

Specification for

Alternating current disconnectors and earthing switches

Sectionneurs et sectionneurs de terre à courant
alternatif

Wechselstromtrennschalter und
Erdungsschalter

Committees responsible for this British Standard

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ASTA Certification Services
Association of Manufacturers Allied to the Electrical and Electronics Industry (BEAMA Ltd.)
British Railways Board
Copper Development Association
Department of the Environment (Property Services Agency)
ERA Technology Ltd.
Electricity Supply Industry in England and Wales
GAMBICA (BEAMA Ltd.)
Health and Safety Executive
Transmission and Distribution Association (BEAMA Ltd.)

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Association of Consulting Engineers
Association of Supervisory and Executive Engineers
British Gas plc
Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
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National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee. It is identical with IEC 129 : 1984 'Alternating current disconnectors and earthing switches' published by the International Electrotechnical Commission (IEC) and implements harmonization document HD 408 S2 : 1990 published by the European Committee for Electrotechnical Standardization (CENELEC).

This standard supersedes BS 5253 : 1975, which is withdrawn. Lower voltage isolators and selectors are covered by BS 5419 : 1987.

Cross-references

International standard	Corresponding British Standard
	BS 4727 Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms
IEC 50(151) : 1978	Part 1 : Group 02 : 1980 Electrical and magnetic devices terminology (Technically equivalent)
IEC 50(441) : 1984	Part 2 : Group 06 : 1985 Switchgear and controlgear terminology (including fuse terminology) (Technically equivalent)
IEC 60-1 : 1973	BS 923 Guide on high-voltage testing techniques Part 1 : 1980 General (Identical)
IEC 137 : 1984	BS 223 : 1985 Specification for bushings for alternating voltages above 1000 V (Technically equivalent)
IEC 270 : 1981	BS 4828 : 1985 Guide for partial discharge measurements (Identical)
IEC 694 : 1980	BS 6581 : 1985 Specification for common requirements for high-voltage switchgear and controlgear standards (Identical)

The Technical Committee has reviewed the provisions of IEC 265, IEC 298 : 1981, IEC 466 : 1987 and IEC 517 : 1986, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. A related British Standard to IEC 265 is BS 5463 'Specification for a.c. switches of rated voltage above 1 kV'. A related British Standard to IEC 298 : 1981 is BS 5227 : 1984 'Specification for a.c. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 72.5 kV'. A related British Standard to IEC 517 : 1986 is BS 5524 : 1987 'Specification for gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above'.

Additional information.

The text of an informative annex to HD 408 S2 is given below.

Rated voltages

To take account of a special national condition where there are appreciable discrepancies between actual network voltages and the next high test IEC rated voltages, two additional rated voltages are permitted, those being 41.5 kV and 82.5 kV.

The rated lightning impulse withstand voltage and the rated one minute power-frequency withstand voltage related to these values are given in HD 448 S2.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

ALTERNATING CURRENT DISCONNECTORS AND EARTHING SWITCHES

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.

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 *Disconnecter*

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)*

3.102.6 *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.

3.104 *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.

Notes 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.

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 *1 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.

- Notes* 1. — The term applies to discharges in solid, liquid and gaseous dielectrics and to combinations of these.
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.

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

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.

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		Indoor 1 min dry	Outdoor	
						1 min dry	10 s wet*		1 min dry	10 s wet*
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

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

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.

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 disconnectors and earthing switches having “fixed” contact pieces supported by flexible conductors are illustrated in Figures 1 and 2, pages 74 and 75, 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
<i>L</i> = horizontal deflection <i>S</i> = vertical deflection <i>U</i> = total amplitude of longitudinal movement with respect to supporting conductor			

Examples of rated contact zones of disconnectors and earthing switches having “fixed” contacts supported by rigid conductors are given in Table IIB and in Figure 3, page 76.

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			

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.

TABLE III
Examples of rated mechanical terminal loads

Rated voltage (kV)	Rated normal current (A)	Two- and three-column disconnectors		Divided support disconnectors	
		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 8, page 81		In Figure 9, page 82	
		(N)	(N)	(N)	(N)
72.5	800-1 250	400	130	800	200
100-123-145	1 250	500	170	800	200
245	800-1 250	800	270	1 250	400
	2 000	1 000	330	1 600	500
420	2 000	1 600	530	2 000	800
	4 000	2 000	660	4 000	1 600

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.