

Specification for

Alternating current disconnectors and earthing switches

The European Standard EN 60129:1994, with the incorporation of its Amendment A1:1994, has the status of a British Standard

ICS 29.120.60

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National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee and is the English language version of EN 60129:1994 *Alternating current disconnectors and earthing switches* and its amendments A1:1994 and A2:1996, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 129:1984 including its amendments 1:1992 and 2:1996, published by the International Electrotechnical Commission (IEC).

This standard supersedes BS 5253:1990, which is withdrawn. Lower voltage isolators and selectors are covered by BS EN 60947-3:1992.

The text of Amendment A1 to EN 60129 is shown by a sideline in the margin. References in the text to IEC page numbers should be ignored.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Alternating current disconnectors and earthing switches

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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.

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CENELEC

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Foreword

At the request of the 76th Technical Board of CENELEC, HD 408 S2:1990 (IEC 129:1984) was submitted to the CENELEC voting procedure for conversion into a European Standard.

The text of the International Standard was approved by CENELEC as EN 60129 on 8 March 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-03-15
- latest date of withdrawal of conflicting national standards (dow) —

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative.

Foreword of EN 60129:1994/A1:1994

The CENELEC questionnaire procedure, performed for finding out whether or not amendment 1:1992 to the International Standard IEC 129:1984 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as a European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as amendment A1 to EN 60129 on 8 March 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-03-15
- latest date of withdrawal of conflicting national standards (dow) 1995-03-15

Foreword of amendment A2

The text of document 17A/468/FDIS, future amendment 2 to IEC 129:1984, 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 amendment A2 to EN 60129:1994 on 1996-07-02.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-04-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-04-01

Annexes designated “normative” are part of the body of the standard.

In this standard, Annex ZA is normative.

Annex ZA has been added by CENELEC.

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1 Scope

This standard applies to alternating current disconnectors and earthing switches, designed for indoor and outdoor installation, for voltages above 1 000 V and for service frequencies up to and including 60 Hz.

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

This standard does not deal with additional requirements for disconnectors and earthing switches in enclosed switchgear and controlgear as these are covered by IEC Publications 298: A.C. Metal-enclosed Switchgear and Controlgear for Rated Voltages Above 1 kV and up to and including 72.5 kV, 466: High-voltage Insulation-enclosed Switchgear and Controlgear and 517: High-voltage Metal-enclosed Switchgear for Rated Voltages of 72.5 kV and Above.

When a position indicating device is used as alternative to the visible isolating distance or gap and is connected to the movable contacts of disconnectors or earthing switches by a mechanical connection the following instructions shall be applied.

NOTE The IEC standards (IEC 129 subclause 5.104.2, IEC 298 subclause 5.105, IEC 265-1 subclause 5.104.2, IEC 265-2 subclause 5.103.2 and IEC 517 subclause 5.106) accept as an alternative to a visible isolating distance or gap that the moving contact position is shown by a reliable indicating device. In this standard, additional design and testing requirements are given and they have to be implemented in order that the indicating device can be considered reliable.

NOTE Disconnectors in which a fuse is an integral part are not covered by this standard.

2 Normal and special service conditions

Clause 2 of IEC Publication 694: Common Clauses for High-voltage Switchgear and Controlgear Standards, is applicable.

3 Definitions

In this clause references are made to definitions in IEC Publication 50(441): International Electrotechnical Vocabulary (IEV), Chapter 441: Switchgear, Controlgear and Fuses, and Publication 50(151), Chapter 151: Electrical and Magnetic Devices, when the relevant definitions exist.

For the purpose of this standard, the following definitions are applicable:

3.101 General terms

3.101.1 switchgear and controlgear (441-11-01)

3.101.2 Indoor switchgear and controlgear (441-11-04)

3.101.3 outdoor switchgear and controlgear (441-11-05)

3.101.4 ambient air temperature (441-11-13)

3.101.5 temperature rise (of a part of a disconnector or earthing switch)

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

3.102 Switching devices

3.102.1 disconnector

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

NOTE “Negligible current” implies currents such as the capacitance currents of bushings, busbars, connections, very short lengths of cables, currents of permanently connected grading impedances of circuit-breakers and currents of voltage transformers and dividers. For rated voltages of 420 kV and below, a current not exceeding 0.5 A is deemed to be a negligible current for the purpose of this definition; for rated voltages above 420 kV, 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.

3.102.2 divided support disconnector (earthing switch) (441-14-06(07))

3.102.3 centre-break disconnector (441-14-08)

3.102.4 double-break disconnector (441-14-09)

3.102.5 Earthing switch (441-14-11)

3.102.5.1 earthing switch class A

an earthing switch not falling into the category of class B as defined in 3.102.5.2

3.102.5.2

earthing switch class B

an earthing switch designed so as not to require maintenance of the main contacts during the expected operating life of the earthing switch, and only minimal maintenance of its other parts

NOTE 1 Minimal maintenance may include lubrication, replenishment of gas and cleaning of external surfaces, where applicable.

NOTE 2 This definition is limited to earthing switches having a rated voltage less than 52 kV

NOTE 3 There are two choices: use an earthing switch requiring maintenance of its main contacts and maintain as needed during its expected working life, or use a class B earthing switch but expect a more onerous testing regime to check its capability.

3.102.6

switch-disconnector (441-14-12)

3.103 Parts of switching devices

3.103.1

pole (441-15-01)

3.103.2

main circuit (441-15-02)

3.103.3

control circuit (441-15-03)

3.103.4

auxiliary circuit (441-15-04)

3.103.5

contact (441-15-05)

3.103.6

contact piece (441-15-06)

3.103.7

main contact (441-15-07)

3.103.8

auxiliary contact (441-15-10)

3.103.9

control contact (441-15-09)

3.103.10

a-contact, make contact (441-15-12)

3.103.11

b-contact, break contact (441-15-13)

3.103.12

position indicating device (441-15-25)

3.103.13

position-signalling device

a part of a disconnector or earthing switch which enables a signal to be given, generally at a location remote from the disconnector or earthing switch, indicating whether the contacts of the main circuit are in the open or closed position

3.103.14

terminal (151-01-03)

3.103.15

contact zone (for divided support disconnectors and earthing switches)

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

3.103.16

power kinematic chain

the mechanical connecting system from and including the operating mechanism up to and including the moving contacts (refer to Figure 10)

3.103.17

position indicating kinematic chain

the mechanical connecting system from and including the moving contacts up to and including the indicating device

3.103.18

connecting point

the most upstream point of the common part of the kinematic chains (power and indicating)

3.103.19

opening point

the nearest accessible point upstream of the connecting point where the power kinematic chain may be opened

3.103.20

test positions

— for disconnectors: the closed position with moving contact locked;

— for earthing switches: the open position with moving contact locked.

In the case of a multipolar switching device, only the moving contact of the pole with the greatest length of the power kinematic chain is locked

3.104 Operation (of a mechanical switching device)

3.104.1

operation (441-16-01)

3.104.2

operating cycle (441-16-02)

3.104.3

closing operation (441-16-08)

3.104.4

opening operation (441-16-09)

3.104.5

dependent manual operation (441-16-13)

3.104.6

dependent power operation (441-16-14)

3.104.7
stored energy operation (441-16-15)

3.104.8
independent manual operation (441-16-16)

3.104.9
closed position (441-16-22)

3.104.10
open position (441-16-23)

3.104.11
interlocking device (441-16-49)

3.105 Characteristic quantities

3.105.1
prospective current (of a circuit and with respect to a disconnector or to an earthing switch) (441-17-01)

3.105.2
prospective peak current
the peak value of the first major loop of the prospective current during the transient period following initiation

NOTE The definition assumes that the current is made by an ideal switching device, i.e. with instantaneous and simultaneous transition of its impedance across the terminals of each pole from infinity to zero. The peak value may differ from one pole to another; it depends on the instant of current initiation relative to the voltage wave across the terminals of each pole.

3.105.3
maximum prospective peak current (of an a.c. circuit) (441-17-04)

3.105.4
(peak) making current (of an earthing switch)

The 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 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, this is, unless otherwise stated, the highest value in any phase.

3.105.5
peak current

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

3.105.6
normal current (of a disconnector)

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

3.105.7
short-time withstand current (441-17-17)

3.105.8
peak withstand current (441-17-18)

3.105.9
rated value (151-04-03)

3.105.10
insulation level (151-04-14)

3.105.11
 I_{min} power frequency withstand voltage

the 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

3.105.12
impulse withstand voltage

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

NOTE Depending on the shape of the wave, the term may be qualified as switching impulse withstand voltage or lightning impulse withstand voltage.

3.105.13
external insulation

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

3.105.14
internal insulation

the internal solid, liquid or gaseous parts of the insulation of equipment which are protected from the effects of atmospheric and other external conditions such as pollution, humidity, vermin, etc.

3.105.15
self-restoring insulation

insulation which completely recovers its insulating properties after a disruptive discharge caused by the application of a test voltage. Insulation of this kind is generally, but not necessarily, external insulation

3.105.16
non-self-restoring insulation

insulation which loses its insulating properties or does not recover them completely after a disruptive discharge caused by the application of a test voltage. Insulation of this kind is generally, but not necessarily, internal insulation

3.105.17

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 in 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).

3.105.18

clearance (441-17-31)

3.105.19

clearance between poles (441-17-32)

3.105.20

clearance to earth (441-17-33)

3.105.21

clearance between open contacts (gap) (441-17-34)

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.

3.105.22

isolating distance (441-17-35)

3.105.23

mechanical terminal load

the external mechanical load at each terminal equivalent to the combined mechanical forces to which the disconnector or earthing switch may be subjected, not including wind forces acting on the equipment itself

NOTE 1 A disconnector or earthing switch may be subjected to several mechanical forces different in value, direction and point of action.

NOTE 2 Mechanical terminal loads do not include electromagnetic forces of short-circuit currents.

4 Rating

Clause 4 of IEC Publication 694: 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
- m) Rated mechanical terminal load
- n) Rated values of maximum force required for manual operation (under consideration).

4.1 Rated voltage

Sub-clause 4.1 of IEC Publication 694 is applicable.

4.2 Rated insulation level

Sub-clause 4.2 of IEC Publication 694 is applicable with the following additions:

For rated voltages 72.5 kV and below, the current practice in the United States of America and Canada is given in Table I.

Disconnectors with rated voltage 300 kV and above are divided into two classes depending upon their rated switching impulse withstand voltage across open poles. Referring to Table IV of IEC Publication 694, the rated values in column 5 apply to Class A disconnectors and those in column 6 apply to Class B disconnectors.

4.3 Rated frequency

Sub-clause 4.3 of IEC Publication 694 is applicable.

4.4 Rated normal current and temperature rise

Sub-clause 4.4 of IEC Publication 694 is applicable. This sub-clause applies only for disconnectors.

4.5 Rated short-time withstand current

Sub-clause 4.5 of IEC Publication 694 is applicable with the following addition:

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

4.6 Rated peak withstand current

Sub-clause 4.6 of IEC Publication 694 is applicable with the following addition:

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

4.7 Rated duration of short circuit

Sub-clause 4.7 of IEC Publication 694 is applicable.

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

Sub-clause 4.8 of IEC Publication 694 is applicable.

4.9 Rated supply frequency of operating devices and auxiliary circuits

Sub-clause 4.9 of IEC Publication 694 is applicable.

4.10 Rated pressure of compressed gas supply for operation

Sub-clause 4.10 of IEC Publication 694 is applicable.

Table I — Series II (based upon current practice in the United States of America and Canada, for 60 Hz only)

Rated voltage (kV) (r.m.s)	Rated lightning impulse withstand voltage (kV) (peak)				Rated power-frequency withstand voltage (kV) (r.m.s.)					
	To earth and between poles		Across the isolating distance		To earth and between poles			Across the isolating distance		
1)	2)		3)		4)			5)		
	Indoor	Outdoor	Indoor	Outdoor	Indoor 1 min dry	Outdoor 1 min dry 10 s wet ^a		Indoor 1 min dry	Outdoor 1 min dry	10 s wet ^a
4.76	60	—	70	—	19	—	—	21	—	—
8.25	75	95	80	105	26	35	30	29	39	33
15	95	—	105	—	36	—	—	40	—	—
15.5	110	110	125	125	50	50	45	55	55	50
25.8	125	150	140	165	60	70	60	66	77	66
38	150	200	165	220	80	95	80	88	105	88
48.3	—	250	—	275	—	120	100	—	132	110
72.5	—	350	—	385	—	175	145	—	195	160

^a Test requirements are given in IEC Publication 60-1: High-voltage Test Techniques. Part 1: General Definitions and Test Requirements.

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.

4.102 Rated contact zone

Divided frame disconnectors and earthing switches shall be able to operate within the limits of their rated contact zone.

The manufacturer shall state the values of maximum and minimum mechanical reaction forces and the method of fixing the “fixed” contact required in case these forces are relevant to the satisfactory operating conditions of the disconnector or earthing switch.

Examples of rated contact zones of pantograph and semi-pantograph disconnectors and earthing switches having “fixed” contacts supported by flexible conductors are illustrated in Figure 1 and Figure 2 and given in Table IIA.

Table IIA — Examples of rated contact zones for “fixed” contact pieces supported by flexible conductors

Rated voltage (kV)	<i>L</i> (m)	<i>S</i> (m)	<i>U</i> (m)
72.5	0.30	0.20	0.20
100	0.30	0.20	0.20
123	0.35	0.20	0.25
145	0.35	0.20	0.25
170	0.40	0.20	0.30
245	0.50	0.25	0.30
300	0.50	0.25	0.35
362	0.50	0.30	0.35
420	0.50	0.30	0.40
525	0.60	0.40	0.50
550	0.60	0.40	0.50
765	0.70	0.50	0.60

L = horizontal deflection
S = vertical deflection
U = total amplitude of longitudinal movement with respect to supporting conductor

Examples of rated contact zones of pantograph and semi-pantograph disconnectors and earthing switches having “fixed” contacts supported by rigid conductors are given in Table IIB and in Figure 3.

Table IIB — Examples of rated contact zones for “fixed” contact pieces supported by rigid conductors

Rated voltage (kV)	<i>L</i> (m)	<i>S</i> (m)	<i>U</i> (m)
72.5	0.10	0.10	0.10
100	0.10	0.10	0.10
123	0.10	0.10	0.10
145	0.10	0.10	0.10
170	0.15	0.15	0.20
245	0.15	0.15	0.20
300	0.15	0.15	0.20
362	0.15	0.15	0.20
420	0.15	0.15	0.20
525	0.20	0.20	0.25
550	0.20	0.20	0.25
765	0.25	0.25	0.30
<i>L</i> = horizontal deflection <i>S</i> = vertical deflection <i>U</i> = total amplitude of longitudinal movement with respect to supporting conductor			

The rated contact zones of other types of divided support disconnectors and earthing switches, for example suspended disconnectors, are determined by agreement between manufacturer and user.

4.103 Rated mechanical terminal load

Disconnectors and earthing switches should be able to close and open whilst subjected to their rated mechanical terminal loads, where assigned, plus wind loads acting on the equipment itself.

NOTE Wind loads on outdoor equipment and conductors are of a variable nature and are increased by the presence of ice or hoar frost. Methods of proving that wind loads will not endanger the equipment are under consideration.

Rated mechanical terminal loads need not be assigned to disconnectors and earthing switches which are not intended to be subject to substantial mechanical terminal loads.

Some examples of rated mechanical terminal loads (not including wind forces on the equipment itself) are given in Table III and are intended to be used as a guide.

4.104 Rated values of maximum force required for manual operation

Under consideration.

4.105 Behaviour when carrying rated peak withstand current and rated short-time withstand current

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:

- material mechanical damage to any part of the disconnector;
- separation of the contacts;
- a temperature rise that, added to the maximum temperature obtained when carrying the rated normal current continuously, is likely to damage the insulation.

After the passage of these currents, the disconnector shall be able to carry its rated normal current without its temperature rise exceeding the values specified in Table V, Sub-clause 4.4.2 of IEC Publication 694, and shall be capable of operating under conditions specified therein in Sub-clauses 4.8 to 4.10.

b) The rated peak withstand current and the rated short-time withstand current, carried by an earthing switch in the closed position during the rated duration of short circuit, shall not cause:

- material mechanical damage to any part of the earthing switch;
- separation of the contacts or substantial contact welding;
- a temperature rise likely to damage the insulation.

NOTE Only light welding of contacts is permitted provided the earthing switch can be operated under the conditions given in Sub-clause 6.5.4 of IEC Publication 694.

4.106 Behaviour of earthing switches when making short-circuit currents

Earthing switches having a rated short-circuit making current shall, when making short circuit, comply with the following conditions of behaviour:

a) During operation, the earthing switch shall neither show signs of excessive distress nor endanger the operator.

From liquid-filled earthing switches, there shall be no outward emission of flame, and the gases produced, together with the liquid carried with the gases, shall be allowed to escape in such a way as not to cause electrical breakdown.