

Common clauses for high-voltage switchgear and controlgear standards —

(Implementation of
CENELEC HD 448 S3)

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- ASTA Certification Services
- Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)
- British Railways Board
- Copper Development Association
- ERA Technology Ltd.
- Electricity Association
- GAMBICA (BEAMA Ltd.)
- Health and Safety Executive
- Ministry of Defence
- Transmission and Distribution Association (BEAMA Ltd.)

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- Association of Consulting Engineers
- British Cable Makers' Confederation
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
- Engineering Equipment and Materials Users' Association
- Institution of Incorporated Executive Engineers

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National foreword

This British Standard has been prepared by Technical Committee PEL/17 and is the English language version of HD 448 S3:1995, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 694:1980 and its amendments 1:1985 and 2:1993 published by the International Electrotechnical Commission (IEC).

This British Standard supersedes BS 6581:1985 which is withdrawn.

Cross-references

Publications referred to	Corresponding British Standard
HD 472 S1:1988 (IEC 38:1975)	BS 7697:1993 <i>Nominal voltages for low voltage public electricity supply systems</i>
IEC 50(441):1974	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms</i> Part 2. <i>Terms particular to power engineering</i> Group 06:1985 <i>Switchgear and controlgear terminology (including fuse terminology)</i> BS 923 <i>Guide on high-voltage testing techniques</i> Part 1:1990 <i>General</i>
HD 588.1 S1:1991 (IEC 60-1:1989)	
EN 60060-2:1994 (IEC 60-2:1994)	BS EN 60060 <i>High-voltage test techniques</i> Part 2:1995 <i>Measuring systems</i> BS 5622 <i>Guide for insulation co-ordination</i> Part 1:1979 <i>Terms, definitions, principles and rules</i> Part 2:1979 <i>Application guide</i>
IEC 71-1:1976	
HD 540.2 S1:1991 (IEC 71-2:1976)	
HD 566 S1:1990 (IEC 85:1984)	BS 2757:1986 <i>Method for determining the thermal classification of electrical insulation</i>
IEC 270:1981	BS 4828:1985 <i>Guide for partial discharge measurements</i>
EN 60507:1993 (IEC 507:1991)	BS EN 60507:1993 <i>Artificial pollution tests on high-voltage insulators to be used on a.c. systems</i>
IEC 233:1974	BS 4963:1973 <i>Specification for tests on hollow insulators for use in high voltage electrical equipment</i>
HD 578 S1:1992 (IEC 273:1990)	BS 3297 <i>Post insulators of ceramic material or glass for nominal voltages greater than 1 000 V</i> Part 2:1993 <i>Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1 000 V</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the HD title page, pages 2 to 32, 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.

Descriptors: High-voltage switchgear and controlgear, requirements, testing

English version

Common clauses for high-voltage switchgear and controlgear standards

(IEC 694:1980 + A1:1985 + A2:1993)

Clauses communes pour les normes de l'appareillage à haute tension
(CEI 694:1980 + A1:1985 + A2:1993)

Gemeinsame Bestimmungen für Hochspannungsschaltgeräte-Normen
(IEC 694:1980 + A1:1985 + A2:1993)

This Harmonization Document was approved by CENELEC on 1994-12-06. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this Harmonization Document on a national level.

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

This Harmonization Document exists in three official versions (English, French, German).

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of the International Standard IEC 694:1980 and its amendments 1:1985 and 2:1993, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the formal vote and was approved by CENELEC as HD 448 S3 on 1994-12-06 without any modification.

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- latest date by which the national standards conflicting with the HD have to be withdrawn (dow) 1995-12-01

Appendices and annexes designated “normative” are part of the body of the standard. In this standard, Annex A and Appendix B and Annex ZA and Annex ZB are normative. Annex ZA and Annex ZB have been added by CENELEC.

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1 Scope

This standard applies to a.c. switchgear and controlgear, designed for indoor and outdoor installation and for operation at service frequencies up to and including 60 Hz on systems having voltages above 1 000 V.

This standard applies to all high-voltage switchgear and controlgear except as otherwise specified in the relevant IEC standards for the particular type of switchgear and controlgear.

2 Normal and special service conditions

Unless otherwise specified, high-voltage switchgear and controlgear, including the operating devices and the auxiliary equipment which form an integral part of it, is intended to be used at its rated characteristics under the normal service conditions listed in Sub-clause 2.1.

If the actual service conditions differ from these normal service conditions, high-voltage switchgear and controlgear and associated operating devices and auxiliary equipment shall be designed to comply with any special service conditions required by the user, or appropriate arrangements shall be made (see Sub-clause 2.2).

NOTE Appropriate action should also be taken to ensure proper operation under such conditions of other components, such as relays.

2.1 Normal service conditions

2.1.1 Indoor switchgear and controlgear

- a) The ambient air temperature does not exceed 40 °C and its average value, measured over a period of 24 h, does not exceed 35 °C.

The minimum ambient air temperature is – 5 °C for class “minus 5 indoor” and – 25 °C for class “minus 25 indoor”.

- b) The altitude does not exceed 1 000 m.
- c) The ambient air is not significantly polluted by dust, smoke, corrosive or flammable gases, vapours or salt.
- d) The conditions of humidity are under consideration but, in the meantime, the following figures can be used as a guide:
 - the average value of the relative humidity, measured during a period of 24 h, does not exceed 95 %,
 - the average value of the vapour pressure, for a period of 24 h, does not exceed 22 mbar,
 - the average value of the relative humidity, for a period of one month, does not exceed 90 %,
 - the average value of the vapour pressure, for a period of one month, does not exceed 18 mbar.

For these conditions, condensation may occasionally occur.

NOTE 1 Condensation can be expected where sudden temperature changes occur in periods of high humidity.

NOTE 2 To withstand the effects of humidity and occasional condensation, such as breakdown of insulation or corrosion of metallic parts, indoor switchgear, designed for such conditions and tested accordingly, or outdoor switchgear may be used.

NOTE 3 Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station or by the use of dehumidifying equipment.

- e) Vibrations due to causes external to the switchgear and controlgear or earth tremors are negligible.

2.1.2 Outdoor switchgear and controlgear

- a) The ambient air temperature does not exceed 40 °C and its average value, measured over a period of 24 h, does not exceed 35 °C.

The minimum ambient air temperature is – 25 °C for class “minus 25 outdoor” and – 40 °C for class “minus 40 outdoor”.

- b) The altitude does not exceed 1 000 m.
- c) Ambient air pollution (classification is under consideration).
- d) The ice coating does not exceed 1 mm for Class 1, 10 mm for Class 10 and 20 mm for Class 20.
- e) The wind pressure does not exceed 700 Pa (corresponding to 34 m/s wind speed).
- f) Account should be taken of the presence of condensation or rain, rapid temperature changes, and the effects of solar radiation.

NOTE This does not imply that outdoor switchgear and controlgear will carry its rated normal current under all conditions of solar radiation without exceeding the specified temperature rise. When required, appropriate measures shall be taken, e.g. roofing, forced ventilation, etc.

g) Vibrations due to causes external to the switchgear and controlgear or earth tremors are negligible.

2.2 Special service conditions

By agreement between manufacturer and user, high-voltage switchgear and controlgear may be used under conditions different from the normal service conditions given in Subclause 2.1. For any special service condition, the manufacturer shall be consulted.

NOTE 1 For internal insulation, the dielectric characteristics are identical at any altitude and no special precautions need be taken. For definitions of external and internal insulation see IEC Publication 71-1.

NOTE 2 For low-voltage auxiliary equipment, no special precautions need be taken if the altitude is lower than 2 000 m.

3 Definitions

For the definitions of general terms used in this publication, reference is made to IEC Publication 50(441). (To be replaced by Publication 50(443), under consideration.)

4 Rating

The common ratings of switchgear and controlgear including their operating devices and auxiliary equipment should be selected from the following:

- a) Rated voltage.
- b) Rated insulation level.
- c) Rated frequency.
- d) Rated normal current.
- e) Rated short-time withstand current.
- f) Rated peak withstand current.
- g) Rated duration of short circuit.
- h) Rated supply voltage of closing and opening devices and of auxiliary circuits.
- i) Rated supply frequency of closing and opening devices and of auxiliary circuits.
- j) Rated pressure of compressed gas supply for operation.

NOTE Other rated characteristics may be necessary and will be specified in the relevant IEC standards.

4.1 Rated voltage

The rated voltage indicates the upper limit of the highest voltage of systems for which the switchgear and controlgear is intended. Standard values of rated voltages are given below:

NOTE For editorial reasons, mainly due to the characteristics of the transient recovery voltages, the subdivision in voltage ranges differs from that in IEC Publication 38 and IEC Publication 71.

4.1.1 For rated voltages of 72.5 kV and below

Series I 3.6 kV – 7.2 kV – 12 kV – 17.5 kV – 24 kV – 36 kV – 52 kV – 72.5 kV.

Series II 4.76 kV – 8.25 kV – 15 kV – 15.5 kV – 25.8 kV – 38 kV – 48.3 kV – 72.5 kV.

NOTE Series I 50 Hz and 60 Hz.

Series II 60 Hz, based on current practice in the United States of America and Canada.

4.1.2 For rated voltages above 72.5 kV

100 kV – 123 kV – 145 kV – 170 kV – 245 kV – 300 kV – 362 kV – 420 kV – 525 kV – 765 kV.

NOTE The value 550 kV is also used, as well as values between 765 kV and 800 kV.

4.2 Rated insulation level

The rated insulation level shall be selected from the values given in the following Table I, Table II, Table III and Table IV. The withstand voltage values in Table I, Table II, Table III and Table IV apply at the standard reference atmosphere (temperature, pressure and humidity) specified in IEC Publication 60.

4.2.1 Rated voltages up to and including 72.5 kV

In Table I and Table II, two series are given; Series I (Table I) is based on current practice in most European and several other countries. Series II (Table II) is mainly based on current practices in the United States of America and Canada.

The choice between lists 1 and 2 of Table I should be made by considering the degree of exposure to lightning and switching overvoltages, the type of system of neutral earthing and, where applicable, the type of overvoltage protective device (see IEC Publication 71).

Table I — Series I (based on current practice in most European and several other countries)

Rated voltage U (r.m.s. value) (kV)	Rated lightning impulse withstand voltage (peak value)				Rated 1 min power-frequency withstand voltage (r.m.s. value)	
	List 1		List 2		To earth, between poles and across open switching device (kV)	Across the isolating distance (kV)
	To earth, between poles and across open switching device (kV)	Across the isolating distance (kV)	To earth, between poles and across open switching device (kV)	Across the isolating distance (kV)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.6	20	23	40	46	10	12
7.2	40	46	60	70	20	23
12	60	70	75	85	28	32
17.5	75	85	95	110	38	45
24	95	110	125	145	50	60
36	145	165	170	195	70	80
52	—	—	250	290	95	110
72.5	—	—	325	375	140	160

NOTE The withstand voltage values “across the isolating distance” in Table I are valid only for the switching devices where the clearance between open contacts is designed to meet the safety requirements specified for disconnectors.

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

Under consideration.

4.2.2 Rated voltages from 100 kV to 245 kV

The voltages shall be selected from values given in Table III using the lightning impulse withstand voltage and the power-frequency withstand voltage value of the same line.

For the choice between the alternative values for the same rated voltage, see IEC Publication 71.

Table III

Rated voltage U (r.m.s. value) (kV)	Rated lightning impulse withstand voltage (peak value)		Rated 1 min power-frequency withstand voltage (r.m.s. value)	
	To earth, between poles and across open switching device (kV)	Across the isolating distance (kV)	To earth, between poles and across open switching device (kV)	Across the isolating distance (kV)
(1)	(2)	(3)	(4)	(5)
100	380	440	150	175
	450	520	185	210
123	450	520	185	210
	550	630	230	265
145	550	630	230	265
	650	750	275	315
170	650	750	275	315
	750	860	325	375
245	850	950	360	415
	950	1 050	395	460
	1 050	1 200	460	530

NOTE The withstand voltage values “across the isolating distance” in Table III are valid only for the switching devices where the clearance between open contacts is designed to meet the safety requirements specified for disconnectors.

4.2.3 Rated voltage 300 kV and above

The voltages shall be selected from values of Table IV using lightning impulse withstand voltage and switching impulse withstand voltage values of the same line.

For the choice between the alternative values for the same voltage, see IEC Publication 71.

Table IV

Rated voltage U (r.m.s. value) (kV)	Rated lightning impulse withstand voltage (peak value)		Rated switching impulse withstand voltage (peak value)			1 min power-frequency test withstand voltage (r.m.s. value)	
	To earth	Across open switching device	To earth	Across open switching device		To earth	Across open switching device
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
300	950 1 050	950 (+ 170) 1 050 (+ 170)	750 850	850	700 (+ 245)	380	435
362	1 050 1 175	1 050 (+ 205) 1 175 (+ 205)	850 950	950	800 (+ 295)	450	520
420	1 300 1 425	1 300 (+ 240) 1 425 (+ 240)	950 1 050	1 050	900 (+ 345)	520	610
525	1 425 1 550	1 425 (+ 300) 1 550 (+ 300)	1 050 1 175	1 175	900 (+ 430)	620	760
765	1 800 2 100	1 800 (+ 435) 2 100 (+ 435)	1 300 1 425	1 550	1 100 (+ 625)	830	1 100

NOTE 1 For column (1) it is permissible to adopt values between 765 kV and 800 kV provided that the test values for switching devices should be the same as defined by the IEC for 765 kV.

NOTE 2 For column (3), values in brackets are the peak values of the power-frequency voltage, $0.7 U \sqrt{2}/\sqrt{3}$, applied to the opposite terminal.

For column (6), values in brackets are the peak values of the power-frequency voltage, $U \sqrt{2}/\sqrt{3}$, applied to the opposite terminal.

NOTE 3 For column (7), values applicable:

a) for type tests to earth,

b) for routine tests to earth, and across the open switching device.

For column (8), values applicable for type tests only across the open switching device.

NOTE 4 The withstand voltage values "between poles" are under consideration and will be given in IEC Publication 71-3.

NOTE 5 The choice between alternative values of rated switching impulse withstand voltage in columns (5) and (6) across the open switching device is given in the relevant IEC standards for the particular type of switching device.

4.3 Rated frequency

The standard values of the rated frequency for three-pole switchgear and controlgear are 50 Hz or 60 Hz.

4.4 Rated normal current and temperature rise

4.4.1 Rated normal current

The rated normal current of a switching device is the r.m.s. value of the current which the switching device shall be able to carry continuously under specified conditions of use and behaviour.

The values of rated normal currents should be selected from the R 10 series, specified in IEC Publication 59.

NOTE Current ratings for temporary or for intermittent duty are subject to agreement between manufacturer and user.

4.4.2 Temperature rise

The temperature rise of any part of a switching device for an ambient air temperature not exceeding 40 °C shall not exceed the temperature-rise limits specified in Table V under the conditions specified in the test clauses.

NOTE In this standard, the terms "contact" and "connection" are used according to the following definitions:

Contact: Two or more conductors designed to establish circuit continuity when they touch, and which, due to their relative motion during operation, open or close circuit or (in the case of hinged or sliding contacts) maintain circuit continuity.

Connection (bolted or the equivalent): Two or more conductors designed to ensure permanent circuit continuity when forced together by means of screws, bolts or the equivalent.