sur des isolateurs propres et secs sont spécifiés dans le présent document.

NOTE Les effets des conditions de surface de l'isolateur, y compris la pollution, sont présentés dans la CISPR 18-2:2017, paragraphe 6.3.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60060-1:2010, *Technique des essais à haute tension – Partie 1: Définitions et exigences générales*

IEC 60137:2017, *Traversées isolées pour tensions alternatives supérieures à 1 000 V*

IEC 60168:1994, *Essais des supports isolants d'intérieur et d'extérieur, en matière céramique ou en verre, destinés à des installations de tension nominale supérieure à 1 000 V*

IEC 60168:1994/AMD1:1997

IEC 60168:1994/AMD2:2000

IEC 60383-1:2023, *Isolateurs pour lignes aériennes de tension nominale supérieure à 1 000 V – Partie 1: Éléments d'isolateurs en matière céramique ou en verre pour systèmes à courant alternatif – Définitions, méthodes d'essai et critères d'acceptation*

IEC 60383-2:1993, *Isolateurs pour lignes aériennes de tension nominale supérieure à 1 000 V – Partie 2: Chaînes d'isolateurs et chaînes d'isolateurs équipées pour systèmes à courant alternatif – Définitions, méthodes d'essai et critères d'acceptation*

IEC 61109:2008, *Isolateurs pour lignes aériennes – Isolateurs composites de suspension et d'ancrage destinés aux systèmes à courant alternatif de tension nominale supérieure à 1 000 V – Définitions, méthodes d'essai et critères d'acceptation*