

Australian Standard™

**Insulators—Ceramic or glass—
Station post for indoor or outdoor use—
Voltages greater than 1000 V a.c.**

**Part 2: Tests
(IEC 60168, Ed. 4.2 (2001) MOD)**



This Australian Standard was prepared by Committee EL-010, Overhead Lines. It was approved on behalf of the Council of Standards Australia on 21 April 2005. This Standard was published on 24 May 2005.

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Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturers Association
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This Standard was issued in draft form for comment as DR 05020.

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Originated as part of AS 1137.3—1972.
Revised and redesignated in part as AS 4398.2—1996.
Second edition 2005.

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Published by Standards Australia, GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 6690 0

PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee EL-010, Overhead Lines, to supersede AS 4398.2—1996. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than Australian/New Zealand Standard.

The objective of this Standard is to provide users and manufacturers of station post insulators with definitions and terms, test methods and acceptance criteria to facilitate their specification.

This Standard is an adoption with national modifications and has been reproduced from IEC 60168, Ed. 4.2 (2001), *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V*.

Variations to IEC 60168, Ed. 4.2 (2001) are indicated at the appropriate places throughout this standard. Strikethrough (~~example~~) identifies IEC text, tables and figures which, for the purposes of this Australian Standard, are deleted. Where text, tables or figures are added, each is set in its proper place and identified by shading (**example**). Added figures are not themselves shaded, but are identified by a shaded border.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) In the source text ‘this international standard’ should read ‘this Australian Standard’.
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- (d) Any French text on figures should be ignored.

The term ‘informative’ is used to define the application of the annex to which it applies. An informative annex is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard
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Station post for indoor or outdoor use—Voltages greater than 1000 V a.c.
Part 2: Tests
(IEC 60168, Ed. 4.2 (2001) MOD)**

Section 1 - General**1.1 Scope and object**

This International Standard IEC 60168 is applicable to post insulators and post insulator units of ceramic material or glass, for indoor and outdoor use in electrical installations or equipment, operating on alternating current with a nominal voltage greater than 1 000 V and a frequency not greater than 100 Hz.

This standard may be regarded as a provisional standard for post insulators for use on d.c. systems. IEC 60438 gives general guidance for those insulators.

This standard does not apply to composite insulators, or to those indoor post insulators in organic material which are covered by another IEC standard [1]*.

The object of this standard is to define:

- the terms used;
- the electrical and mechanical characteristics of post insulators;
- the conditions under which the specified values of these characteristics are verified;
- the methods of test;
- the acceptance criteria.

Numerical values of characteristics of post insulators are specified in IEC 60273.

This standard does not include requirements dealing with the choice of post insulators for specific operating conditions.

AS 1137.3—1981 has been retained as an obsolescent Standard. It is not recommended for new equipment or to be used in current practice, but is retained to provide for servicing of existing equipment or requirements. In some conditions of high pollution, a purchaser may wish to specify tests in accordance with AS 1137.3—1981.

NOTE 1 A guide for the choice of insulators under polluted conditions is available, see [2].

NOTE 2 This standard does not include radio interference tests or artificial pollution tests. These subjects and relevant test methods are dealt with in other IEC publications, see [3], [4] and [5].

NOTE 3 When this standard is applied to hollow post insulators, other IEC publications should also be taken into account, see [6] and [7].

* The figures in square brackets refer to annex C (Bibliography).

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid normative documents.

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter and identified by shading. Any Australian or Australian/New Zealand Standard that is identical to the International Standard it replaces is identified as such.

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

AS 1852.471, *International electrotechnical vocabulary—Insulators*

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

AS 1931.1, *High-voltage test techniques—General definitions and test requirements* (identical to IEC 60060-1:1989)

~~IEC 60071-1:1993, Insulation co-ordination — Part 1: Definitions, principles and rules~~

AS 1824.1, *Insulation co-ordination—Definitions, principles and rules*

~~IEC 60071-2:1976, Insulation co-ordination — Part 2: Application guide~~

AS 1824.2, *Insulation co-ordination (phase-to-earth and phase-to-phase, above 1 kV)—Application guide*

~~IEC 60071-3:1982, Insulation co-ordination — Part 3: Phase-to-phase insulation co-ordination. Principles, rules and application guide~~

AS 1824.1, *Insulation co-ordination—Definitions, principles and rules*

AS 1824.2, *Insulation co-ordination (phase-to-earth and phase-to-phase, above 1 kV)—Application guide*

~~IEC 60273:1990, Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1 000 V~~

AS 4398.1, *Insulators—Ceramic or glass—Station post for indoor and outdoor use—Voltages greater than 1000 V a.c.—Characteristics*

IEC 60438:1973, *Tests and dimensions for high-voltage d.c. insulators*

~~ISO 1459:1973, Metallic coatings — Protection against corrosion by hot dip galvanizing — Guiding principles~~

~~ISO 1460:1992, Metallic coatings — Hot dip galvanized coatings on ferrous metals — Gravimetric determination of the mass per unit area~~

~~ISO 1461:1973, *Metallic coatings — Hot dip galvanized coatings on fabricated ferrous products — Requirements*~~

AS 1214, *Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)*

ISO 1463:1982, *Metal and oxide coatings — Measurement of coating thickness — Microscopical method*

ISO 2064:1980, *Metallic and other non-organic coatings — Definitions and conventions concerning the measurement of thickness*

ISO 2178:1982, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

The following Australian/New Zealand document is referred to in this Standard:

AS/NZS 4680, *Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

1.3 Definitions

For the purposes of this standard, the following definitions apply.

The definitions given below are those which either do not appear in IEC 60050(471), or differ from those given in IEC 60050(471).

1.3.1 insulator

the term "insulator" is used in this standard to refer to the object being tested. Unless otherwise specified, this refers to an assembled post insulator, complete with metal fittings. In this standard, the term "post insulator" shall be taken to mean post insulator, or post insulator unit, as required by the text

NOTE 1 The term "approximately cylindrical shape" covers a unit of circular cross-section, which may vary in diameter.

NOTE 2 For indoor installations subject to excessive condensation, outdoor post insulators, or special indoor post insulators may be used.

1.3.2 lot

a group of insulators offered for acceptance from the same manufacturer, of the same design and manufactured under similar conditions of production. One or more lots may be offered together for acceptance; the lot(s) offered may consist of the whole, or part, of the quantity ordered

1.3.3 dry lightning-impulse withstand voltage

the lightning-impulse voltage which the post insulator withstands dry, under the prescribed conditions of test

1.3.4 50% dry lightning impulse flashover voltage

the value of the lightning-impulse voltage which, under the prescribed conditions of test, has a 50% probability of producing flashover on the post insulator, dry

NOTE The term "flashover" used in this standard includes flashover across the insulator surface as well as disruptive discharges by sparkover through air adjacent to the insulator. Disruptive discharges should only occur occasionally elsewhere (for instance, to other structures or to earth), in which event they should not be taken into account for the purpose of this standard.

1.3.5**dry or wet switching-impulse withstand voltage**

the switching-impulse voltage which the post insulator withstands, dry or wet respectively, under the prescribed conditions of test

1.3.6**50% dry or wet switching-impulse flashover voltage**

the value of the switching-impulse voltage which, under the prescribed conditions of test, has a 50% probability of producing flashover on the post insulator, dry or wet respectively

1.3.7**dry or wet power-frequency withstand voltage**

the power-frequency voltage which the post insulator withstands dry or wet respectively, under the prescribed conditions of test

1.3.8**dry or wet power-frequency flashover voltage**

the arithmetic mean value of the measured voltages which cause flashover on the post insulator, dry or wet respectively, under the prescribed conditions of test

1.3.9**puncture voltage**

the voltage which causes puncture of a post insulator under the prescribed conditions of test

1.3.10**mechanical failing load**

the maximum load reached when a post insulator is tested under the prescribed conditions of test

1.3.11**creepage distance**

the shortest distance, or the sum of the shortest distances, along the contours of the external surfaces of the ceramic or glass insulating parts of the post insulator between those parts which normally have the operating voltage between them

NOTE 1 The surface of cement, or other non-insulating jointing material, is not considered as forming part of the creepage distance.

NOTE 2 If a high-resistance coating is applied to parts of the surface of an insulator, such parts are considered to be effective insulating surfaces, and the distance over them is included in the creepage distance.

NOTE 3 The surface resistivity of such high-resistance coatings is usually about $10^6 \Omega$, but may be as low as $10^4 \Omega$.

NOTE 4 If high-resistance coatings are applied to the whole surface of the post insulator (the so-called stabilized insulator), the questions of surface resistivity and creepage distance should be subject to agreement between the purchaser and the manufacturer.

NOTE 5 The creepage distance according to this definition is specified as minimum nominal creepage distance in IEC 60273.

1.3.12**specified characteristic**

a specified characteristic is:

- either the numeric value of a voltage, of a mechanical load, or any other characteristic specified in an IEC standard,
- or the numeric value of any such characteristic agreed between the purchaser and the manufacturer.

Specified withstand and flashover voltages are referred to standard atmospheric conditions (see 4.2.1).

1.3.13**parallelism of the end faces**

the maximum difference in the height of a post insulator measured across the surfaces of the metal fittings at each end

NOTE The difference in height is usually related to a circle of 250 mm diameter.

1.3.14**eccentricity**

the displacement, perpendicular to the axis of the post insulator, between the centres of the pitch circles of the fixing holes in the top and bottom metal fittings

1.3.15**angular deviation of the fixing holes**

the rotational displacement, expressed as an angle, between corresponding fixing holes in the metal fittings at the top and bottom of a post insulator

Section 2 - Insulators

2.1 Insulator designs and insulating materials

2.1.1 Insulator designs

Post insulators and post insulator units are divided into different design categories according to their construction. The design categories covered by the tests in this standard are:

- 1) solid-core cylindrical post insulators with external metal fittings, having solid insulating material throughout the height of each post insulator unit, i.e. a puncture-proof insulator (see figure 1);
- 2) cavity core cylindrical post insulators, with external metal fittings, having an internal ceramic barrier produced and fired integrally in each post insulator unit (see figure 2);
- 3) cylindrical post insulators with internal metal fittings in which the length of the shortest puncture path through solid insulating material is at least equal to half the external arcing distance between the metal fittings, i.e. a puncture-proof insulator (see figure 3);
- 4) cylindrical post insulators with internal metal fittings in which the length of the shortest puncture path through solid insulator material is less than half the external arcing distance between the metal fittings (see figure 4);
- 5) pedestal post insulators, in which each post insulator unit comprises metal fittings with one or more insulating components, where the thickness of the solid insulating material is small compared with the external dimensions (see figure 5);
- 6) cylindrical post insulators, in which each post insulator unit comprises metal fittings, and multiplicity of insulating components where the thickness of the solid insulating material of each component is small compared with the external dimensions, and also where the whole assembly is characterized as puncture-proof (see figure 6).

NOTE The term "cylindrical insulators" is intended to cover insulators of the truncated conical form also.

The type, sample, and routine tests applicable to post insulators in each of the above categories are detailed in section 6 and summarized in tables 3, 4, and 5.

2.1.2 Insulating materials

The insulating materials of post insulators covered by this standard are:

- ceramic material, porcelain;
- annealed glass, being glass in which the mechanical stresses have been relaxed by thermal treatment;
- toughened glass, being glass in which controlled mechanical stresses have been induced by thermal treatment.

NOTE 1 Further information on the definition and classification of ceramic and glass insulating materials can be found in other IEC publications, see [8] and [9].

NOTE 2 The term "ceramic material" is used in this standard to refer to porcelain materials and, contrary to North American practice, does not include glass.

2.2 Values which characterize a post insulator

A post insulator is characterized by the following values, where applicable:

- a) the specified dry lightning-impulse withstand voltage;
- b) the specified dry switching-impulse withstand voltage (for indoor insulators only);*
- c) the specified wet switching-impulse withstand voltage (for outdoor insulators only);*

* Switching-impulse withstand voltage should be specified only for post insulators for use on a.c. systems with highest voltage for equipment above 245 kV.

- d) the specified dry power-frequency withstand voltage (for indoor insulators only);
- e) the specified wet power-frequency withstand voltage (for outdoor insulators only);
- f) the specified minimum puncture voltage (for insulators in design categories 4) and 5) only, see 2.1.1);
- g) the specified mechanical failing load(s);
- h) the specified significant dimensions, including the creepage distance.

NOTE Experience has shown that with many existing systems from 300 kV to 420 kV highest voltage of equipment, the switching-impulse withstand voltage has not been a critical factor in the design of post insulators. Therefore, for post insulators used to extend such existing systems, switching-impulse tests should only be carried out by agreement between the purchaser and the manufacturer.

The following characteristics may also be agreed between the purchaser and the manufacturer:

- deflection under bending load;
- radio interference characteristics, see [3];
- artificial pollution withstand characteristics, see [4].

The applicability of the characteristics as a function of the highest voltage for equipment shall be determined by reference to IEC 60071.

2.3 Identification of insulators

Each post insulator shall be marked with the name or trade mark of the manufacturer, the year of manufacture, and the post insulator reference mark **or type number**. These markings shall be legible and indelible.

The designations included in IEC 60273 may also be used, where no ambiguity can result.

Section 3 - Classification of the tests, sampling rules and procedures

3.1 Classification of the tests

The tests are divided into three groups, as follows:

3.1.1 Type tests

The type tests are intended to verify the main characteristics of an insulator, which depend mainly on its design. They are usually carried out on one insulator, and once only for a new design or manufacturing process, and then subsequently repeated only when the design, material or manufacturing process is changed; when the change only affects certain characteristics, only the test(s) relevant to those characteristics need to be repeated. Moreover, it is not necessary to perform all the electrical and mechanical type tests on a new design of insulator if a valid test certificate is available for a post insulator of equivalent design. The meaning of electrically equivalent design is given in 3.3.3 and of mechanically equivalent design in 3.3.4.

The results of type tests are certified either by test certificates accepted by the purchaser or by test certificates confirmed by a qualified organization. For mechanical tests, the certificates shall be valid for 10 years from the date of issue. There is no time limit for the validity of certificates for electrical type tests.

The type tests shall be carried out on insulator(s) which have passed all the requirements for the routine and the sample tests, except the sample mechanical test.

3.1.2 Sample tests

The sample tests are carried out to verify the characteristics of an insulator, which can vary with the manufacturing process and the quality of the component materials of the insulator. Sample tests are used as acceptance tests on a sample of post insulators, taken at random from a lot which has met the requirements of the relevant routine tests.

3.1.3 Routine tests

The routine tests are intended to eliminate defective units and are carried out during the manufacturing process. Routine tests are carried out on every insulator.

NOTE When, in certain cases, the type, sample and routine tests are carried out as a whole on a new design of insulator, they are referred to as "prototype tests".

3.2 Quality assurance

A quality assurance programme, taking into account the requirements of this standard, can be used, after agreement between the purchaser and the manufacturer, to verify the quality of the insulators during the manufacturing process.

NOTE 1 Detailed information on the use of quality assurance is given in ISO standards, see [10], [11], [12] and [13].

ISO 9002 is recommended as a guide for a quality system for insulators.

NOTE 2 Certain well-established national standards for quality assurance programmes are also available.

3.3 General requirements for type tests

3.3.1 Insulator selection for type tests

Normally, only one post insulator shall be subjected to each test. The test shall be carried out on an insulator which has passed all the requirements for the routine and the sample tests, except the sample mechanical test. Insulators which have been submitted to type tests which may affect their mechanical and/or electrical characteristics shall not be used in service.

3.3.2 Verification of the dimensions

The relevant dimensions of the post insulator used for type tests shall be verified, before other tests are commenced, in accordance with clause 5.1.

NOTE By agreement between the purchaser and the manufacturer, an insulator, having dimensional variations outside the tolerances specified on the drawing or in the standard, may be used provided it is agreed that these discrepancies will not affect the performance under test. This also applies to the use for type tests of an insulator having larger areas of glaze defects than are permitted by clause 5.8.

3.3.3 Electrical type tests

The electrical type tests, as indicated in table 3 (clause 6.4), shall be carried out on one post insulator, and once only.

The results obtained during the electrical type tests on a post insulator of "electrically equivalent design" shall be extended to all post insulators represented by it. These are insulators made with the same materials and having the following characteristics when compared with the post insulator of "electrically equivalent design":

- a) the arcing distance is the same or greater;
- b) the nominal core diameter is the same or smaller;
- c) the number and approximate position of metal fittings is the same;
- d) the nominal shed spacing is the same within $\pm 5\%$;
- e) the nominal shed projection is the same within $\pm 10\%$;
- f) the shed profile is the same.

NOTE 1 A post insulator of "electrically equivalent design" will normally be an outdoor cylindrical post insulator. Other designs of post insulator, particularly pedestal post insulators, are unlikely to be of "electrically equivalent design".

NOTE 2 The effect of the shape and size of metal fittings on the electrical equivalence of a design may need to be taken into consideration.

NOTE 3 The flashover and withstand voltages of insulators under service conditions may differ from the flashover and withstand voltages under standard testing conditions. This effect has been recognized with lightning impulse testing, especially for very high voltages of equipment, but the effect of ambient conditions and the arrangement of post insulators and associated metalwork is much greater with switching impulses, due to the differences in electric field distribution between the standard test arrangement and the mounting arrangement in service. The verification of the specified switching impulse withstand voltage therefore may be required with a mounting arrangement which closely represents the service conditions. The details of the mounting arrangement should then be agreed between the purchaser and the manufacturer.

NOTE 4 The concept of "electrical equivalence of design" primarily applies in respect of the tests included in this standard. The effect of different nominal creepage distances on post insulators of "electrically equivalent design" may need to be considered in relation to pollution performance.

3.3.4 Mechanical failing load type tests

The type test for mechanical strength shall be carried out on one post insulator, and once only. Normally, this test will be a mechanical failing load test carried out in bending. When additional information is required, then by agreement between the purchaser and the manufacturer, one or more of the following tests may also be carried out as a type test:

- tensile test;
- torsion test;
- compression test.

The results obtained during the mechanical failing load type tests on a post insulator of "mechanically equivalent design" shall be extended to all post insulators represented by it. These are insulators made in the same factory, with the same materials, and by the same manufacturing process, and having the following characteristics, when compared with the post insulator of "mechanically equivalent design":