

Australian Standard™

High-voltage switches

**Part 2: High-voltage switches for rated
voltages of 52 kV and above
(IEC 60265-2, Ed.1.0(1988) MOD)**



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Energy Networks Association
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High-voltage switches

Part 2: High-voltage switches for rated voltages of 52 kV and above (IEC 60265-2, Ed.1.0(1988) MOD)

Originated as part of AS C339—1967.
Previous edition AS 1025.2—1989.
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PREFACE

This Standard was prepared by the Standards Australia Committee EL-007 Power Switchgear, to supersede AS 1025.2—1989.

The objective of this Standard is to establish requirements for a.c. switches and switch-disconnectors having, making and breaking current ratings at rated voltages of 52 kV and above, for in-door and outdoor installations.

This Standard is Part 2 of a two-Part Standard consisting of the following:

AS

60265 High-voltage switches

60265-1 Part 1: Switches for rated voltages above 1 kV and less than 52 kV

60265-2 Part 2: High-voltage switches for rated voltages of 52 kV and above
(this Standard)

This Standard is an adoption with national modifications and has been reproduced from IEC 60265-2, Ed.1.0(1988), *High-voltage switches Part 2 High-voltage switches for rated voltages of 52 kV and above*, incorporating its Corrigendum 1:1990, Amendment 1:1994 and Amendment 2:1998. It has been varied as indicated to take account of Australian conditions and it has been brought into line with the latest edition of AS 2650—2005, *Common specifications for high voltage switchgear and controlgear standards*.

Australian variations include the introduction of type testing, upon agreement between the manufacturer and user, for partial discharge, dielectric dissipation factor and radio interference voltage; routine testing, upon agreement between manufacturer and user, for partial discharge and dielectric dissipation factor, and an Australian annex listing items to be agreed between the purchaser and the user.

This Standard differs from the Standard it supersedes in the following major areas:

- (a) 'Terminals' (clause 5.10) has been deleted.
- (b) 'Independent Manual Operation' (clause 5.7) has been added and following clauses 5.7 to 5.9 are renumbered.
- (c) Clauses 5.11 to 5.18 have been added.
- (d) Clauses 6.7 to 6.10 have been added.
- (e) Table IX 'Suggested maximum permissible switching overvoltages when switching capacitive and inductive currents' has been deleted.
- (f) Condition of switch after breaking tests (subclause 6.101.15) has been updated.
- (g) Condition of switch during and after short-circuit making test (subclause 6.101.16) item c) has been updated.
- (h) Tests for limited-purpose and special-purpose switches (subclause 6.102.3), requirements for mechanical endurance tests for frequently operated switches have been added.
- (i) 'Quality control during manufacture' has been replaced by (Clause 11) 'Safety'.
- (j) Annex ZA 'Items subject to agreement between the manufacturer and user' has been added.
- (k) References have been updated.
- (l) IEC 60265-2, Ed.1.0 (1988) Corrigendum 1: 1990, Amendment 1:1994 and Amendment 2: 1998 have been incorporated.

Variations to IEC 60265-2, Ed.1.0(1988) 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'.
- (c) A full point should be substituted for a comma when referring to a decimal marker.
- (d) Any French text on figures should be ignored.

The terms 'normative' and 'informative' are used to define the application of the annex to which they apply. A normative annex is an integral part of a standard, whereas an informative annex is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

High-voltage switches

**Part 2: High-voltage switches for rated voltages of 52 kV and above
(IEC 60265-2, Ed.1.0(1988) MOD)**

Any table, figure or text of the international standard that is struck through is not part of this standard. Any Australian table, figure or text that is added (and identified by shading) is part of this standard.

1 Scope

This standard is applicable to three-phase alternating-current switches, having making and breaking current ratings, for indoor and outdoor installations, for rated voltages 52 kV and above; and for rated frequencies up to and including 60 Hz.

This standard is also applicable to the operating devices of these switches and to their auxiliary equipment.

Note 1 - Switches for gas insulated switchgear are covered by this standard.

Note 2 - Switches having a disconnecting function and called switch-disconnectors are also covered by IEC 62271-102.

Note 3 - Earthing switches are not covered by this standard. Earthing switches forming an integral part of a switch are covered by IEC 62271-102.

1.101 Object

The main object of this standard is to establish requirements for switches used in transmission and distribution systems. General-purpose switches for this application shall comply with the following service applications:

- carrying rated normal current continuously;
- carrying short-circuit currents for a specified time;
- switching of mainly active loads;
- switching of no-load transformers;
- switching of the charging current of unloaded cables, overhead lines or busbars;
- switching of closed-loop circuits;
- making short-circuit currents.

A further object of this standard is to establish requirements for limited-purpose and special-purpose switches used in transmission and distribution systems.

Limited-purpose switches shall comply with one or more of the service applications indicated above.

Special-purpose switches may comply with one or more of the service applications indicated above and, in addition, shall be suitable for one or more of the following applications:

- switching single capacitor banks;
- switching back-to-back capacitor banks;
- switching shunt reactors including secondary or tertiary reactors switched from the primary side of the transformer;

- applications requiring an increased number of operating cycles;
- switching under earth fault conditions in systems with isolated neutral or in resonant earthed systems.

1.102 Normative references

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

~~IEC 60050(441), International electrotechnical vocabulary (IEV), Chapter 441: Switchgear, controlgear and fuses~~

AS 1852 (441), International electrotechnical vocabulary—Switchgear, controlgear and fuses (identical to IEC 60050(441))

~~IEC 62271-100, High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit-breakers~~

AS 62271.100, High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit-breakers

IEC 60059, IEC standard current ratings

~~IEC 60071-1, Insulation co-ordination, Part 1: Terms, definitions, principles and rules~~

AS 1824.1, Insulation co-ordination, Part 1: Definitions, principles and rules

IEC 62271-102, High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches

~~IEC 60137, Bushings for alternating voltages above 1000 V~~

AS 1265, Bushings for alternating voltages above 1000 V

~~IEC 60270, High-voltage test techniques – Partial discharge measurements~~

AS 60270, High-voltage test techniques—Partial discharge measurements

~~IEC 60694, Common clauses for high-voltage switchgear and controlgear Standards~~

AS 2650, Common specifications for high voltage a.c. switchgear and controlgear standards

2 Normal and special service conditions

IEC 60694 is applicable.

3 Definitions

For the definitions of general terms used in this standard, reference is made to the IEC 60050 (441) and IEC 60071-1.

3.101

Switch (441-14-10)

A switching device capable of making, carrying and breaking currents under normal circuit conditions, which may include specified operating overload conditions and also carrying for a specified time currents under specified abnormal circuit conditions, such as those of short-circuit.

3.102

Switch-disconnector (441-14-12)

A switch which, in the open position, satisfies the isolating requirements specified for a disconnector.

3.103

General-purpose switch

A switch capable of performing, with currents up to its rated breaking currents, all making and breaking operations which may normally occur. The switch shall also be capable of carrying and making short-circuit currents.

NOTE - Refer to Subclause 4.114 for specific ratings of a general-purpose switch.

3.104

Limited-purpose switch

A switch which complies with one or more, but not with all, service applications of a general-purpose switch.

3.105

Special-purpose switch

A switch suitable for switching requirements other than those specified for a general-purpose switch.

NOTE - Examples of such requirements are capacitor bank switching, shunt reactor switching, switching under earth fault conditions, and a capability of an increased number of operating cycles.

3.106

Single capacitor bank switch

A special-purpose switch intended for switching of a single capacitor bank with charging currents up to its rated single capacitor bank breaking current.

3.107

Back-to-back capacitor bank switch

A special-purpose switch intended for breaking capacitor bank-charging currents, with one or more capacitor banks connected to the bus or supply side of the switch, up to its rated back-to-back capacitor bank breaking current. The switch shall be capable of making the associated inrush current, up to its rated capacitor bank inrush making current.

3.108

Shunt reactor switch

A special-purpose switch intended for switching a shunt reactor, including secondary or tertiary reactors switched from the primary side of the transformer.

3.109**Breaking capacity* (441-17-08)****3.110****Mainly active load breaking capacity**

The breaking capacity when opening a mainly active load circuit in which the load can be represented by resistors and reactors in parallel.

3.111**No-load transformer breaking capacity**

The breaking capacity when opening a no-load transformer circuit.

3.112**Closed-loop breaking capacity**

The breaking capacity when opening a closed transmission line loop circuit, or a transformer in parallel with one or more transformers, i.e., a circuit in which both sides of the switch remain energized after breaking, and in which the voltage appearing across the terminals is substantially less than the system voltage.

3.113**Cable-charging breaking capacity**

The breaking capacity when opening a cable circuit at no load.

3.114**Line-charging breaking capacity**

The breaking capacity when opening an overhead line circuit at no load.

3.115**Busbar charging breaking capacity**

The breaking capacity when opening a busbar circuit at no load.

3.116**Single capacitor bank breaking capacity**

The breaking capacity when opening a single capacitor bank circuit connected to a supply that does not include another capacitor bank adjacent to the bank being switched.

3.117**Back-to-back capacitor bank breaking capacity**

The breaking capacity when opening a capacitor bank circuit connected to a supply that includes one or more capacitor banks adjacent to the bank being switched.

3.118**Capacitor bank inrush making current**

The high frequency and high magnitude current occurring when closing a capacitor bank circuit onto a supply including one or more capacitor banks adjacent to the bank being switched.

NOTE - The frequency and magnitude of the inrush current depend upon the values of capacitance and the values of the inductance between the capacitor banks.

* Note concerning the rated values:

In English, the terms 'rated making current' and 'rated breaking current' are being used where formerly 'rated making capacity' and 'rated breaking capacity' were used, the intended meaning being adequately conveyed by the use of 'rated'.

3.119**Shunt reactor breaking capacity**

The breaking capacity when opening a shunt reactor circuit, including secondary or tertiary reactors switched from the primary side of the transformer.

3.120**Earth-fault breaking capacity**

The breaking capacity in the faulty phase of an isolated neutral or resonant earthed system when clearing an earth fault on an unloaded cable or overhead line on the load side of the switch.

3.121**Cable and line charging breaking capacity under earth fault conditions**

The breaking capacity in the sound phases of an isolated neutral or resonant earthed system when switching off an unloaded cable or overhead line, with an earth fault on the supply side of the switch.

3.122**Breaking current (441-17-07)****3.123****(Peak)-making current**

The peak value of the first major loop of the current in a pole of a switch during the transient period following the initiation of current during a making operation.

Note 1 – The peak value may differ from one pole to another and from one operation to another as it depends on the instant of current initiation relative to the wave of the applied voltage.

Note 2 - Where, for a polyphase circuit, a single value of (peak) making current is referred to, it is, unless otherwise stated, the highest value in any phase.

3.124**Short-circuit making capacity (441-17-10)****4 Rating**

Clause 4 of IEC 60694 is applicable with the additions and exceptions indicated below.

4.1 Rated voltage

Subclause 4.1 of IEC 60694 is applicable.

4.2 Rated insulation level

Subclause 4.2 of IEC 60694 is applicable.

4.3 Rated frequency

Subclause 4.3 of IEC 60694 is applicable.

4.4 Rated normal current and temperature rise

Subclause 4.4 of IEC 60694 is applicable.

4.5 Rated short-time withstand current

Subclause 4.5 of IEC 60694 is applicable.

4.6 Rated peak withstand current

Subclause 4.6 of IEC 60694 is applicable.

4.7 Rated duration of short-circuit

Subclause 4.7 of IEC 60694 is applicable.

4.8 Rated supply voltage of closing and opening devices and auxiliary circuits

Subclause 4.8 of IEC 60694 is applicable.

4.9 Rated supply frequency of operating devices and auxiliary circuits

Subclause 4.9 of IEC 60694 is applicable.

4.10 Rated pressure of compressed gas supply for operation

Subclause 4.10 of IEC 60694 is applicable.

4.101 Rated mainly active load-breaking current*

The rated mainly active load-breaking current is the maximum mainly active load current that the switch shall be capable of breaking at its rated voltage.

4.102 Rated closed-loop breaking current*

The rated closed-loop breaking current is the maximum closed-loop current the switch shall be capable of breaking. Separate ratings for transmission line loop current and parallel transformer current may be assigned.

4.103 Rated no-load transformer breaking current*

The rated no-load transformer breaking current is the maximum no-load transformer current the switch shall be capable of breaking at its rated voltage.

4.104 Rated cable-charging breaking current*

The rated cable-charging breaking current is the maximum cable-charging current that the switch shall be capable of breaking at its rated voltage.

4.105 Rated line-charging breaking current*

The rated line-charging breaking current is the maximum line-charging current that the switch shall be capable of breaking at its rated voltage.

4.106 Rated single capacitor bank breaking current*

The rated single capacitor bank breaking current is the maximum capacitor bank breaking current that the switch shall be capable of breaking at its rated voltage with no capacitor bank connected to the supply side of the switch adjacent to the bank being switched.

4.107 Rated back-to-back capacitor bank breaking current*

The rated back-to-back capacitor bank breaking current is the maximum capacitor bank breaking current that the switch shall be capable of breaking at its rated voltage with one or more capacitor banks connected on the supply side of the switch adjacent to the bank being switched, such as to produce the rated capacitor bank inrush making current.

* Note concerning the rated values:

In English, the terms 'rated making current' and 'rated breaking current' are being used where formerly 'rated making capacity' and 'rated breaking capacity' were used, the intended meaning being adequately conveyed by the use of 'rated'.

4.108 Rated capacitor bank inrush making current*

The rated capacitor bank inrush making current is the peak value of the current that the switch shall be capable of making at its rated voltage and with a frequency of the inrush current appropriate to the service conditions.

The assignment of a rated capacitor bank inrush making current is mandatory for switches that have a rated back-to-back capacitor bank breaking current.

NOTE - The frequency of the inrush current for back-to-back capacitor banks may be in the range of 2 kHz to 30 kHz. The specific values are dependent upon the size and configuration of the capacitor bank being switched, the supply side capacitor bank and the inclusion of limiting impedances, if any.

4.109 Rated shunt reactor breaking current*

The rated shunt reactor breaking current is the maximum shunt reactor current that the switch shall be capable of breaking at its rated voltage.

NOTE - The minimum shunt reactor breaking current, if other than zero, that the switch is capable of breaking should be specified by the manufacturer.

4.110 Rated short-circuit making current*

The rated short-circuit making current is the maximum peak prospective current that the switch shall be capable of making at its rated voltage.

4.111 Rated earth fault breaking current*

The rated earth fault breaking current, for an isolated neutral or resonant earthed system, is the maximum earth fault current in the faulted phase that the switch shall be capable of breaking at its rated voltage.

NOTE - The TRV of an isolated neutral system is more severe than the TRV of a resonant earthed system, even if detuned.

4.112 Rated cable and line-charging breaking current under earth fault conditions*

The rated cable and line-charging breaking current under earth fault conditions, for an isolated neutral or resonant earthed system, is the current in the sound phases that the switch shall be capable of breaking at its rated voltage.

NOTE - The maximum cable and line-charging current under fault conditions is $\sqrt{3}$ times the cable and line charging current occurring in normal conditions. This covers the most severe case, which occurs with individually screened cables.

4.113 Rated mechanical terminal load

Subclause 4.103 of IEC 62271-102 is applicable.

4.114 Co-ordination of rated values for a general-purpose switch

A general-purpose switch shall have specific ratings for each switching duty as follows:

- rated mainly active load breaking current shall be equal to the rated normal current;
- rated no-load transformer breaking current shall be equal to 1.0% of the rated normal current;
- rated transmission line loop breaking current shall be equal to the rated normal current;

* Note concerning the rated values:

In English, the terms 'rated making current' and 'rated breaking current' are being used where formerly 'rated making capacity' and 'rated breaking capacity' were used, the intended meaning being adequately conveyed by the use of 'rated'.

- rated parallel transformer breaking current shall be equal to 50% of the rated normal current;
- rated cable-charging breaking current shall be as shown in Table I;
- rated line-charging breaking current shall be as shown in Table I;
- the rated short-circuit making current shall be equal to the rated peak withstand current.

The standard values of ratings should be selected from the R10 series specified in IEC 60059.

Note 1 - Specific co-ordination between rated normal current and rated voltage is not a requirement of this standard.

Note 2 - Specific co-ordination between rated normal current and short-time withstand current is not a requirement of this standard.

4.115 Co-ordination of rated values for limited-purpose and special-purpose switches

A limited-purpose switch should preferably have the same specific ratings as those for a general-purpose switch, where such ratings are applicable. If other ratings are specified, values from the R10 series should be selected.

A special-purpose switch is not required to have coordinated ratings. The rated values, however, should be selected from the R10 series specified in IEC 60059.

5 Design and construction

Clause 5 of IEC 60694 is applicable with the additions indicated below.

5.1 Requirements for liquids in high-voltage switches

Subclause 5.1 of IEC 60694 is applicable.

5.2 Requirements for gases in high-voltage switches

Subclause 5.2 of IEC 60694 is applicable.

5.3 Earthing of high-voltage switches

Subclause 5.3 of IEC 60694 is applicable.

5.4 Auxiliary equipment

Subclause 5.4 of IEC 60694 is applicable.

5.5 Dependent power closing

Subclause 5.5 of IEC 60694 is applicable.

5.6 Stored energy closing

Subclause 5.6 of IEC 60694 is applicable.

5.7 Independent manual operation

Subclause 5.7 of IEC 60694 is applicable.

5.8 Operation of releases

Subclause 5.8 of IEC 60694 is applicable.

5.9 Low-and high-pressure interlocking and monitoring devices

Subclause 5.9 of IEC 60694 is applicable.

5.10 Nameplates

Subclause 5.10 of IEC 60694 is applicable. Switches and their operating devices shall be provided with nameplates which contain information in accordance with table 2 as applicable.

NOTE – Manufacturers wishing to claim compliance with this Australian Standard on products, on packaging or on related promotional material are advised to ensure that such a claim is capable of being verified.

5.11 Interlocking devices

Subclause 5.11 of IEC 60694 is applicable.

5.12 Position indication

Subclause 5.12 of IEC 60694 is applicable.

The open and closed positions of the switches shall be clearly indicated. This requirement is met if one of the following conditions is fulfilled:

- a) the gap or isolating distance is visible;
- b) the position of each movable contact is indicated by a reliable indicating device.

NOTE 1 – A visible moving contact may serve as the indicating device.

NOTE 2 – In the case of a group operated switch (all poles are operated as a single unit), it is permissible to use a common indicating device.

NOTE 3 – The reliable indicating device is specified in IEC 62271-102.

5.13 Degrees of protection by enclosures

Subclause 5.13 of IEC 60694 is applicable.

5.14 Creepage distances

Subclause 5.14 of IEC 60694 is applicable for outdoor equipment. No specific requirements for creepage distance are given for indoor equipment.

5.15 Gas and vacuum tightness

Subclause 5.15 of IEC 60694 is applicable.

5.16 Liquid tightness

Subclause 5.16 of IEC 60694 is applicable.

5.17 Flammability

Subclause 5.17 of IEC 60694 is applicable.

5.18 Electromagnetic compatibility (EMC)

Subclause 5.18 of IEC 60694 is applicable.

5.101 Closing mechanism

For switches having a short-circuit making current rating, only switches having stored energy closing or dependent power closing mechanisms are allowed.

5.102 Mechanical strength

Switches shall be capable of bearing the rated mechanical terminal load when installed according to the manufacturer's instructions, as well as electromagnetic forces, without reduction of their reliability or current carrying capacity.

5.103 Position of the movable contact system and its indicating or signalling device

5.103.1 Securing the position

Switches, including their operating devices, shall be so constructed that they cannot come out of their open or closed positions by forces arising from gravity, vibration, reasonable shocks or accidental touching of the connecting rods of their operating devices, or by electromagnetic forces. Switches or their operating devices shall be designed to allow the application of means to prevent unauthorized operation.

5.103.2 Indication of position

The open and closed positions of the switches shall be clearly indicated. This requirement is met if one of the following conditions is fulfilled:

- a) the gap or isolating distance is visible;
- b) the position of each movable contact is indicated by a reliable indicating device.

Note 1 - A visible moving contact may serve as the indicating device.

Note 2 - In the case where all poles of a switch are so coupled as to be operated as a single unit, it is permissible to use a common indicating device.

5.103.3 Auxiliary contracts for signalling

Signalling of the closed position shall not take place until it is certain that the movable contacts will reach a position in which the rated normal, peak withstand, and short-time withstand currents can be carried safely.

Signalling of the open position shall not take place until the movable contacts have reached a position such that the corresponding gap or isolating distance is at least 80% of the total isolating distance, or until it is certain that the movable contacts will reach their fully open position.

6 Type tests

Clause 6 of IEC 60694 is applicable, with additions and exceptions indicated below.

6.1 General

The purpose of type test is to prove the characteristics of high-voltage switches, their operating devices and their auxiliary equipment.

Type tests include:

- a) normal type tests:
 - dielectric tests including lightning and switching impulse tests, power-frequency voltage withstand tests, and power-frequency voltage withstand tests on auxiliary and control circuits;
 - temperature-rise tests;
 - measurement of the resistance of the main circuit;
 - short-time withstand current and peak withstand current tests;
 - tests to prove the ability of the switch to make and break the specified currents;

- tests to prove satisfactory mechanical operation and endurance;
- verification of the protection;
- tightness test;
- electromagnetic compatibility (EMC) tests.

All of the above tests should be made on the complete high-voltage switch (filled with the specified types and quantities of liquid or gas at specified pressure or reduced pressure, as required), and on its operating devices and auxiliary equipment.

The high-voltage switch tested shall conform in all essential details to drawings of the type of switch specified.

b) type tests upon special request of the user:

- tests to prove the ability of the switch to make or break currents that are specified by the user and are beyond the scope of the normal type tests;
- tests to prove the ability of the switch to interrupt earth faults in systems with isolated neutrals or in resonant earthed systems;
- tests to prove satisfactory operation under severe ice conditions;
- tests to prove the integrity of the external insulation under conditions of air pollution;
- tests to determine the capability of a switch for applications requiring an increased number of operating cycles;
- radio interference voltage (R.I.V.) tests;
- partial discharge tests;
- tests for verification of operation during application of rated mechanical terminal loads.

6.1.1 Grouping of tests

Subclause 6.1.1 of IEC 60694 is applicable for normal type tests. Additional test samples may be used for additional type tests.

6.1.2 Information for identification of specimens

Subclause 6.1.2 of IEC 60694 is applicable.

6.1.3 Information to be included in the type-test report

Subclause 6.1.3 of IEC 60694 is applicable.

6.2 Dielectric tests

Subclause 6.2 of IEC 60694 is applicable with the following exception:

6.2.8 Artificial pollution test

Subclause 6.2.8 of IEC 60694 is applicable for outdoor equipment. No tests are required for indoor equipment.

6.2.9 Partial discharge tests

Subclause 6.2.9 of IEC 60694 is replaced by the following: