

High-voltage alternating-current circuit-breakers —

(Implementation of CENELEC
HD 348 S7:1998)

ICS 29.120.50

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PEL/17, Switchgear, controlgear and high voltage/low-voltage co-ordination, upon which the following bodies were represented:

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.)

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

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

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 April 1996

© BSI 09-1999

First published as BS 5311-1:1976
 to BS 5311-7:1976
 Second (combined) edition as BS 5311 April 1988
 Third edition April 1996

The following BSI references relate to the work on this standard:
 Committee reference PEL/17
 Draft for comment 88/25931 DC

ISBN 0 580 25183 7

Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------------|--|
| 10268 | March 1999 | Indicated by a sideline in the margin (see also national foreword) |
| | | |
| | | |
| | | |

Contents

| | Page |
|--|--------------------|
| Committees responsible | Inside front cover |
| National foreword | ii |
| Foreword | 2 |
| Text of HD 348 S7 | 9 |
| National annex NA (informative) Original IEC text amended by CENELEC common modifications | 165 |
| List of references | Inside back cover |

National foreword

This British Standard has been prepared by Technical Committee PEL/17. It implements HD 348 S7:1998 which supersedes HD 348 S6:1995, published by the European Committees for Electrotechnical Standardization (CENELEC). It was derived by CENELEC from IEC 56:1987, *High-voltage alternating-current circuit-breakers* and its amendments 1:1992, 2:1995 and 3:1996 published by the International Electrotechnical Commission (IEC).

CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by a sideline in the margin. Parts of the original IEC text that have been modified by CENELEC have been quoted in National annex NA.

This British Standard supersedes BS 5311:1988 which is withdrawn.

Cross-references

| Publication referred to | Corresponding British Standard |
|---|--|
| | BS 4727 <i>Glossary of electrotechnical, power; telecommunication, electronics, lighting and colour terms Part 1 Terms common to power, telecommunications and electronics</i> |
| IEC 50(151):1978 | Group 02:1980 <i>Electrical and magnetic devices terminology</i> (Technically equivalent) Part 2 <i>Terms particular to power engineering</i> |
| IEC 50(441):1974 | Group 06:1985 <i>Switchgear and controlgear terminology (including fuse terminology)</i> (Technically equivalent) |
| HD 323.2.5 S1:1988 (IEC 68-2-5:1975) | BS 2011 <i>Environmental testing</i> Part 2.1 Sa:1977 Test Sa. <i>Simulated solar radiation at ground level</i> |
| HD 540.2 S1:1991 (IEC 71-2:1976) | BS 5622 <i>Guide for insulation co-ordination</i> Part 2:1979 <i>Application guide</i> (Identical) |
| IEC 77:1968 | BS 2618:1975 <i>Specification for electric traction equipment</i> (Technically equivalent) |
| EN 60129:1994 (IEC 129:1984) | BS EN 60129:1994 <i>Specification for alternating current disconnectors and earthing switches</i> (Identical) |
| IEC 137:1984 | BS 223:1985 <i>Specification for bushings for alternating voltages above 1 000 V</i> (Technically equivalent) |
| HD 553 S2:1993 (IEC 185:1987) | BS 7626:1993 <i>Specification for current transformers</i> (Technically equivalent) |
| HD 448 S2:1989 (IEC 694:1980) | BS 6581:1985 <i>Specification for common requirements for high-voltage switchgear and controlgear standards</i> (Technically equivalent) |

IEC 60-1:1973 has been superseded by IEC 601:1989. An identical British Standard to IEC 60-1:1989 is BS 923-1:1990, which implements HD 588.1 S1.

IEC 68-2-17:1978 has been superseded by IEC 68-2-17:1994 which has been adopted by CENELEC as EN 60068-2-17:1994 and published as BS EN 60068-2-17:1995.

IEC 427:1973 has been superseded by IEC 427:1989 which has been adopted by CENELEC as EN 60427:1992 and published as BS EN 60427:1992.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the HD title page, pages 2 to 166, 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: Switchgear and controlgear, high voltage, circuit-breaker, characteristic, design, test

English version

High-voltage alternating-current circuit-breakers

(IEC 56:1987 + A1:1992 + A2:1995 + A3:1996, modified)

Disjoncteurs à courant alternatif à haute
tension
(CEI 56:1987 + A1:1992 + A2:1995 + A3:1996,
modifiée)

Hochspannungs-Wechselstrom-
Leistungsschalter
(IEC 56:1987 + A1:1992 + A2:1995 + A3:1996,
modifiziert)

This Harmonization Document was approved by CENELEC on 1998-04-01. 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 standards 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).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, 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 to HD 384 S6

The text of the International Standard IEC 56:1987 and its amendment 1:1992, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17. Switchgear and controlgear, together with common modifications prepared by Technical Committee CENELEC TC 17A, was submitted to the formal vote and was approved by CENELEC as HD 348 S5.

The text of document 17A(CO)249, future amendment 2 to IEC 56:1987, was submitted to the IEC-CENELEC parallel vote.

As CENELEC TC 17A had decided to postpone the conversion of the HD into an EN to the next edition of IEC 56, the combined text of HD 348 S5 and amendment 2:1995 to IEC 56:1987 was approved by CENELEC as HD 348 S6 on 1995-07-04.

The following dates were fixed:

- latest date by which the existence of the HD has to be announced at national level (doa) 1995-08-15
- latest date by which the HD has to be implemented at national level by publication of a harmonized national standard or by endorsement (dop) 1996-02-15
- latest date by which the national standards conflicting with the HD have to be withdrawn (dow) 1996-02-15

Annexes designated “normative” are part of the body of the standard. In this standard, Appendix AA, Appendix BB, Appendix CC, Appendix DD, Appendix EE, Appendix FF, Appendix GG, Appendix HH, Appendix JJ, Annex ZA and Annex ZB are normative.

Annex ZA and Annex ZB have been added by CENELEC.

Foreword to HD 384 S7

The text of the International Standard IEC 60056:1987 and its amendment 3:1996, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, together with common modifications prepared by the Technical Committee CENELEC TC 17A, High-voltage switchgear controlgear, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as HD 348 S7 on 1998-04-01.

This European Standard supersedes HD 348 S6:1995.

The following dates were fixed:

- latest date by which the existence of the HD has to be announced at national level (doa) 1998-07-01
- latest date by which the HD has to be implemented at national level by publication of a harmonized national standard or by endorsement (dop) 1999-01-01
- latest date by which the national standards conflicting with the HD have to be withdrawn (dow) 1999-01-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. In this standard, Appendix AA, Appendix BB, Appendix CC, Appendix DD, Appendix EE, Appendix FF, Appendix GG, Appendix HH, Annex ZA and Annex ZB are normative and Appendix JJ and Annex KK are informative. Annex ZA and Annex ZB have been added by CENELEC.

Contents

| | | Page | | | Page |
|-------|--|------|-------|--|------|
| | Foreword | 2 | 4.110 | Rated back-to-back capacitor bank breaking current | 36 |
| 1 | Scope | 9 | 4.111 | Rated capacitor bank inrush making current | 36 |
| 2 | Normal and special service conditions | 9 | 4.112 | Rated small inductive breaking current | 38 |
| 3 | Definitions | 9 | 4.113 | Rated time quantities | 38 |
| 3.101 | General terms | 9 | 4.114 | Co-ordination of rated values | 39 |
| 3.102 | Switching devices | 12 | 5 | Design and construction | 39 |
| 3.103 | Parts of circuit-breakers | 13 | 5.1 | Requirements for liquids in circuit-breakers | 39 |
| 3.104 | Operation | 14 | 5.2 | Requirements for gases in circuit-breakers | 39 |
| 3.105 | Characteristic quantities of circuit-breakers | 16 | 5.3 | Earthing of circuit-breakers | 39 |
| 3.106 | Index of definitions | 20 | 5.4 | Auxiliary equipment | 39 |
| 4 | Rating | 24 | 5.5 | Dependent power closing | 42 |
| 4.1 | Rated voltage | 25 | 5.6 | Stored energy closing | 42 |
| 4.2 | Rated insulation level | 25 | 5.7 | Operation of releases | 43 |
| 4.3 | Rated frequency | 25 | 5.8 | Low and high pressure interlocking devices | 43 |
| 4.4 | Rated normal current and temperature rise | 25 | 5.9 | Nameplates | 43 |
| 4.5 | Rated short-time withstand current | 26 | 5.101 | Requirements for simultaneity of poles | 43 |
| 4.6 | Rated peak withstand current | 26 | 5.102 | General requirement for operation | 43 |
| 4.7 | Rated duration of short-circuit | 26 | 5.103 | Pressure limits of compressed gas for interruption in gas blast circuit-breakers | 45 |
| 4.8 | Rated supply voltage of closing and opening devices and auxiliary circuits | 26 | 5.104 | Vent outlets | 45 |
| 4.9 | Rated supply frequency of closing and opening devices and auxiliary circuits | 26 | 6 | Type tests | 59 |
| 4.10 | Rated pressures of compressed gas supply for operation and for interruption | 26 | 6.1 | Dielectric tests | 59 |
| 4.101 | Rated short-circuit breaking current | 26 | 6.2 | Radio interference voltage (r.i.v.) tests | 61 |
| 4.102 | Rated transient recovery voltage for terminal faults | 27 | 6.3 | Temperature-rise tests | 61 |
| 4.103 | Rated short-circuit making current | 31 | 6.4 | Measurement of the resistance of the main circuit | 62 |
| 4.104 | Rated operating sequence | 31 | 6.5 | Short-time withstand current and peak withstand current tests | 62 |
| 4.105 | Rated characteristics for short-line faults | 32 | 6.101 | Mechanical and environmental tests | 62 |
| 4.106 | Rated out-of-phase breaking current | 33 | 6.102 | Miscellaneous provisions for making and breaking tests | 70 |
| 4.107 | Rated line-charging breaking current | 35 | 6.103 | Test circuits for short circuit making and breaking tests | 78 |
| 4.108 | Rated cable-charging breaking current | 35 | 6.104 | Short-circuit test quantities | 79 |
| 4.109 | Rated single capacitor bank breaking current | 36 | 6.105 | Short-circuit test procedure | 87 |
| | | | 6.106 | Basic short-circuit test-duties | 88 |
| | | | 6.107 | Critical current tests | 90 |
| | | | 6.108 | Single-phase short-circuits tests | 90 |
| | | | 6.109 | Short-line fault tests | 90 |

| | Page | | Page |
|-------------|------|---|------|
| 6.110 | 92 | Out-of-phase making and breaking tests | |
| 6.111 | 94 | Capacitive current switching tests | |
| 6.112 | 99 | Magnetizing and small inductive current switching tests | |
| 7 | 99 | Routine tests | |
| 7.1 | 100 | Power frequency voltage withstand dry tests on the main circuit | |
| 7.2 | 100 | Voltage withstand tests on control and auxiliary circuits | |
| 7.3 | 100 | Measurement of the resistance of the main circuit | |
| 7.101 | 100 | Mechanical operating tests | |
| 7.102 | 101 | Design and visual checks | |
| 8 | 101 | Guide to the selection of circuit-breakers for service | |
| 8.101 | 101 | General | |
| 8.102 | 102 | Selection of rated values for service conditions | |
| 8.103 | 104 | Selection of rated values for fault conditions | |
| 8.104 | 106 | Selection for electrical endurance in networks of rated voltage above 1 kV, and up to and including 52 kV | |
| 9 | 107 | Information to be given with enquiries, tenders and orders | |
| 9.101 | 107 | Information to be given with enquiries and orders | |
| 9.102 | 108 | Information to be given with tenders | |
| 10 | 109 | Rules for transport, storage, erection and maintenance | |
| 10.1 | 109 | Conditions during transport, storage and erection | |
| 10.2 | 109 | Erection | |
| 10.3 | 110 | Maintenance | |
| Appendix AA | 124 | Calculation of transient recovery voltages for short-line faults from rated characteristics | |
| Appendix BB | 128 | Capacitor bank inrush currents | |
| Appendix CC | 130 | Records and reports of type tests for making, breaking and short-time current performance | |
| Appendix DD | 132 | Determination of short-circuit power factor | |
| Appendix EE | 134 | Tightness specifications and tests | |
| | | Appendix FF Method of drawing the envelope of the prospective transient recovery voltage of a circuit and determining the representative parameters | 141 |
| | | Appendix GG Methods of determining prospective transient recovery voltage waves | 143 |
| | | Appendix HH Example of a commissioning test programme | 157 |
| | | Appendix JJ Some remarks regarding multipliers for TRV values for second and third clearing poles, of Table IIF | 160 |
| | | Annex KK (informative) Rationale behind introduction of circuit-breakers class B | 162 |
| | | Annex ZA (normative) Special national conditions | 163 |
| | | Annex ZB (normative) Normative references to international publications with their corresponding European publications | 163 |
| | | Figure 1 — Typical oscillogram of a three-phase short-circuit make-break cycle | 46 |
| | | Figure 2 — Circuit-breaker without switching resistors. Opening and closing operations | 48 |
| | | Figure 3 — Circuit-breaker without switching resistors. Close-open cycle | 49 |
| | | Figure 4 — Circuit-breaker without switching resistors. Reclosing (auto-reclosing) | 50 |
| | | Figure 5 — Circuit-breaker with switching resistors. Opening and closing operations | 51 |
| | | Figure 6 — Circuit-breaker with switching resistors. Close-open cycle | 52 |
| | | Figure 7 — Circuit-breaker with switching resistors. Reclose (auto-reclosing) | 53 |
| | | Figure 8 — Determination of short-circuit making and breaking currents, and of percentage d.c. component | 54 |
| | | Figure 9 — Percentage d.c. component in relation to time interval τ | 55 |
| | | Figure 10 — Representation of a specified TRV by a four-parameter reference line and a delay line | 55 |
| | | Figure 11 — Representation of a specified TRV by a two-parameter reference line and a delay line | 56 |
| | | Figure 12 — Representation of ITRV and its relationship to the TRV | 57 |
| | | Figure 13 — Short-line fault circuit | 58 |

| | Page | | Page |
|--|------|--|------|
| Figure 14 — Example of a line-side transient voltage with time delay and rounded crest showing construction to derive the values u_L^* , t_L and t_{dL} | 58 | Figure 31 — Test circuit for out-of-phase tests with one terminal of the circuit-breaker earthed (subject to agreement of the manufacturer) | 122 |
| Figure 15 — Test sequences for low and high temperature tests | 111 | Figure 32a — Recovery voltage for capacitive current-breaking tests, test-duties 1 and 2 | 123 |
| Figure 16 — Humidity test | 112 | Figure 32b — Recovery voltage for capacitive current-breaking tests, test-duties 3 and 4 | 123 |
| Figure 17 — Static terminal load forces | 113 | Figure AA.1 — Construction of TRV for short-line fault | 127 |
| Figure 18 — Directions for static terminal load tests | 114 | Figure AA.2 — Relation of u_o/U_m and u_m/U_m as a function of I_L/I | 128 |
| Figure 19 — Earthing of test circuits for three-phase short-circuit tests, first-pole-to-clear factor 1.5 | 115 | Figure BB.1 — Capacitor bank inrush currents | 129 |
| Figure 20 — Earthing of test circuits for three-phase short-circuit tests, first-pole-to-clear factor 1.3 | 116 | Figure DD.1 — Determination of circuit impedance for calculation of power factor in accordance with Method I of Appendix DD | 133 |
| Figure 21 — Earthing of test circuits for single-phase short-circuit tests, first-pole-to-clear factor 1.5 | 117 | Figure EE.1 — Example for a tightness coordination chart TC. Three-pole circuit-breaker (SF ₆ single pressure) | 139 |
| Figure 22 — Earthing of test circuits for single-phase short-circuit tests, first-pole-to-clear factor 1.3 | 117 | Figure EE.2 — Comparison of leak detection methods | 140 |
| Figure 23 — Example of prospective test TRV with four-parameter envelope which satisfies the conditions to be met during type test: case of specified TRV with four-parameter reference line | 118 | Figure FF.1 — Representation by four parameters of a prospective transient recovery voltage of a circuit. Case of Sub-clause FF.2.3.1 of Appendix FF | 142 |
| Figure 24 — Example of prospective test TRV with two-parameter envelope which satisfies the conditions to be met during type test: case of specified TRV with two-parameter reference line | 118 | Figure FF.2 — Representation by four parameters of a prospective transient recovery voltage of a circuit. Case of Sub-clause FF.2.3.2 of Appendix FF | 142 |
| Figure 25 — Example of prospective test TRV with four-parameter envelope which satisfies the conditions to be met during type test: case of specified TRV with two-parameter reference line | 119 | Figure FF.3 — Representation by four parameters of a prospective transient recovery voltage of a circuit. Case of Sub-clause FF.2.3.3 a) of Appendix FF | 143 |
| Figure 26 — Example of prospective test TRV with two-parameter envelope which satisfies the conditions to be met during type test: case of specified TRV with four-parameter reference line | 119 | Figure FF.4 — Representation by two parameters of a prospective transient recovery voltage of a circuit. Case of Sub-clause 2.3.3 b) of Appendix FF | 143 |
| Figure 27 — Example of two prospective test TRV-waves and their combined envelope in two-part tests | 120 | Figure GG.1 — Effect of depression on the peak value of the TRV | 151 |
| Figure 28 — Determination of power frequency recovery voltage | 121 | Figure GG.2 — TRV in case of ideal breaking | 151 |
| Figure 29 — Test circuit for single-phase out-of-phase tests | 122 | Figure GG.3 — Breaking with arc-voltage present | 152 |
| Figure 30 — Test circuit for out-of-phase tests using two voltages separated by 120 electrical degrees | 122 | Figure GG.4 — Breaking with pronounced premature current-zero | 152 |
| | | Figure GG.5 — Breaking with post-arc current | 152 |

| | Page | | Page |
|--|------|---|------|
| Figure GG.6 — Relationship between the values of current and TRV occurring in test and those prospective to the system | 153 | Table IVA — Standard values of rated transient recovery voltage of the supply circuit for short-line faults — Rated voltages Series I — Representation by two parameters | 32 |
| Figure GG.7 — Schematic diagram of power-frequency current injection apparatus | 154 | Table IVB — Standard values of rated transient recovery voltage of the supply circuit for short-line faults — Rated voltages Series II — Representation by two parameters Under consideration | 32 |
| Figure GG.8 — Sequence of operation of power-frequency current injection apparatus | 155 | Table IVC — Standard values of rated transient recovery voltage of the supply circuit for short-line faults — Rated voltages 100 kV and above — Representation by four parameters | 33 |
| Figure GG.9 — Schematic diagram of capacitance injection apparatus | 156 | Table V — Standard values of rated line characteristics for short-line faults | 33 |
| Figure GG.10 — Sequence of operation of capacitance-injection apparatus | 157 | Table VIA — Standard values of rated transient recovery voltage for out-of-phase breaking — Rated voltages Series I — Representation by two parameters | 34 |
| Figure JJ.1 — Three-phase short-circuit representation | 161 | Table VIB — Standard values of rated transient recovery voltages for out-of-phase breaking — Rated voltages 100 kV to 170 kV — Representation by four parameters | 34 |
| Figure JJ.2 — Alternative representation of Figure JJ.1 | 162 | Table VIC — Standard values of rated transient recovery voltages for out-of-phase breaking — Rated voltages 100 kV to 170 kV — Representation by four parameters | 34 |
| Table I — Series II (based on current practice in the United States of America and Canada, for 60 Hz only) | 25 | Table VID — Standard values of rated transient recovery voltage for out-of-phase breaking — Rated voltages 245 kV and above — Representation by four parameters | 35 |
| Table IIA — Standard values of rated transient recovery voltage — Rated voltages Series I | 29 | Table VII — Standard values of rated line-charging breaking current | 35 |
| Table IIB — Standard values of rated transient recovery voltage — Rated voltages Series II | 29 | Table VIII — Standard values of rated cable-charging breaking current | 36 |
| Table IIC — Standard values of rated transient recovery voltage — Rated voltages 100 kV to 170 kV | 29 | Table IX — Suggested values of maximum permissible switching overvoltages when interrupting line-charging, cable-charging and single capacitor bank breaking current | 37 |
| Table IID — Standard values of rated transient recovery voltage — Rated voltages 100 kV to 170 kV | 29 | Table XA — Co-ordination table of rated values for circuit-breakers | 40 |
| Table IIE — Standard values of rated transient recovery voltage — Rated voltages from 245 kV and above | 30 | Table XB — The values given in this table show for information the present practice in the United States of America and Canada | 41 |
| Table IIF — Multipliers for transient recovery voltage values for second and third clearing poles for rated voltages above 72,5 kV, to be applied at three-phase testing | 30 | Table XC — Co-ordination table of rated values for circuit-breakers | 42 |
| Table III — Standard values of rated initial transient recovery voltage — Rated voltages 100 kV and above | 31 | Table XI — Nameplate information | 44 |

| | Page | | Page |
|--|------|--|------|
| Table XII | 65 | Table XVE — Standard values of prospective transient recovery voltage for Test-duty No. 3 — Rated voltages 245 kV and above | 85 |
| Table XIII | 69 | Table XVIA — Standard values of prospective transient recovery voltage for Test-duty, No. 2 — Rated voltages Series I | 85 |
| Table XIVA — Standard limit values of delay lines of prospective transient recovery voltage for Test-duties Nos. 4 and 5 where short-line fault tests are also made — Rated voltage Series I — First-pole-to-clear factor 1.5 | 82 | Table XVIB — Standard values of prospective transient recovery voltage for Test-duty No. 2 — Rated voltages Series II | 85 |
| Table XIVB — Standard limit values of delay lines of prospective transient recovery voltage for Test-duties Nos. 4 and 5 where short-line fault tests are also made — Rated voltage Series II — First-pole-to-clear factor 1.5 | 82 | Table XVIC — Standard values of prospective transient recovery voltage for Test-duty No. 2 — Rated voltages 100 kV and above | 86 |
| Table XIVC — Standard limit values of delay lines of prospective transient recovery voltage for Test-duties Nos. 4 and 5 where short-line fault tests are also made — Rated voltages 100 kV to 170 kV — First-pole-to-clear 1.3 | 82 | Table XVII — Standard values of prospective transient recovery voltage for Test-duty No. 1 — Rated voltages 100 kV and above | 86 |
| Table XIVD — Standard limit values of delay lines of prospective transient recovery voltage for Test-duties Nos. 4 and 5 where short-line fault tests are also made — Rated voltages 100 kV to 170 kV — First-pole-to-clear factor 1.5 | 83 | Table XVIII — Test duties to demonstrate the out-of-phase rating | 93 |
| Table XIVE — Standard limit values of delay lines of prospective transient recovery voltage for Test-duties Nos. 4 and 5 where short-line fault tests are also made — Rated voltages 245 kV and above — First-pole-to-clear factor 1.3 | 83 | Table XXII — Operating sequence for electrical endurance test on class B circuit-breakers | 93 |
| Table XVA — Standard values of prospective transient recovery voltage for Test-duty No. 3 — Rated voltage Series I | 84 | Table XIX | 97 |
| Table XVB — Standard values of prospective transient recovery voltage for Test-duty No. 3 — Rated voltages Series II | 84 | Table XX | 99 |
| Table XVC — Standard values of prospective transient recovery voltage for Test-duty No. 3 — Rated voltages 100 kV to 170 kV | 84 | Table XXI | 100 |
| Table XVD — Standard values of prospective transient recovery voltage for Test-duty No. 3 — Rated voltages 100 kV to 170 kV | 84 | Table AA.1 — Initial voltage to earth and peak value of transient recovery voltage for short-line faults | 125 |
| | | Table GG.1 — Methods for determination of prospective TRV | 149 |

1 Scope

This standard is applicable to a.c. circuit-breakers designed for indoor or outdoor installation and for operation at frequencies up to and including 60 Hz on systems having voltages above 1 000 V.

It is only applicable to three-pole circuit-breakers for use in three-phase systems and single-pole circuit-breakers for use in single-phase systems. Two-pole circuit-breakers for use in single-phase systems are subject to agreement between manufacturer and user.

This standard is also applicable to the operating devices of circuit-breakers and to their auxiliary equipment. However, a circuit-breaker with a closing mechanism for dependent manual operation is not covered by this standard, as a rated short-circuit making-current cannot be specified, and such dependent manual operation may be objectionable because of safety considerations.

This standard does not cover circuit-breakers intended for use on motive power units of electrical traction equipment; these are covered by IEC Publication 77: Rules for Electric Traction Equipment.

Circuit-breakers for use with overhead lines which include series capacitors are not within the scope of this standard.

NOTE Tests to prove the performance under abnormal conditions should be subject to agreement between manufacturer and user. Such abnormal conditions are, for instance, cases where the voltage is higher than the rated voltage of the circuit-breaker, conditions which may occur due to sudden loss of load on long lines or cables.

This standard is not necessarily applicable to circuit-breakers for special conditions, for example, those produced by two earth faults on two different phases one of which occurs on one side of the circuit-breaker and the other on the other side.

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 reference is made to definitions in the following publications of the International Electrotechnical Vocabulary (IEV):

- 50(151) (1978): Chapter 151: Electrical and Magnetic Devices,
- 50(441) (1984): Chapter 441: Switchgear; Controlgear and Fuses,
- 50(604) (—): Chapter 604: Generation, Transmission and Distribution of Electricity: Operation (being printed).

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

short-circuit current (441-11-07)

3.101.5

isolated neutral system

a system which has no intentional connection to earth except through indicating, measuring or protective devices of very high impedance