

High-voltage switchgear and controlgear —

Part 102: Alternating current disconnectors and earthing switches

ICS 29.120.40; 29.130.10

National foreword

This British Standard is the UK implementation of EN 62271-102:2002+A2:2013. It is identical to IEC 62271-102:2001, incorporating corrigenda December 2001, May 2003, February 2005, January 2012, and June 2014, and amendments 1:2011 and 2:2013. It supersedes BS EN 62271-102:2002+A1:2011, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO text carry the number of the ISO amendment. For example, text altered by ISO amendment 1 is indicated by **A1** **A1**.

IEC Corrigendum May 2003 incorporates changes to document title, the “common numbering” table (see EN version in Foreword), Figure 5, Figure 6, A.6.105.1.2, Table C.2, F.6.2 and Table F.1.

IEC Corrigendum February 2005 changes details of the date of validity given, for this publication, in the IEC Foreword. The sentence which used to read: “The committee has decided that this publication remains valid until 2013” is now changed to read: “The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under ‘http://webstore.iec.ch’ in the data related to the specific publication.”

The UK participation in its preparation was entrusted by Technical Committee PEL/17, Switchgear, controlgear, and HV-LV co-ordination, to Subcommittee PEL/17/1, High-voltage switchgear and controlgear.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Amendments/corrigenda issued since publication

Amd. No.	Date	Comments
14425 Corrigendum No. 1	2 September 2003	Revision of supersession details and implementation of IEC Corrigendum May 2003
16299 Corrigendum No. 2	31 January 2007	See National Foreword
	31 December 2011	Implementation of IEC amendment 1:2011 with CENELEC endorsement A1:2011
	30 April 2012	Implementation of IEC corrigendum January 2012. Clause 3.4.105.3 has been amended.
	30 June 2013	Implementation of IEC amendment 2:2013 with CENELEC endorsement A2:2013
	30 September 2014	Implementation of IEC corrigendum June 2014: Subclause 4.103, reference to “3.7.122” corrected to read “3.7.121” in paragraph 8

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English version

**High-voltage switchgear and controlgear
Part 102: Alternating current disconnectors
and earthing switches**

Appareillage à haute tension
Partie 102: Sectionneurs et sectionneurs
de terre à courant alternatif

Hochspannungs-Schaltgeräte
Teil 102: Wechselstrom-
Trennschalter und -Erdungsschalter

This European Standard was approved by CENELEC on 2002-03-05. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 17A/617/FDIS, future edition 1 of IEC 62271-102, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62271-102 on 2002-03-05.

This European Standard supersedes the European Standards EN 60129:1994 + A1:1994 + A2:1996 , EN 61129:1994 + A1:1995 and EN 61259:1994.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2003-02-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2005-03-01

This European Standard is to be used in conjunction with EN 60694:1996 to which it refers and which is applicable, unless otherwise specified. In order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses is used as in EN 60694. Additional subclauses are numbered from 101.

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, B, C, E, F and ZA are normative and annex D is informative.

Annex ZA has been added by CENELEC.

The contents of the corrigendum of February 2005 have been included in this copy.

COMMON NUMBERING OF IEC 62271 PUBLICATIONS FALLING UNDER THE RESPONSIBILITY OF SUBCOMMITTEES SC 17A AND SC 17C

In accordance with the decision taken at the joint SC 17A/SC 17C meeting in Frankfurt, June 1998 (item 20.7 of 17A/535/RM), a common numbering system has been established for the publications falling under the responsibility of SC 17A and SC 17C. IEC 62271 - *High-voltage switchgear and controlgear* is the publication number and main title element for the common publications.

Numbering of these publications will apply the following principle:

- a) Common standards prepared by SC 17A and SC 17C will start with IEC 62271-1;
- b) Standards of SC 17A will start with IEC 62271-100;
- c) Standards of SC 17C will start with number IEC 62271-200;
- d) Publications prepared by SC 17A and SC 17C will start with number IEC 62271-300.

The table below relates the new numbers to the old numbers. The parts numbered (xxx) will be given a final number pending the decision to publish the revised publication as standard or technical report.

**Common numbering of IEC 62271 publications falling under
the responsibility of subcommittees SC 17A and SC 17C**

IEC 62271/ EN 62271	High-voltage switchgear and controlgear – Original title	Number of previous standard, if any	
		IEC	EN/HD
1	Common specifications	60694;	EN 60694;
2	Seismic qualification for rated voltages of 72,5 kV and above	—	—
100	High-voltage alternating current circuit-breakers	60056	HD 348, mod.
101	Synthetic testing	60427	EN 60427
102	Alternating current disconnectors and earthing switches	60129	EN 60129
103	Switches for rated voltages above 1 kV and less than 52 kV	60265-1	EN 60265-1
104	Switches for rated voltages of 52 kV and above	60265-2	EN 60265-2
105	Alternating current switch-fuse combinations	60420	EN 60420
106	Alternating current contactors and contactor-based motor-starters	60470	EN 60470
107	Alternating current switchgear-fuse combinations	—	--
108	Switchgear having combined functions	—	--
109	Series capacitor by-pass switches	—	—
200	Metal enclosed switchgear and controlgear for rated voltages up to and including 52 kV	60298	EN 60298
201	Insulation -enclosed switchgear and controlgear for rated voltages up to and including 52 kV	60466	--
202	High-voltage/low-voltage prefabricated substations	61330	EN 61330
203	Gas-insulated metal enclosed switchgear for rated voltages above 52kV	60517;	EN 60517;
204	High-voltage gas-insulated transmission lines for rated voltages of 72,5 kV and above	61640	--
(300)	Guide for seismic qualification of high-voltage alternating current circuit-breakers	61166	EN 61166
(301)	Guide for inductive load switching	61233	--
(302)	Guide for short-circuit and switching test procedures for metal-enclosed and dead tank circuit-breakers	61633	--
(303)	Use and handling of sulphur hexafluoride (SF ₆) in high-voltage switchgear and controlgear	61634	--
(304)	Additional requirements for enclosed switchgear and controlgear from 1 kV to 72,5 kV to be used in severe climatic conditions	60932	--
(305)	Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52kV	60859	--
(306)	Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52kV	61639	--
(307)	The use of electronic and associated technologies in auxiliary equipment of switchgear and controlgear	62063	--
308	Guide for asymmetrical short-circuit breaking test duty T100a	—	--
309	TRV parameters for high-voltage switchgear and controlgear for related voltages above 1 kV and less than 100 kV	—	—
310	Electrical endurance testing for circuit-breakers rated 72,5kV and above	—	—

Endorsement notice

The text of the International Standard IEC 62271-102:2001 and its corrigendum April 2002 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of document 17A/972/FDIS, future edition 1 of IEC 62271-102:2001/A1, prepared by SC 17A, "High-voltage switchgear and controlgear", of IEC TC 17, "Switchgear and controlgear" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62271-102:2002/A1:2011.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-06-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2014-09-23

This standard is to be read in conjunction with EN 62271-1:2008, to which it refers and which is applicable unless otherwise specified in this standard. In order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses is used as in EN 62271-1. Amendments to these clauses and subclauses are given under the same references whilst additional subclauses are numbered from 101.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62271-102:2001/A1:2011 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A2

The text of document 17A/1029/FDIS, future edition 1 of IEC 62271-102:2001/A2, prepared by SC 17A, "High-voltage switchgear and controlgear", of IEC TC 17, "Switchgear and controlgear" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62271-102:2002/A2:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-12-21
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-03-21

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62271-102:2001/A2:2013 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Addition to Annex ZA of EN 62271-102:2002

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62271-1	2007	High-voltage switchgear and controlgear - Part 1: Common specifications	EN 62271-1	2008
IEC 62271-100	2008	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers	EN 62271-100	2009

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 102: High-voltage alternating current disconnectors and earthing switches

1 General

1.1 Scope

This part of IEC 62271 applies to alternating current disconnectors and earthing switches, designed for indoor and outdoor enclosed and open terminal installations for voltages above 1 000 V and for service frequencies up to and including 60 Hz.

It also applies to the operating devices of these disconnectors and earthing switches and their auxiliary equipment.

Additional requirements for disconnectors and earthing switches in enclosed switchgear and controlgear are given in IEC 60298, IEC 60466 and IEC 60517.

NOTE Disconnectors in which the fuse forms an integral part are not covered by this standard.

1.2 Normative references

Subclause 1.2 of IEC 60694 is applicable with the following additions:

IEC 60137:1995, *Insulating bushings for alternating voltages above 1 000 V*

IEC 60265-1:1998, *High-voltage switches – Part 1: Switches for rated voltages above 1 kV and less than 52 kV*

IEC 60265-2:1988, *High-voltage switches – Part 2: High-voltage switches for rated voltages of 52 kV and above*

IEC 60298:1990, *A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 60466:1987, *A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 38 kV*

IEC 60517:1990, *Gas-insulated metal-enclosed switchgear for rated voltages of 72,5 kV and above*

IEC 60694:1996, *Common specifications for high-voltage switchgear and controlgear standards*

IEC 60865-1:1993, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

Ⓐ IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

IEC 62271-100:2008, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers* Ⓐ

ISO 2768-1:1989, *General tolerances – Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

2 Normal and special service conditions

Clause 2 of IEC 60694 is applicable.

3 Definitions

Clause 3 of IEC 60694 is applicable with the following additions:

This clause covers required definitions, most of them by reference to IEC 60050(151), IEC 60050(441) and IEC 60050(604).

3.1 General terms

3.1.101

indoor switchgear and controlgear

[IEV 441-11-04]

3.1.102

outdoor switchgear and controlgear

[IEV 441-11-05]

3.1.103

temperature rise (of a part of a disconnecter or earthing switch)

difference between the temperature of the part and the ambient air temperature

3.1.104

user

person or legal entity using the disconnectors or earthing switches

NOTE This may include the purchaser (for example an electricity supplier), but it may also include the contracting company, the staff responsible for installation, the maintenance or operating staff or anybody else temporarily or permanently responsible for the disconnecter, earthing switch or substation, or even the operation of the switchgear.

3.2 Assemblies of switchgear and controlgear

No particular definitions.

3.3 Parts of assemblies

No particular definitions.

3.4 Switching devices

3.4.101

disconnecter

IEV 441-14-05 is applicable with the following additional notes:

A1 NOTE 1 "Negligible current" implies currents such as the capacitive currents of bushings, busbars, connections, very short lengths of cable, currents of permanently connected grading impedances of circuit-breakers and currents of voltage transformers and dividers (see also IEC 62271-305). For rated voltages of 420 kV and below, a current not exceeding 0,5 A is a negligible current for the purpose of this definition; for rated voltage above 420 kV and currents exceeding 0,5 A, the manufacturer should be consulted. "No significant change in voltage" refers to such applications as the by-passing of induction voltage regulators or circuit-breakers and bus transfer.

NOTE 2 For a disconnector having a rated voltage of 52 kV and above, a rated ability of bus transfer current switching may be assigned. **A1**

3.4.101.1 **disconnecter class M0**

disconnecter having a mechanical endurance of 1 000 operating cycles, suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard

3.4.101.2 **disconnecter class M1**

disconnecter having an extended mechanical endurance of 2 000 operating cycles, mainly for applications where the disconnector is operated in conjunction with a circuit-breaker of an equal class

3.4.101.3 **disconnecter class M2**

disconnecter having an extended mechanical endurance of 10 000 operating cycles, mainly for applications where the disconnector is operated in conjunction with a circuit-breaker of an equal class

3.4.102 **divided support disconnector** **(earthing switch)**

[IEV 441-14-06(07)]

NOTE Examples are pantograph and semi-pantograph disconnectors.

3.4.103 **centre-break disconnector**

[IEV 441-14-08]

3.4.104 **double-break disconnector**

[IEV 441-14-09]

3.4.105 **earthing switch**

A1 IEC 441-14-11 is applicable with the following additional notes

NOTE 101 An earthing switch having a rated voltage of 52 kV and above may have a rating for switching and carrying induced currents.

NOTE 102 These devices may sometimes be operated against short-circuit. The different classes of earthing switches are related to the number of short-circuit making operations.

NOTE 103 For special applications such as fault initiating earthing switches the test procedures and the number of tests may be agreed upon between the manufacturer and the user. **A1**

3.4.105.1 **earthing switch class E0**

A1 earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, without a short-circuit making capability **A1**

3.4.105.2

earthing switch class E1

[A1] earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand two short-circuit making operations **[A1]**

3.4.105.3

earthing switch class E2 (for earthing switches up to and including 52 kV)

earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand five short-circuit making operations

NOTE The increased number of making operations in Class E2 is restricted to voltages up to and including 52 kV only depending on the operating conditions and the protection systems typical to such networks.

[A1] 3.4.105.4

earthing switch class M0 (for earthing switches)

earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand 1 000 operating cycles

3.4.105.5

combined function earthing switch

earthing switch having a common contact system for earthing and at least one of the following functions:

- disconnecting;
- making and/or breaking of load currents;
- making and/or breaking of currents up to the rated short-circuit current

3.4.105.6

toggle point

point beyond which any further movement of the charging mechanism causes the stored energy to be released **[A1]**

3.5 Parts of switching devices

3.5.101

pole of a switching device

[IEV 441-15-01]

3.5.102

main circuit (of a switching device)

[IEV 441-15-02]

3.5.103

contact (of a mechanical switching device)

[IEV 441-15-05]

3.5.104

main contact

[IEV 441-15-07]

3.5.105

control contact

[IEV 441-15-09]

3.5.106

“a” contact

make contact

[IEV 441-15-12]

3.5.107

“b” contact

break contact

[IEV 441-15-13]

3.5.108

position signalling device

part of a disconnector or earthing switch which uses auxiliary energy to indicate whether the contacts of the main circuit are in the open or closed position

3.5.109

terminal (as a component)

component provided for the connection of a device to external conductors

[IEV 151-01-03]

3.5.110

contact zone (for divided support disconnectors and earthing switches)

spatial region of positions the fixed contact may take up for correct engagement with the moving contact

3.6 Operation

3.6.101

operation (of a mechanical switching device)

[IEV 441-16-01]

3.6.102

operation cycle (of a mechanical switching device)

[IEV 441-16-02]

3.6.103

closing operation (of a mechanical switching device)

[IEV 441-16-08]

3.6.104

opening operation (of a mechanical switching device)

[IEV 441-16-09]

3.6.105

positively driven operation

[IEV 441-16-12]

3.6.106

dependent manual operation (of a mechanical switching device)

IEV 441-16-13 is applicable with the following addition:

NOTE Dependent manual operation may be performed by a crank or by a swing lever (horizontal or vertical).

A1 NOTE 101 Earthing switches with dependent manual operations should not be rated for short circuit making capability. **A1**

3.6.107

dependent power operation (of a mechanical switching device)

[IEV 441-16-14]

3.6.108

stored energy operation (of a mechanical switching device)

[IEV 441-16-15]

3.6.109

independent manual operation (of a mechanical switching device)

[IEV 441-16-16]

3.6.110
closed position (of a mechanical switching device)

IEV 441-16-22 is applicable with the following addition:

NOTE Predetermined continuity means that the contacts are fully engaged to carry the rated normal and the rated short-circuit currents, as applicable.

3.6.111
open position (of a mechanical switching device)

[IEV 441-16-23]

3.6.112
interlocking device

[IEV 441-16-49]

3.7 Characteristic quantities

3.7.101
peak making current (of an earthing switch)

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

NOTE Where, for a three-phase circuit, a single value of (peak) making current is referred to, this is, unless otherwise stated, the highest value in any phase.

3.7.102
peak current

peak value of the first major loop of current during the transient period following initiation

3.7.103
normal current (of a disconnector)

current which the main circuit of the disconnector is capable of carrying continuously under specified conditions of use and behaviour

3.7.104
short-time withstand current

[IEV 441-17-17]

3.7.105
peak withstand current

[IEV 441-17-18]

3.7.106
rated value

quantity value assigned, generally by a manufacturer, for a specified operating condition of a component, device or equipment

[IEV 151-04-03]

3.7.107
insulation level

test voltage, under specified conditions, that the insulation of a device is designed to withstand

[IEV 151-04-14]

3.7.108

one minute power frequency withstand voltage

r.m.s. value of the sinusoidal alternating voltage at power frequency which the insulation of the disconnector or earthing switch withstands under specified test conditions

(see IEC 60060-1)

3.7.109

impulse withstand voltage

peak value of the standard impulse voltage wave which the insulation of the disconnector or earthing switch withstands under specified test conditions

(see IEC 60060-1)

NOTE Depending on the shape of the wave, the term may be qualified as switching impulse withstand voltage or lightning impulse withstand voltage. [IEV 604-03-29, IEC 604-03-30].

3.7.110

external insulation

distances in atmospheric air, and surfaces of solid insulation of disconnectors and earthing switches in contact with the air, which are subject to dielectric stresses and to the effect of atmospheric and other external conditions such as pollution, humidity, vermin, etc.

[IEV 604-03-02, modified]

NOTE External insulation is either weather-protected or non-weather-protected, designed to operate outside or inside closed shelters, respectively

3.7.111

internal insulation

internal solid, liquid or gaseous parts of the insulation of equipment which are protected from the effects of atmospheric and other external conditions

[IEV 604-03-03]

3.7.112

self-restoring insulation

insulation which completely recovers its insulating properties after a disruptive discharge

[IEV 604-03-04]

3.7.113

non-self-restoring insulation

insulation which loses its insulating properties or does not recover them completely after a disruptive discharge

[IEV 604-03-05]

NOTE Definitions 3.7.112 and 3.7.113 apply only when the discharge is caused by the application of a test voltage during a dielectric test. However, discharges occurring in service may cause a self-restoring insulation to lose partially or completely its original insulating properties.

3.7.114

parallel insulation

insulator arrangement with two insulators in parallel where the distance between the two insulators might influence the dielectric strength

NOTE With open terminal disconnectors and earthing switches, parallel insulation is used when a drive insulator is situated next to a support insulator.

3.7.115

disruptive discharge

phenomena associated with the failure of insulation under electric stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly to zero

NOTE 1 The term applies to discharges in solid, liquid and gaseous dielectrics and to combinations of these.

NOTE 2 A disruptive discharge through a solid dielectric produces permanent loss of dielectric strength (non-self-restoring insulation); in a liquid or gaseous dielectric the loss may be only temporary (self-restoring insulation).

3.7.116
clearance

[IEV 441-17-31]

3.7.117
clearance between poles

[IEV 441-17-32]

3.7.118
clearance to earth

[IEV 441-17-33]

3.7.119
clearance between open contacts

IEV 441-17-34 is applicable with the following additional note:

NOTE When determining the total clearance, the sum of the distances should be taken into consideration.

3.7.120
isolating distance (of a pole of a mechanical switching device)

[IEV 441-17-35]

3.7.121
mechanical terminal load

external load acting on each terminal

NOTE 1 The external load is the result of the combined mechanical forces to which the disconnector or earthing switch may be subjected. Wind forces acting on the equipment itself are not included as they do not contribute to the external load.

NOTE 2 A disconnector or earthing switch may be subjected to several mechanical forces different in value, direction and point of action.

NOTE 3 The terminal loads as defined here do not usually apply to enclosed switchgear.

3.7.121.1
static mechanical terminal load

static mechanical terminal load at each terminal equivalent to the mechanical force to which this terminal of the disconnector or earthing switch is subjected by the flexible or rigid conductor connected to this terminal

3.7.121.2
dynamic mechanical terminal load

combination of the static mechanical load and the electromagnetic forces under short-circuit conditions

3.7.122
bus-transfer current switching

opening and closing of disconnectors under load when this load is not interrupted, but transferred from one bus to another

3.7.123

induced current switching

breaking or making of an earthing switch of inductive or capacitive currents that are induced in an earthed or unearthed system by a parallel high-voltage system

NOTE When two or more transmission lines are mounted together on line towers or where two or more lines mounted on different towers are located close by, energy will be induced electrostatically and electromagnetically from a live system into a de-energized system resulting in capacitive or inductive currents flowing in this system, depending whether it is earthed at one or at both ends.

4 Ratings

Clause 4 of IEC 60694 is applicable with the following additions to the list of ratings:

- k) rated short-circuit making current (for earthing switches only);
- l) rated contact zone (for divided support disconnectors only);
- m) rated mechanical terminal load;

and for rated voltages 52 kV and above:

- n) rated values of the bus-transfer current switching capability of disconnectors;
- o) rated values of the induced current switching capability of earthing switches.

4.1 Rated voltage (U_r)

Subclause 4.1 of IEC 60694 is applicable.

4.2 Rated insulation level

Subclause 4.2 of IEC 60694 is applicable with the following addition:

For disconnectors having an isolating distance in parallel to the base of the disconnector and having integral earthing switches, the safety requirements are fulfilled during the temporary approach of the earthing blade to the opposite live parts, if the 1 min power frequency withstand voltage for the smallest gap is not lower than that specified in 6.2.5.

NOTE 1 The temporary reduction of dielectric strength is not a general problem of safety requirements, except during the short period of operation of an earthing switch having a manual operating mechanism only. For this reason, and because no ageing is taken into consideration, the reduced dielectric strength is acceptable. An impulse voltage test is not required because of the very low probability of a lightning or switching impulse during the earthing procedure.

NOTE 2 If national safety regulations specify higher withstand values for earthing switches which have manual operating mechanisms only, this has to be agreed upon between user and manufacturer.

NOTE 3 If the minimum temporary clearance is larger than the clearances given in IEC 60071-2, no test is required.

4.3 Rated frequency (f_r)

Subclause 4.3 of IEC 60694 is applicable.

4.4 Rated normal current and temperature rise

Subclause 4.4 of IEC 60694 is applicable. This subclause generally applies only to disconnectors.

NOTE Consideration should be given to the skin effect depending on the shape, construction and material of the main current path of a disconnector operated with 60 Hz, because with rectangular-shaped conductors deviations of more than 5 % compared with 50 Hz have been experienced.

4.5 Rated short-time withstand current (I_k)

 Subclause 4.5 of IEC 62271-1 is applicable with the following addition.

The rated short-time withstand current of an earthing switch forming an integral part of a combined function earthing switch shall be equal to the rated short-time withstand current of the combined function earthing switch, unless otherwise specified. 

4.6 Rated peak withstand current (I_p)

 Subclause 4.6 of IEC 62271-1 is applicable with the following addition.

The rated peak withstand current of an earthing switch forming an integral part of a combined function earthing switch shall be equal to the rated peak withstand current of the combined function earthing switch, unless otherwise specified. 

4.7 Rated duration of short-circuit (t_k)

Subclause 4.7 of IEC 60694 is applicable with the following addition:

If an earthing switch is combined with a disconnector as a single unit, the rated duration of the short-time withstand current of the earthing switch shall, unless otherwise specified, be at least equal to that assigned to the disconnector.

4.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)

Subclause 4.8 of IEC 60694 is applicable.

4.9 Rated supply frequency of closing and opening devices and of auxiliary circuits

Subclause 4.9 of IEC 60694 is applicable.

4.10 Rated pressure of compressed gas supply for insulation and/or operation

Subclause 4.10 of IEC 60694 is applicable.

4.101 Rated short-circuit making current

Earthing switches to which a rated short-circuit making current has been assigned shall be capable of making at any applied voltage, up to and including that corresponding to their rated voltage, any current up to and including their rated short-circuit making current.

If an earthing switch has a rated short-circuit making current, this shall be equal to the rated peak withstand current.

 The rated short-circuit making current of an earthing switch forming an integral part of a combined function earthing switch shall be equal to the rated peak making current of the combined function earthing switch, unless otherwise specified. 

4.102 Rated contact zone

The manufacturer shall state the rated values of contact zone (indicated by x_r , y_r and z_r). The values in tables 1 and 2 are for reference only. The rated values shall be obtained from the manufacturer. This refers also to a tolerable angular displacement of the fixed contact.

For proper function of the disconnector or earthing switch, the user shall ensure that the fixed contact stays within these limits by considering the service conditions when specifying the substation design and the cantilever strength of insulators (see 8.102.3).

Table 1 – Recommended contact zones for "fixed" contacts supported by flexible conductors

Rated voltage (U_r) kV	x mm	y mm	z_1 mm	z_2 mm
72,5 – 100	100	300	200	300
123 – 145	100	350	200	300
170	200	400	200	300
245	200	500	250	450
300	200	500	250	450
362	200	500	300	450
420	200	500	300	500
550	200	600	400	500
Δ_2 800	250	650	450	550
1 100	300	700	500	600
1 200	300	700	500	600 Δ_2

x = total amplitude of longitudinal movement of the supporting conductor (temperature).

y = total horizontal deflection (perpendicular to supporting conductor) (wind).

z = vertical deflection (temperature and ice).

NOTE z_1 are values for short-span, z_2 are values for long-span of the flexible conductors to which the fixed contacts are mounted.

Table 2 – Recommended contact zones for "fixed" contacts supported by rigid conductors

Rated voltage (U_r) kV	x mm	y mm	z mm
72,5 – 100 – 123 – 145	100	100	100
170 – 245 – 300 – 362 – 420	150	150	150
550	175	175	175
800	200	200	200
Δ_2 1 100	250	250	250
1 200	250	250	250 Δ_2

x = total amplitude of longitudinal movement of the supporting conductor (temperature).

y = total horizontal deflection (perpendicular to supporting conductor) (wind).

z = vertical deflection (ice).

4.103 Rated mechanical terminal load

The rated mechanical terminal load shall be stated by the manufacturer.

Disconnectors and earthing switches shall be able to close and open while subjected to their rated static mechanical terminal loads.

The maximum static mechanical terminal load to which the terminal of a disconnector or earthing switch is allowed to be subjected under the most disadvantageous conditions is the rated static mechanical terminal load of this disconnector.

Recommended rated static mechanical terminal loads are given in table 3 and are intended to be used as a guide.

The maximum external dynamic mechanical load to which the terminal of a disconnector or earthing switch is allowed to be subjected is the rated dynamic mechanical load of this disconnector.

Disconnectors and earthing switches shall be able to withstand their rated dynamic mechanical terminal load under short-circuit.

The rating of the disconnector or earthing switch for terminal loads depends not only on the design, but also on the strength of the insulators used.

The required cantilever strength of an insulator shall be calculated taking into consideration the height of the terminal above the top of the insulator as well as additional forces acting on the insulator (see 3.7.121 and 8.102.3).

NOTE The terminal loads as defined in the following subclauses do not usually apply in enclosed switchgear.

Table 3 – Recommended static mechanical terminal loads

Rated voltage (U_r) KV	Rated normal current A	Two- and three-column disconnectors		Divided support disconnectors		Vertical Force F_c ^a
		Straight load F_{a1} and F_{a2}	Cross-load F_{b1} and F_{b2}	Straight load F_{a1} and F_{a2}	Cross-load F_{b1} and F_{b2}	
		In figure 7		In figure 8		N
		N	N	N	N	N
52 – 72,5	800 – 1 250	400	130	800	200	500
100-123-145	1 250	500	170	800	200	1 000
170	1 250	600	200	1 000	300	
	2 000	800	250	1 250	400	
245	800 – 1 250	800	270	1 250	400	1 250
	2 000	1 000	330	1 600	500	
300 – 362	2 000	1 000	400	1 600	500	
	3 150	1 500	500	1 800	600	1 500
420	2 000	1 600	530	2 000	800	
	4 000	2 000	660	4 000	1 600	
550	2 000	1 600	530	2 000	800	1 500
	4 000	2 000	660	4 000	1 600	
800	2 000	1 600	530	2 000	800	1 500
	4 000	2 000	660	4 000	1 600	
^{A2} 1 100 – 1 200	≤ 4 000	2 000	660	4 000	1 600	2 000 ^{A2}
	> 4 000	2 500	1 000	5 000	2 000	

^a F_c simulates the downward forces caused by the weight of the connecting conductors. With flexible conductors the weight is included in the longitudinal or perpendicular forces.

4.104 Rated values of the bus-transfer current switching capability of disconnectors

The rated values are given together with all other details in annex B.

This subclause is applicable to disconnectors rated 52 kV and above.

4.105 Rated values of the induced current switching capability of earthing switches

The rated values are given together with all other details in annex C.

This subclause is applicable to earthing switches rated 52 kV and above.

4.106 Rated values of mechanical endurance for disconnectors

A disconnector shall be able to perform the following number of operations taking into account the programme of maintenance specified by the manufacturer:

Table 3a – Classification of disconnectors for mechanical endurance

Class	Type of disconnector	Number of operating cycles
M0	Standard disconnector (normal mechanical endurance)	1 000
M1	Disconnector intended for use with a circuit-breaker of equal class (extended mechanical endurance)	2 000
M2	Disconnector intended for use with a circuit-breaker of equal class (extended mechanical endurance)	10 000

4.107 Rated values of electrical endurance for earthing switches

 Table 3b provides a classification of earthing switch for electrical endurance.

Table 7 – Classification of earthing switch for electrical endurance

Class	Type of earthing switch
E0	Earthing switches with no making capability
E1	Earthing switches with capability to withstand two short-circuit making operations
E2	Earthing switches with capability to withstand five short-circuit making operations



5 Design and construction

5.1 Requirements for liquids in disconnectors and earthing switches

Subclause 5.1 of IEC 60694 is applicable.

5.2 Requirements for gases in disconnectors and earthing switches

Subclause 5.2 of IEC 60694 is applicable.

5.3 Earthing of disconnectors and earthing switches

Subclause 5.3 of IEC 60694 is applicable with the following addition.

Metallic enclosures and operating mechanisms not mounted together with and not electrically connected to the metallic frame of the disconnector or earthing switch, shall be provided with an earthing terminal marked with the protective earth symbol.

5.4 Auxiliary and control equipment

Subclause 5.4 of IEC 60694 is applicable with reference to 5.104 of this standard.

5.5 Dependent power operation

Subclause 5.5 of IEC 60694 is applicable with the following additions.

This requirement applies also to disconnectors and earthing switches with dependent power operation having a rated switching and/or making current.

Disconnectors and earthing switches having a pneumatic or hydraulic operating device shall be capable of closing and opening when the supply pressure is between 85 % and 110 % of the rated value. For operation of releases see 5.8.

5.6 Stored energy operation

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 with the following additions:

- the nameplates of disconnectors and earthing switches (and their operating devices) shall be marked in accordance with table 4;
- the nameplate shall be visible in the position of normal service and installation.

Table 4 – Nameplate information

	Abbreviation	Unit	Disconnecter	Earthing switch ^b	Operating device
Manufacturer			x	x	x
Designation of type			x	x	x
Serial number			x	x	x
Year of manufacture			x	x	x
Rated voltage	U_r	kV	x	x	
Rated lightning impulse withstand voltage	U_p	kV	x	x	
Rated switching impulse withstand voltage for rated voltages 300 kV and above	U_s	kV	x	x	
Rated normal current	I_r	A	x		
Rated short-time withstand current	I_k	kA	x	x	
Rated duration of short-circuit	t_k	s	(x) ^a	(x) ^a	
Rated filling pressure for insulation and/or operation	P_{re}	MPa	x	x	x
Rated supply voltage of auxiliary circuits	U_a	V			x
Rated static mechanical terminal load	F	N	(x)	(x)	
Mechanical endurance class of disconnectors	M_r		(x) ^c		
Electrical endurance class of earthing switches	E_r			(x) ^c	
Mass (including liquid)	m	kg	(x)	(x)	(x)
NOTE 1 The marking of values indicated by x is mandatory.					
NOTE 2 The marking of values indicated by (x) is optional.					
NOTE 3 The word "rated" does not need to appear on the nameplate.					
^a Mandatory if t different from 1 s. ^b An earthing switch combined with a disconnector as a single unit does not require a separate nameplate unless it has a short-circuit rating different from the disconnector. ^c The class marking is mandatory if different from M0 or E0. It may be included into the type designation to avoid additional space requirement.					

5.11 Interlocking devices

Subclause 5.11 of IEC 60694 is applicable.

5.12 Position indication

Subclause 5.12 of IEC 60694 is applicable (see also 5.104).

5.13 Degree of protection by enclosures

Subclause 5.13 of IEC 60694 is applicable with the following addition for the cubicles of secondary equipment.

The degree of protection provided by cubicles for outdoor installation shall be a minimum of IP3XDW.

For indoor installations the degree of protection shall be not less than IP2X.

In addition, generally no protection of persons against inadvertent contact with hazardous parts is required after the enclosure has been opened (see clause 11 of IEC 60694).

5.14 Creepage distances

Subclause 5.14 of IEC 60694 is applicable with the following addition:

Although the creepage distance may correspond to 5.14 of IEC 60694, with parallel insulation the distance between the two parallel insulators has to be taken into consideration.

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 Special requirements for earthing switches

Flexible copper connections between movable parts of an earthing switch and its frame shall have a cross-section of at least 50 mm².

This minimum value of the cross-sectional area of copper connections is given to ensure mechanical strength and resistance to corrosion.

Where the flexible connection is used to carry the short-circuit current, it shall be designed accordingly. If another material is used, a suitable equivalent of cross-section shall be provided.

5.102 Requirements in respect of the isolating distance of disconnectors

For reasons of safety, disconnectors shall be designed in such a way that no dangerous leakage currents can pass from the terminals of one side to any of the terminals of the other side of the disconnector.

This safety requirement is met when any leakage current is led away to earth by a reliable earth connection or when the insulation involved is effectively protected against pollution in service.

NOTE It is usual that the isolating gap of a disconnector is longer than the phase-to-ground insulating distance since IEC 60694 specifies higher withstand test levels across the isolating distance than for the phase-to-ground insulation.

Where a long creepage distance is required, the phase-to-ground insulation distance should become longer than the isolating gap. For such cases, to maintain low probability of disruptive discharge across the isolating gap, the use of protective devices such as surge arresters or rod gaps may be necessary.

5.103 Mechanical strength

Disconnectors and earthing switches having a rated static mechanical terminal load when installed according to the manufacturer's instructions shall be able to withstand their rated static and dynamic mechanical terminal load without impairing their reliability or current-carrying capacity.

5.104 Operation of disconnectors and earthing switches – Position of the movable contact system and its indicating and signalling devices

5.104.1 Securing of position

Disconnectors and earthing switches, including their operating mechanisms, shall be designed in such a way that they cannot come out of their open or closed position by gravity, wind pressure, vibrations, reasonable shocks or accidental touching of the connecting rods of their operating system.

Disconnectors and earthing switches shall permit temporary mechanical locking in both the open and closed position for safety purposes (for example maintenance).

NOTE This last requirement need not be met in the case of disconnectors or earthing switches that are operated by means of a hook-stick.

5.104.2 Additional requirements for power-operated mechanisms

Power operated mechanisms shall also provide a manual operating facility. Connecting a hand-operating device (for instance a hand crank) to the power-operated mechanism shall ensure safe interruption of the control energy to the power-operated mechanism.

5.104.3 Indication and signalling of position

Indication and signalling of the closed and open position shall not take place unless the movable contacts have reached their closed or open position, respectively, and the first paragraph of 5.104.1 is fulfilled.

NOTE For the definition of "closed" and "open" see 3.6.110 and 3.6.111.

5.104.3.1 Indication of position

It shall be possible to know the operating position of the disconnector or earthing switch. For the open position this requirement is met if one of the following conditions is fulfilled:

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

NOTE In some countries the design of the disconnector is such that the isolating distance is visible.

The kinematic chain between the movable contacts and the position indicating device shall be designed with sufficient mechanical strength to meet the requirements of the specified tests (annex A). The position indicating kinematic chain shall be a continuous mechanical connection to ensure a positively driven operation. The position indicating device may be marked directly on a mechanical part of the power kinematic chain by suitable means. The strain-limiting device, if any, shall not be part of the position indicating kinematic chain.

Where all poles of a disconnector or earthing switch are mechanically coupled so as to be operable as a single unit, it is permissible to use a common position indicating device.

5.104.3.2 Electrical position signalling by auxiliary contacts

A common signal for all poles of a disconnector or earthing switch shall be given only if all poles of the disconnector or earthing switch have a position in accordance with 5.104.3.

Where all poles of a disconnector or earthing switch are mechanically coupled so as to be operable as a single unit, it is permissible to use a common position indicating device.

5.105 Maximum force required for manual operation

The values given below also apply to maintenance hand operation of normally motor-operated disconnectors and earthing switches.

NOTE These values include ice-breaking, if applicable.

The operating height above servicing level should be agreed between manufacturer and user.

5.105.1 Operation requiring more than one revolution

The force needed to operate a disconnector or earthing switch requiring more than one revolution (hand crank for example) shall not be higher than 60 N with a possible peak of 120 N during a maximum of 10 % of the total required revolutions.

5.105.2 Operation requiring up to one revolution

The force needed to operate a disconnector or earthing switch requiring up to one revolution (swing lever for example) should not exceed 250 N (refer to 5.6.3 of IEC 60694). A peak value of 450 N is accepted during a rotation of 15° maximum.

5.106 Dimensional tolerances

For the mounting dimensions and the dimensions of high-voltage connections as well as the earthing connections of disconnectors and earthing switches, the tolerances given in ISO 2768-1 shall apply for linear and angular dimensions.

6 Type tests

Clause 6 of IEC 60694 is applicable with the following additions:

6.1 General

Subclause 6.1 of IEC 60694 is applicable.

6.1.1 Grouping of tests

Subclause 6.1.1 of IEC 60694 is applicable with the following additions to the mandatory type tests given in IEC 60694:

Mandatory type tests:

- tests to prove satisfactory operation and mechanical endurance (6.102) (M);

Optional type tests:

- tests to prove the short-circuit making performance of earthing switches (6.101);
- tests to prove satisfactory operation under severe ice conditions (6.103);
- tests to prove satisfactory operation at temperature limits (6.104);
- tests to verify the proper function of position indicating devices (6.105 and annex A);

- tests to prove the bus-transfer current switching capability of disconnectors (6.106 and annex B);
- tests to prove the induced current-switching capability of earthing switches (6.107 and annex C);
- tests to prove the bus-charging current switching ability of disconnectors used in metal enclosed switchgear (6.108 and annex F).

For the mandatory tests, not more than four samples shall be used; for optional tests, additional test samples are accepted.

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 type-test reports

Refer to 6.1.3 of IEC 60694 with the following addition (where applicable):

The following details concerning insulators used during the type tests are of particular importance and shall be given in the relevant test reports:

- rated cantilever strength;
- rated torsional strength of support insulators (and operating insulators, where applicable);
- height and number of elements;
- creepage length and shed-profile.

In the case of dielectric tests, information shall be included regarding the smallest gap at which the indicating or signalling device can signal the position OPEN. The minimum size of the gap and the height above ground used for the test shall be stated (see 6.2.3). Also the distance of the lowest part of insulation to ground shall be given.

In the case of short-circuit tests, the following information shall be included:

- details of the mechanical and electrical connection of the tested switchgear to the other parts of the test circuit including the static terminal load and the dimensions of the conductor;
- information on the mounting arrangements used;
- details of the mounting of the fixed contact to the upper conductor with divided support disconnectors;
- arrangement of the operating mechanism of disconnector or earthing switch having one mechanism for three phases;
- the contact resistance before and after the short-circuit test;
- where access is possible, the contact force before and after tests.

6.2 Dielectric tests

Subclause 6.2 of IEC 60694 is applicable.

6.2.1 Ambient air conditions during tests

Subclause 6.2.1 of IEC 60694 is applicable.

6.2.2 Wet test procedure

Subclause 6.2.2 of IEC 60694 is applicable.

6.2.3 Conditions of disconnectors and earthing switches during dielectric tests

Subclause 6.2.3 of IEC 60694 is applicable with the following addition:

Dielectric tests on disconnectors or earthing switches when in the OPEN position shall be carried out with the minimum isolating distance for the disconnector or gap for the earthing switch at which the indicating or signalling device can signal the position OPEN or the minimum isolating distance compatible with the locking arrangements specified in 5.104, whichever is the smallest.

This requirement does not apply to independent operated indoor disconnectors and earthing switches.

6.2.4 Criteria to pass the test

Subclause 6.2.4 of IEC 60694 is applicable with the following addition.

The disconnector or earthing switch shall be considered to have passed the impulse tests if the following conditions are fulfilled:

- a) the number of disruptive discharges shall not exceed two for each series of 15 impulses;
- b) no disruptive discharges on non-self-restoring insulation shall occur.

This is verified by at least five impulses without disruptive discharge following that impulse out of the series of 15 impulses, which caused the last disruptive discharge. If this impulse is one of the last five out of the series of 15 impulses, additional impulses shall be applied.

If disruptive discharges occur and, for any reason, evidence cannot be given during testing that the disruptive discharges were on self-restoring insulation, after the completion of the dielectric tests the disconnector or earthing switch shall be dismantled and inspected. If punctures of non-self-restoring insulation are observed, the disconnector or earthing switch shall be considered to have failed the test.

NOTE 1 If the atmospheric correction factor K_t is less than 1,00 but greater than 0,95, it is permissible to follow the criteria stated in 6.2.4 of IEC 60694 if the correction factor is not applied during the tests. Then, if one or two disruptive discharges out of 15 impulses occur in the external insulation, the particular test series showing flashover(s) is repeated with the appropriate correction factor so that no external disruptive discharge occurs.

NOTE 2 For GIS disconnectors or earthing switches tested with test bushings which are not part of the disconnector or earthing switch, flashover across the test bushings should be disregarded and should not be counted.

NOTE 3 The determination of the location of the observed disruptive discharges should be carried out by the laboratory using sufficient detection means, for example, photographs, video recordings, internal inspection, etc.

Where applicable, the requirements of IEC 60298 and IEC 60517 shall be considered.

6.2.5 Application of the test voltage and test conditions

Subclause 6.2.5 of IEC 60694 is applicable with the following addition.

Disconnectors having an isolating distance in parallel to the base of the disconnector and having integrated earthing switches, shall be tested in the most unfavourable position of the earthing blade with the power frequency test voltage given in table 5 (see 4.2).

These tests are not required for disconnectors that can only be operated with both terminals de-energized.

Table 5 – Power frequency 1 min withstand voltages

U_r kV	Test voltage kV	
	Solidly earthed neutral	Unearthed neutral
72,5	84	94
100	116	130
123	142	160
145	167	188
170	196	221
245	283	-
300	346	-
362	418	-
420	484	-
550	635	-
800	924	-
Δ_2 1 100	1 270	-
1 200	1 386	- Δ_2

NOTE 1 For an explanatory note see annex D.

NOTE 2 These tests are not required with disconnectors of lower rated voltage.

6.2.6 Tests of disconnectors and earthing switches of a rated voltage $U_r \leq 245$ kV

Subclause 6.2.6 of IEC 60694 is applicable.

6.2.7 Test of disconnectors and earthing switches of rated voltage above 245 kV

Subclause 6.2.7 of IEC 60694 is applicable.

6.2.8 Artificial pollution tests

Subclause 6.2.8 of IEC 60694 is applicable with the following addition.

NOTE Care should be taken when considering the performance of parallel insulation under pollution and rain (additional pollution tests may be necessary).

6.2.9 Partial discharge tests

Subclause 6.2.9 of IEC 60694 is applicable.

6.2.10 Test on auxiliary and control circuits

Subclause 6.2.10 of IEC 60694 is applicable.

6.2.11 Voltage test as condition check

Subclause 6.2.11 of IEC 60694 is applicable.

6.3 Radio interference voltage (riv) test

Subclause 6.3 of IEC 60694 is applicable.

6.4 Measurement of the resistance of circuits

Subclause 6.4 of IEC 60694 is applicable.

6.5 Temperature-rise tests

Subclause 6.5 of IEC 60694 is applicable.

6.6 Short-time withstand current and peak withstand current tests

Subclause 6.6 of IEC 60694 is applicable.

6.6.1 Arrangement of the disconnectors and earthing switches and of the test circuit

Subclause 6.6.1 of IEC 60694 is applicable with the following additions:

6.6.1.101 General test conditions

The disconnector or earthing switch under test shall be installed with its own operating mechanism as far as necessary to make the test representative.

Disconnectors having accessories to accommodate a bus-transfer current switching capability, and earthing switches having accessories to accommodate induced current switching capability, shall be tested with these devices mounted.

Tests shall be carried out employing the least favourable position of the operating mechanism and the main contacts. Consideration should be given to 5.104.3 and, where applicable, to annex A.

Where the design requires an adjustment of the position indicator or the position signalling device, this shall be performed according to the instruction manual. No deviation of these devices is acceptable for dielectric tests and short-circuit tests.

If the design allows tolerances, these shall be declared by the manufacturer prior to the test. The short-time withstand current and peak current withstand tests shall be performed with the signalling device set at the maximum or minimum specified tolerance giving the least favourable status of the main contacts indicated by the signalling device. This requirement does not apply to independent operated indoor disconnectors and earthing switches.

In any case, the same setting of the position signalling device shall be used for the dielectric test and the short-time withstand current and peak withstand current tests.

NOTE The least favourable status of the main contacts is for dielectric tests, the smallest gap at which the "OPEN" signal appears, and for short-circuit tests the first position at which during closing operation the "CLOSED" signal appears.

To make the test results generally applicable, disconnectors and earthing switches shall be tested with the test arrangements specified in figures 3, 4, 5 or 6. Where flexible conductors are used in the test set-up, disconnectors and earthing switches shall be loaded with their rated static mechanical terminal loads.

The test arrangement shall also be representative of the least favourable conditions of electromagnetic forces tending to open the disconnector or earthing switch. The tests on an earthing switch integral to a disconnector shall be made with the same test connections as for the disconnector test.

Disconnectors or earthing switches having one common operating mechanism for three poles shall be tested with the operating mechanism mounted at a distance from the pole under test, which shall not be less than the phase distance.

Earthing switches not forming an integral part of a disconnector shall be tested in an arrangement that fulfils the same requirements as for disconnectors.

Disconnectors and earthing switches integrated in enclosed switchgear shall be tested as part of the switchgear assembly according to IEC 60298, IEC 60466 or IEC 60517.

For divided support disconnectors the vertical position of the contact in the contact zone shall be chosen to represent the most unfavourable condition with respect to the mounting of the fixed contact to flexible conductors or a rigid conductor. In case of doubt the tests shall be performed in the highest and the lowest position of the contact within the rated contact zone.

All tests should preferably be performed three-phase. If a single-phase test is performed, the test should preferably be performed on two adjacent poles. If the test is performed on one pole, the return conductor shall be at phase distance from the tested pole. The return conductor shall be parallel to the main current path of the disconnector or earthing switch and at the same elevation above the base, or the equivalent, for disconnectors and earthing switches with vertical blade. The length of the return conductor shall be as given in figures 3 to 6, as appropriate.

6.6.1.102 Disconnectors and earthing switches with rated voltages below 52kV

The test arrangement given in figure 3 shall be used for disconnectors and earthing switches.

6.6.1.103 Disconnectors and earthing switches with rated voltages of 52 kV and above

The single-phase test arrangement given in figure 4 shall be used for disconnectors with a horizontal isolating distance and the relevant earthing switches; the test arrangement given in figures 5 and 6 shall be used for divided support disconnectors with a vertical isolating gap and the relevant earthing switches.

NOTE Deviations from these test arrangements are only acceptable when based on an agreement between user and manufacturer which might be necessary because of special requirements given by the service conditions.

Three-phase test arrangements shall follow the same general pattern as the single-phase test arrangements of figures 4 to 6.

6.6.2 Test current and duration

Subclause 6.6.2 of IEC 60694 is applicable.

6.6.3 Behaviour of disconnectors and earthing switches during test

Subclause 6.6.3 of IEC 60694 is applicable with the following addition:

- a) The rated peak withstand current and the rated short-time withstand current, carried by a disconnector in the closed position during the rated duration of short circuit, shall not cause
 - mechanical damage to any part of the disconnector;
 - separation of the contacts;
 - arcing.

The behaviour of the contact system during the short-circuit test shall be documented by recording the voltage drop across the main current path of the disconnector.

- b) For earthing switches the rated peak and short-time currents shall not cause substantial contact erosion or substantial contact welding.

Where contact erosion or contact welding is observed following the short-time withstand and peak withstand current test, a second peak withstand current test shall be carried out without any maintenance permitted between the two tests. Sufficient time needs to be allowed between the tests for the contacts to cool down. A no load-operation shall be performed before the second test.