## CONTENTS

**FOREWORD**....................................................................................................................... 9

1 General ....................................................................................................................................... 13
  1.1 Scope.................................................................................................................................. 13
  1.2 Normative references ....................................................................................................... 13

2 Normal and special service conditions .............................................................................. 23
  2.1 Normal service conditions .............................................................................................. 25
  2.2 Special service conditions .............................................................................................. 27

3 Definitions ................................................................................................................................ 29
  3.1 General terms ................................................................................................................. 29
  3.2 Assemblies of switchgear and controlgear ................................................................. 33
  3.3 Parts of assemblies ........................................................................................................ 35
  3.4 Switching devices .......................................................................................................... 35
  3.5 Parts of switchgear and controlgear ............................................................................. 35
  3.6 Operation ....................................................................................................................... 45
  3.7 Characteristic quantities ............................................................................................... 51
  3.8 Index of definitions ....................................................................................................... 51

4 Ratings ................................................................................................................................... 55
  4.1 Rated voltage ($U_r$) .................................................................................................... 55
  4.2 Rated insulation level .................................................................................................... 57
  4.3 Rated frequency ($f_r$) .................................................................................................. 65
  4.4 Rated normal current and temperature rise ............................................................... 65
  4.5 Rated short-time withstand current ($I_k$) ................................................................ 71
  4.6 Rated peak withstand current ($I_p$) ........................................................................... 71
  4.7 Rated duration of short circuit ($t_k$) ........................................................................... 71
  4.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits ($U_a$) ......................................................................................................................... 71
  4.9 Rated supply frequency of closing and opening devices and of auxiliary circuits ......... 75
  4.10 Rated pressure of compressed gas supply for insulation and/or operation ............... 75

5 Design and construction ........................................................................................................ 75
  5.1 Requirements for liquids in switchgear and controlgear ............................................. 75
  5.2 Requirements for gases in switchgear and controlgear .............................................. 77
  5.3 Earthing of switchgear and controlgear ...................................................................... 77
  5.4 Auxiliary and control equipment ................................................................................. 77
  5.5 Dependent power operation ....................................................................................... 99
  5.6 Stored energy operation ........................................................................................... 101
  5.7 Independent manual operation ................................................................................. 103
  5.8 Operation of releases .............................................................................................. 103
  5.9 Low- and high-pressure interlocking and monitoring devices ................................. 103
  5.10 Nameplates .............................................................................................................. 105
  5.11 Interlocking devices ................................................................................................... 107
  5.12 Position indication ....................................................................................................... 107
  5.13 Degrees of protection by enclosures ........................................................................ 107
  5.14 Creepage distances ................................................................................................. 111
Figure 1 – Altitude correction factor (see 2.2.1) ................................................................. 189
Figure 2 – Diagram of connections of a three-pole switching device (see 6.2.5.1) ................. 191
Figure 3 – Diagram of a test circuit for the radio interference voltage test of switching devices (see 6.3) .............................................................................................................. 193
Figure 4 – Examples of classes of contacts ........................................................................... 87
Figure 5 – Example of secondary system in medium voltage cubicle ..................................... 97
Figure 6 – Example of secondary system of air insulated circuit-breaker with single mechanism ....................................................................................................................................... 97
Figure 7 – Example of secondary system of air insulated circuit-breaker with separate control cubicle ...................................................................................................................... 99
Figure 8 – Example of secondary system for GIS bay ........................................................... 99
Figure 9 – Example of choice of EMC severity class ........................................................... 115
Figure B.1 – Determination of short-time current .................................................................. 199
Figure C.1 – Arrangement for weatherproofing test ............................................................... 203
Figure C.2 – Nozzle for weatherproofing test ...................................................................... 205
Figure E.1 – Example of a tightness coordination chart, TC, for closed pressure systems ................................................................................................................................. 213
Figure E.2 – Sensitivity and applicability of different leak detection methods for tightness tests ........................................................................................................................................ 215
Figure F.1 – Examples of impulse voltage shapes with incorporated voltage-limiting devices .................................................................................................................................... 221

Table 1a – Rated insulation levels for rated voltages of range I, series I ............................... 59
Table 1b – Rated insulation levels for rated voltages of range I, series II (used in North America) ................................................................................................................................. 61
Table 2a – Rated insulation levels for rated voltages of range II ........................................... 63
Table 2b – Additional rated insulation levels in North America for range II ......................... 65
Table 3 – Limits of temperature and temperature rise for various parts, materials and dielectrics of high-voltage switchgear and controlgear ........................................................................ 67
Tables 4 and 5 (withdrawn)
Table 6 – Degrees of protection ......................................................................................... 109
Table 7 – Application factors for creepage distances ........................................................... 111
Table 8 – Example of grouping of type tests ....................................................................... 117
Table 9 – Test conditions in general case ............................................................................ 125
Table 10 – Power-frequency test conditions for longitudinal insulation ............................... 125
Table 11 – Impulse test conditions for longitudinal insulation .............................................. 127
Table 12 – Permissible temporary leakage rates for gas systems ......................................... 151
Table 13 (withdrawn)
Table 14 – Direct current voltage ......................................................................................... 73
Table 15 – Alternating current voltage .................................................................................. 73
Table 16 – Auxiliary contacts classes ................................................................................... 87
Table 17 – Application of voltage at the fast transient/burst test .......................................... 159
Table 18 – Application of voltage at the damped oscillatory wave test .................................. 161
Table 19 – Assessment criteria for transient disturbance immunity tests ............................. 163
INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMON SPECIFICATIONS FOR HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR STANDARDS

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60694 has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, and subcommittee 17C: High-voltage enclosed switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.


The technical content is therefore identical to the base edition and its amendments and has been prepared for user convenience.

It bears the edition number 2.2.

A vertical line in the margin shows where the base publication has been modified by amendment 1, amendment 2 and the corrigenda.

Annexes A, B and C form an integral part of this standard.

Annexes D to H are for information only.

The following differences exist in some countries:

6.2.11 The required test voltage for disconnectors and switch-disconnectors of all rated voltages is 100 % of the tabulated voltage in columns 3 of tables 1a or 1b and 2a or 2b (Canada, France, Italy).
The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2007. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.
1 General

1.1 Scope

This International 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.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.


IEC 60038:1983, IEC standard voltages


IEC 60050(441):1984, International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses

IEC 60050(446):1983, International Electrotechnical Vocabulary (IEV) – Chapter 446: Electrical relays


IEC 60051-2:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 2: Special requirements for ammeters and voltmeters*

IEC 60051-4:1984, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 4: Special requirements for frequency meters*

IEC 60051-5:1985, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 5: Special requirements for phase meters, power factor meters and synchroscopes*

IEC 60056:1987, *High-voltage alternating-current circuit-breakers*

IEC 60059:1938, *IEC standard current ratings*

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60064:1993, *Tungsten filament lamps for domestic and similar general lighting purposes – Performance requirements*

IEC 60068-2 (all parts), *Environmental testing – Part 2: Tests*


IEC 60073:1996, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indication devices and actuators*

IEC 60083:1997, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*


IEC 60130 (all parts), *Connectors for frequencies below 3 MHz*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60228:1978, *Conductors of insulated cables*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*


IEC 60255-8:1990, *Electrical relays – Part 8: Thermal electrical relays*


IEC 60269-2:1986, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)*

IEC 60269-2-1:1998, *Low-voltage fuses – Part 2-1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to V: Examples of types of standardized fuses*

IEC 60270:1981, *Partial discharge measurements*

IEC 60296:1982, *Specification for unused mineral insulating oils for transformers and switchgear*

IEC 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60309-2:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60326 (all parts), *Printed boards*
IEC 60376:1971, Specification and acceptance of new sulphur hexafluoride


IEC 60417 (all parts), Graphical symbols for use on equipment

IEC 60445:1999, Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals and of terminations of certain designated conductors, including general rules for an alphanumeric system

IEC 60480:1974, Guide to the checking of sulphur hexafluoride (SF₆) taken from electrical equipment

IEC 60485:1974, Digital electronic d.c. voltmeters and d.c. electronic analogue-to-digital converters

IEC 60502-1:1997, Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Uₘ = 1,2 kV) up to 30 kV (Uₘ = 36 kV) – Part 1: Cables for rated voltages of 1 kV (Uₘ = 1,2 kV) and 3 kV (Uₘ = 3,6 kV)

IEC 60507:1991, Artificial pollution tests on high-voltage insulators to be used on a.c. systems

IEC 60512-2:1985, Electromechanical components for electronic equipment; basic testing procedures and measuring methods – Part 2: General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests

IEC 60529:1989, Degrees of protection provided by enclosures (IP code)

IEC 60617, Graphical symbols for diagrams

IEC 60669-1:1998, Switches for household and similar fixed-electrical installations – Part 1: General requirements

IEC 60721, Classification of environmental conditions

IEC 60730-2-8:1992, Automatic electrical controls for household and similar use – Part 2: Particular requirements for temperature sensing controls


IEC 60815:1986, Guide for the selection of insulators in respect of polluted conditions

IEC 60816:1984, Guide on methods of measurement of short-duration transients on low-voltage power and signal lines

IEC 60947-3:1999, Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units

IEC 60947-4-1:1990, Low-voltage switchgear and controlgear – Part 4: Contactors and motor-starters – Section One: Electromechanical contactors and motor-starters

IEC 60947-4-2:1995, Low-voltage switchgear and controlgear – Part 4: Contactors and motor-starters – Section 2: AC semiconductor motor controllers and starters

IEC 60947-5-1:1997, Low-voltage switchgear and controlgear – Part 5: Control circuit devices and switching elements – Section One: Electromechanical control circuit devices

IEC 60947-7-1:1989, Low-voltage switchgear and controlgear – Part 7: Ancillary equipment – Section One: Terminal blocks for copper conductors

IEC 60947-7-2:1995, Low-voltage switchgear and controlgear – Part 7: Ancillary equipment – Section 2: Protective conductor terminal blocks for copper conductors

IEC 61000-4-1:1992, Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 1: Overview of immunity tests – Basic EMC publication


IEC 61000-4-12:1995, Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 12: Oscillatory waves immunity test – Basic EMC Publication

IEC 61000-4-17:1999, Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test

IEC 61000-4-29:—, Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power ports, immunity tests 1)

IEC 61000-5 (all parts), Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines

IEC 61000-5-1:1996, Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 1: General considerations – Basic EMC publication


IEC 61000-6-5:—, Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for power station and substation environments 1)

1) To be published.


IEC 61180-1:1992, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61634:1995, *High-voltage switchgear and controlgear – Use and handling of sulphur hexafluoride (SF₆) in high-voltage switchgear and controlgear*

IEC 61810 (all parts), *Electromechanical non-specified time all-or-nothing relays*

IEC 61810-1:1998, *Electromechanical non-specified time all-or-nothing relays – Part 1: General requirements*

IEC 61810-7:1997, *Electromechanical all-or-nothing relays – Part 7: Tests and measurement procedures*

CISPR 11:1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*


CISPR 18-2:1986, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits Amendment 1 (1993)*

Other International Standards are referred to for information in this standard. They are listed in annex G.