
British Standard Specification for Common requirements for high-voltage switchgear and controlgear standards

[IEC title: Common clauses for high-voltage switchgear and controlgear standards]

Spécifications communes pour les normes de l'appareillage à haute tension

Anforderungen, die für alle Normen über Hochspannungsschalt- und Steuergeräte
gleichermaßen gelten

Contents

	Page		Page
National foreword	Inside front cover	3. Untitled	6
Committees responsible	Back cover	4. Untitled	7
Specification		5. Limits of temperature and temperature rise for various parts, materials and dielectrics of high-voltage switching devices	9
1. Scope	2	6. Direct current voltage	11
2. Normal and special service conditions	2	7. Alternating current voltage	12
3. Definitions	3	8. Impulse voltage tests and power-frequency voltage tests where the terminal opposite the energized terminal is earthed when testing the open switching device	18
4. Rating	4	9. Power-frequency voltage tests using two voltage sources where the voltage is applied to both terminals when testing the open switching device	19
5. Design and construction	12	10. Impulse voltage tests where the impulse is applied on the terminal opposite the terminal energized by the power-frequency voltage when testing the open switching device	19
6. Type tests	16		
7. Routine tests	28		
8. Guide to the selection of switching devices for service	29		
9. Information to be given with enquiries, tenders and orders	29		
10. Rules for transport, storage, erection and maintenance	29		
Appendices		Figures	
A. Calculation of atmospheric correction factors	33	1. Diagram of connections of a three-pole switching device	35
B. Determination of the equivalent r.m.s. value of a short-time current during a short-circuit of a given duration	34	2. Diagram of a test circuit for the radio-interference voltage test of switching devices	36
Tables		3. Exponent m , for air density and humidity correction	37
1. Series I (based on current practice in most European and several other countries)	5	4. Factor α for humidity correction	38
2. Series II (based on current practice in the United States of America and Canada, for 60 Hz only)	5	5. Determination of short-time current	39



Amendment No. 1
published and effective from 21 December 1990
to BS 6581 : 1985

Common requirements for high-voltage
switchgear and controlgear standards

NOTE. This amendment is being published to effect the implementation of CENELEC HD 448 S2.

Revised text

AMD 6463
December 1990

Front cover

Underneath 'Common requirements for high-voltage switchgear and controlgear standards', delete '[IEC title : Common clauses for high-voltage switchgear and controlgear standards]' and substitute '(Implementation of CENELEC HD 448 S2)'.

Delete the reference to IEC 694 : 1980 from the top right hand corner.

AMD 6463
December 1990

Contents

Delete 'National foreword' and substitute 'Foreword'.

AMD 6463
December 1990

National foreword

Delete the heading 'National foreword' and substitute 'Foreword'.

Delete paragraph 1 and substitute the following.

'This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee. When first published in 1985, BS 6581 was identical to IEC Publication 694 : 1980 'Common clauses for high-voltage switchgear and controlgear standards', and in agreement with CENELEC harmonization document HD 448.

The 1985 edition has been amended by AMD 6463 for alignment with CENELEC HD 448 S2 of 18 September 1989 which modifies the text of amendment No. 1 to IEC Publication 694 : 1980.'

In the list of cross-references insert the following.

'IEC 417

BS 6217 : 1981 Guide to graphical symbols for use on electrical equipment
 (Identical)'

AMD 6463
December 1990

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

Delete the existing table and note and substitute the new table 1 and notes attached.

AMD 6463
December 1990

Clause 5.3 Earthing of switching devices

Delete sentence 3 of this subclause and substitute the following.

'The connecting point shall be marked with the symbol for protective earth, No. 5019 of IEC Publication 417 : Graphical Symbols for use on Equipment. Index, Survey and Compilation of the Single sheets.'

AMD 6463
December 1990

Back cover

Delete the two references to IEC 694 : 1980 from the top right hand corner and the lower right hand side of the page.

TABLE I

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

Rated voltage <i>U</i> (r.m.s. value)	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	Across the isolating distance	To earth, between poles and across open switching device	Across the isolating distance	To earth, between poles and across open switching device	Across the isolating distance
(kV)	(kV)	(kV)	(kV)	(kV)	(kV)	(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
41.5	170	195	200	230	80	92
52	—	—	250	290	95	110
72.5	—	—	325	375	140	160
82.5	380	440	380	440	150	175

Notes 1 – 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.

2 – Rated voltages 41.5 kV and 82.5 kV have been added to Table I of IEC 694 : 1980, in accordance with the ‘Informative Annex’ to HD 448 S2. This is to take account of a Special National Condition where there are appreciable discrepancies between actual network voltages and the next highest IEC rated voltages.

National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Committee and is identical with IEC Publication 694 : 1980 'Common clauses for high-voltage switchgear and controlgear standards' published by the International Electrotechnical Commission (IEC). This British Standard is in agreement with CENELEC harmonization document HD 448.

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used in the figures as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Where page numbers are quoted in the text they refer to IEC page numbers.

Cross-references

International standards	British Standards
IEC 60	BS 923 Guide on high-voltage testing techniques
IEC 60-1 : 1973	Part 1 : 1980 General (Identical)
IEC 60-2 : 1973	Part 2 : 1980 Test procedures (Identical)
IEC 60-3 : 1976	Part 3 : 1980 Measuring devices (Identical)
	BS 5622 Guide for insulation coordination
IEC 71-1 : 1976	Part 1 : 1979 Terms, definitions, principles and rules (Identical)
IEC 71-2 : 1976	Part 2 : 1979 Application guide (Identical)
IEC 85 : 1957	BS 2757 : 1956 Classification of insulating materials for electrical machinery and apparatus on the basis of thermal stability in service (Technically equivalent)
IEC 270 : 1968	BS 4828 : 1972 Guide to partial discharge measurements (Technically equivalent)
IEC 296 : 1969	BS 148 : 1972 Insulating oil for transformers and switchgear (Technically equivalent)

The Technical Committee has reviewed the provisions of IEC Publications 38, 50 (441), 59, 117-1, 376, 480 and 507 to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

Related British Standards for IEC Publications 50 (441), 117-1, 376 and 480 are respectively, BS 4727 : Part 2 : Group 06, BS 3939 : Sections 1 to 4, BS 5207 and BS 5209.

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

British Standard Specification for

Common requirements for high-voltage switchgear and controlgear standards

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.

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

- 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.
- 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 Sub-clause 2.1. For any special service condition, the manufacturer shall be consulted.

Notes 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.

- 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 Tables I, II, III and IV. The withstand voltage values in Tables I, II, III and 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 Tables I and 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 <i>U</i> (r.m.s. value)	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	Across the isolating distance	To earth, between poles and across open switching device	Across the isolating distance	To earth, between poles and across open switching device	Across the isolating distance
(kV)	(kV)	(kV)	(kV)	(kV)	(kV)	(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	Across the isolating distance	To earth, between poles and across open switching device	Across the isolating distance
(1)	(2)	(3)	(4)	(5)
100	380 450	440 520	150 185	175 210
123	450 550	520 630	185 230	210 265
145	550 650	630 750	230 275	265 315
170	650 750	750 860	275 325	315 375
245	850 950 1 050	950 1 050 1 200	360 395 460	415 460 530

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 <i>U</i> (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
	(kV)	(kV)	(kV)	(kV)		(kV)	(kV)
(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

Notes 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.

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.

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.

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

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.

TABLE V

Limits of temperature and temperature rise for various parts, materials and dielectrics of high-voltage switching devices

Nature of the part, of the material and of the dielectric (see Notes 1, 2 and 3)	Maximum values	
	Temperature (°C)	Temperature rise at an ambient air temperature not exceeding 40°C (K)
1. Contacts (see Note 4)		
Bare copper and bare-copper alloy		
- in air	75	35
- in SF ₆ (sulphur hexafluoride)	90	50
- in oil	80	40
Silver-coated or nickel-coated (see Note 5)		
- in air	105	65
- in SF ₆	105	65
- in oil	90	50
Tin-coated (see Notes 5 and 6)		
- in air	90	50
- in SF ₆	90	50
- in oil	90	50
2. Connections, bolted or the equivalent (see Note 7)		
Bare copper, bare-copper alloy or bare-aluminium alloy		
- in air	90	50
- in SF ₆	105	65
- in oil	100	60
Silver-coated or nickel-coated		
- in air	115	75
- in SF ₆	115	75
- in oil	100	60
Tin-coated		
- in air	105	65
- in SF ₆	105	65
- in oil	100	60
3. All other contacts or connections made of bare metals or coated with other materials	(see Note 8)	(see Note 8)
4. Terminals for the connection to external conductors by screws or bolts (see Note 9)		
- bare	90	50
- silver, nickel or tin-coated	105	65
- other coatings	(see Note 8)	(see Note 8)
5. Oil for oil switching devices (see Notes 10 and 11)	90	50
6. Metal parts acting as springs	(see Note 12)	(see Note 12)
7. Materials used as insulation and metal parts in contact with insulation of the following classes (see Note 13)		
- Y (for non-impregnated materials)	90	50
- A (for materials immersed in oil or impregnated)	100	60
- E	120	80
- B	130	90
- F	155	115
- Enamel: oil base	100	60
synthetic	120	80
- H	180	140
- C	(see Note 14)	(see Note 14)
8. Any part of metal or of insulating material in contact with oil, except contacts	100	60

(See notes page 25.)