INTERNATIONAL STANDARD

IEC 60364-5-51

Fifth edition
2005-04

Electrical installations of buildings –

Part 5-51: Selection and erection of electrical equipment – Common rules

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

Reference number
IEC 60364-5-51:2005(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 5-51: Selection and erection of electrical equipment – Common rules

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60364-5-51 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

This fifth edition of IEC 60364-5-51 cancels and replaces the fourth edition published in 2001 and constitutes a technical revision.

The document 64/1438/FDIS, circulated to National Committees as Amendment 1, led to the publication of the new edition.

The main changes with respect to the previous edition are listed below:

- corrections of misprints in Table 51 based on Table 321 derived from the old Part 3;
- introduction of a new Clause 516 dealing with measures for mitigation of protective conductor currents;
- introduction of an informative Annex B extracted from IEC 61140 in Annex E of this standard. Annex B of IEC 61140 deals with protective conductor currents.

The text of this standard is based on the following documents:

FDIS	Report on voting
64/1438/FDIS	64/1460/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60364 consists of the following parts, under the general title *Electrical installations of buildings:*

Part 1: Fundamental principles, assessment of general characteristics, definitions

Part 2: Void

Part 3: Void

Part 4: Protection for safety

Part 5: Selection and erection of electrical equipment

Part 6: Verification

Part 7: Requirements for special installations or locations

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 5-51: Selection and erection of electrical equipment – Common rules

510 Introduction

510.1 Scope

This part of IEC 60364 deals with the selection of equipment and its erection. It provides common rules for compliance with measures of protection for safety, requirements for proper functioning for intended use of the installation, and requirements appropriate to the external influences foreseen.

510.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-11:1981, *Environmental testing – Part 2: Tests. Test Ka: Salt mist*

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

IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*

IEC 60255-22-1:1988, *Electrical relays – Part 22: Electrical disturbance tests for measuring relays and protection equipment – Section 1: 1 MHz burst disturbance tests*

IEC 60364-1:2001, *Electrical installations of buildings – Part 1: Fundamental principles*

IEC 60364-4-41:2001, *Electrical installations of buildings – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-42:2001, *Electrical installations of buildings – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60364-4-44:2001, *Electrical installations of buildings – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60364-5-52:2001, *Electrical installations of buildings – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-5-54, *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors and protective bonding conductors*

IEC 60446:1999, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals*

IEC 60447:1993, *Man-machine interface (MMI) – Actuating principles*

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

IEC 60617-DB:2001[1], *Graphical symbols for diagrams*

IEC 60707:1999, *Flammability of solid non-metallic materials when exposed to flame sources – List of test methods*

IEC 60721-3-0:1984, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Introduction*

IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weather-protected locations*

IEC 60721-3-4:1995, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations*

IEC 60884-1:2002, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 61000-2 (all parts) *Electromagnetic compatibility (EMC) – Part 2: Environment*

IEC 61000-2-2:1990, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-2-5:1995, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 5: Classification of electromagnetic environments.* Basic EMC publication

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test.* Basic EMC publication

IEC 61000-4-3:2002, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test.* Basic EMC publication

IEC 61000-4-6:1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:1993, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 8: Power frequency magnetic field immunity test.* 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 61024-1:1990, *Protection of structures against lightning – Part 1: General principles*

IEC 61082 (all parts), *Preparation of documents used in electrotechnology*

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1 "DB" refers to the IEC on-line database.

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61346-1:1996, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

510.3 General

Every item of equipment shall be selected and erected so as to allow compliance with the rules stated in the following clauses of this part of IEC 60364 and the relevant rules in other parts of the IEC 60364 series.

511 Compliance with standards

511.1 Every item of equipment shall comply with such standards as are appropriate and, in addition, with any applicable standards of the ISO.

511.2 Where there are no applicable or ISO standards, the item of equipment concerned shall be selected by special agreement between the person specifying the installation and the installer.

512 Operational conditions and external influences

512.1 Operational conditions

512.1.1 Voltage

Equipment shall be suitable for the nominal voltage (r.m.s. value for a.c.) of the installation.

If, in IT installations, the neutral conductor is distributed, equipment connected between phase and neutral shall be insulated for the voltage between phases.

NOTE For certain equipment, it may be necessary to take account of the highest and/or lowest voltage likely to occur in normal service.

512.1.2 Current

Equipment shall be selected for the design current (r.m.s. value for a.c.) which it has to carry in normal service.

Equipment shall also be capable of carrying the currents likely to flow in abnormal conditions for such periods of time as are determined by the characteristics of the protective devices.

512.1.3 Frequency

If frequency has an influence on the characteristics of equipment, the rated frequency of the equipment shall correspond to the frequency of the current in the circuit concerned.

512.1.4 Power

Equipment selected for its power characteristics shall be suitable for the normal operational conditions taking account of the load factor.

512.1.5 Compatibility

Unless other suitable precautions are taken during erection, all equipment shall be selected so that it will not cause harmful effects on other equipment nor impair the supply during normal service, including switching operations.

512.2 External influences

512.2.1 Electrical equipment shall be selected and erected in accordance with the requirements of Table 51A, which indicates the characteristics of equipment necessary according to the external influences to which the equipment may be subjected.

Equipment characteristics shall be determined either by a degree of protection or by conformity to tests.

512.2.2 If the equipment does not, by its construction, have the characteristics relevant to the external influences of its location, it may nevertheless be used on condition that it is provided with appropriate additional protection in the erection of the installation. Such protection shall not adversely affect the operation of the equipment thus protected.

512.2.3 When different external influences occur simultaneously, they may have independent or mutual effect and the degree of protection shall be provided accordingly.

512.2.4 The selection of equipment according to external influences is necessary not only for proper functioning, but also to ensure the reliability of the measures of protection for safety complying with the rules of IEC 60364 generally. Measures of protection afforded by the construction of equipment are valid only for the given conditions of external influence if the corresponding equipment specification tests are made in these conditions of external influence.

NOTE 1 For the purposes of this standard, the following classes of external influences are conventionally regarded as normal:

AA Ambient temperature	AA4
AB Atmospheric humidity	AB4
Other environmental conditions (AC to AR)	XX1 of each parameter
Utilization and construction of buildings (B and C)	XX1 of each parameter, except XX2 for the parameter BC

NOTE 2 The word "normal" appearing in the third column of the table signifies that the equipment must generally satisfy applicable IEC standards.

Table 51A – Characteristics of external influences

Code	External influences	Characteristics required for selection and erection of equipment	Reference
A	*Environmental conditions*		
AA	*Ambient temperature* The ambient temperature is that of the ambient air where the equipment is to be installed It is assumed that the ambient temperature includes the effects of other equipment installed in the same location The ambient temperature to be considered for the equipment is the temperature at the place where the equipment is to be installed resulting from the influence of all other equipment in the same location, when operating, not taking into account the thermal contribution of the equipment to be installed Lower and upper limits of ranges of ambient temperature:		
AA1	–60 °C +5 °C	Specially designed equipment or appropriate arrangements[a]	Includes temperature range of IEC 60721-3-3, class 3K8, with high air temperature restricted to +5 °C. Part of temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to –60 °C and high air temperature restricted to +5 °C
AA2	–40 °C +5 °C		Part of temperature range of IEC 60721-3-3, class 3K7, with high air temperature restricted to +5 °C. Includes part of temperature range of IEC 60721-3-4, class 4K3, with high air temperature restricted to +5 °C
AA3	–25 °C +5 °C		Part of temperature range of IEC 60721-3-3, class 3K6, with high air temperature restricted to +5 °C. Includes temperature range of IEC 60721-3-4, class 4K1, with high air temperature restricted to +5 °C
AA4	–5 °C +40 °C	Normal (in certain cases special precautions may be necessary)	Part of the temperature range of IEC 60721-3-3, class 3K5, with the high air temperatures restricted to +40 °C
AA5	+5°C +40 °C	Normal	Identical to temperature range of IEC 60721-3-3, class 3K3

[a] May necessitate certain supplementary precautions (e.g. special lubrication).

[b] This means that ordinary equipment will operate safely under the described external influences.

[c] This means that special arrangements should be made, for example, between the designer of the installation and the equipment manufacturer, e.g. for specially designed equipment.

Table 51A *(continued)*

Code	External influences			Characteristics required for selection and erection of equipment	Reference
AA6	+5 °C +60 °C			Specially designed equipment or appropriate arrangements[a]	Part of temperature range of IEC 60721-3-3, class 3K7, with low air temperature restricted to +5 °C and high air temperature restricted to +60 °C. Includes temperature range of IEC 60721-3-4, class 4K4 with low air temperature restricted to +5 °C
AA7	–25 °C +55 °C			Specially designed equipment or appropriate arrangements[a]	– Identical with temperature range of IEC 60721-3-3, class 3K6
AA8	–50 °C +40 °C				– Identical with temperature range of IEC 60721-3-4, class 4K3
	Ambient temperature classes are applicable only where humidity has no influence The average temperature over a 24 h period must not exceed 5 °C below the upper limits Combination of two ranges to define some environments may be necessary. Installations subject to temperatures outside the ranges require special consideration				
AB	*Atmospheric humidity*				
	Air temperature °C **a) low b) high**	**Relative humidity** % **c) low d) high**	**Absolute humidity** g/m^3 **e) low f) high**		
AB1	–60 +5	3 100	0,003 7	Indoor and outdoor locations with extremely low ambient temperatures Appropriate arrangements shall be made[c]	Includes temperature range of IEC 60721-3-3, class 3K8, with high air temperature restricted to +5 °C. Part of temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to –60 °C and high air temperature restricted to +5 °C
AB2	–40 +5	10 100	0,1 7	Indoor and outdoor locations with low ambient temperatures Appropriate arrangements shall be made[c]	Part of temperature range of IEC 60721-3-3, class 3K7, with high temperature restricted to +5 °C. Part of temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to –60 °C and high air temperature restricted to +5 °C

[a] May necessitate certain supplementary precautions (e.g. special lubrication).

[b] This means that ordinary equipment will operate safely under the described external influences.

[c] This means that special arrangements should be made, for example, between the designer of the installation and the equipment manufacturer, e.g. for specially designed equipment.

Table 51A *(continued)*

Code	External influences						Characteristics required for selection and erection of equipment	Reference
	Air temperature °C		Relative humidity %		Absolute humidity g/m^3			
	Low	high	low	high	low	high		
AB3	-25	+5	10	100	0,5	7	Indoor and outdoor locations with low ambient temperatures Appropriate arrangements shall be made [c]	Part of temperature range of IEC 60721-3-3, class 3K6, with high air temperature restricted to +5 °C. Includes temperature range of IEC 60721-3-4, class 4K1, with high air temperature range restricted to +5 °C
AB4	-5	+40	5	95	1	29	Weather protected locations having neither temperature nor humidity control. Heating may be used to raise low ambient temperatures Normal [b]	Identical with temperature range of IEC 60721-3-3, class 3K5. The high air temperature restricted to +40 °C
AB5	+5	+40	5	85	1	25	Weather protected locations with temperature control Normal [b]	Identical with temperature range of IEC 60721-3-3, class 3K3
AB6	+5	+60	10	100	1	35	Indoor and outdoor locations with extremely high ambient temperatures, influence of cold ambient temperatures is prevented. Occurrence of solar and heat radiation Appropriate arrangements shall be made [c]	Part of temperature range of IEC 60721-3-3, class 3K7, with low air temperature restricted to +5 °C and high air temperature restricted to +60 °C. Includes temperature range of IEC 60721-3-4, class 4K4, with low air temperature restricted to +5 °C
AB7	-25	+55	10	100	0,5	29	Indoor weather-protected locations having neither temperature nor humidity control; the locations may have openings directly to the open air and be subjected to solar radiation Appropriate arrangements shall be made [c]	Identical with temperature range of IEC 60721-3-3, class 3K6
AB8	-50	+40	15	100	0,04	36	Outdoor and non-weather protected locations, with low and high temperatures Appropriate arrangements shall be made [c]	Identical with temperature range of IEC 60721-3-4, class 4K3

[a] May necessitate certain supplementary precautions (e.g. special lubrication).

[b] This means that ordinary equipment will operate safely under the described external influences.

[c] This means that special arrangements need to be made, for example, between the designer of the installation and the equipment manufacturer, e.g. for specially designed equipment.

NOTE 1 All specified values are maximum or limit values which will have a low possibility of being exceeded.

NOTE 2 The low and high relative humidities are limited by the low and high absolute humidities, so that e.g. for environmental parameters a and c, or b and d, the limit values given do not occur simultaneously. Therefore, Annex B contains climatograms which describes the interdependence of air temperature, relative humidity and absolute humidity for the climatic classes specified.

Table 51A *(continued)*

Code	External influences	Characteristics required for selection and erection of equipment	Reference
AC	*Altitude*		
AC1	≤2 000 m	Normal [b]	
AC2	>2 000 m	May necessitate special precautions such as the application of derating factors For some equipment special arrangements may be necessary at altitudes of 1 000 m and above	
AD	*Presence of water*		
AD1	Negligible	Probability of presence of water is negligible Location in which the walls do not generally show traces of water but may do so for short periods, for example in the form of vapour which good ventilation dries rapidly IPX0	IEC 60721-3-4, class 4Z6 IEC 60529
AD2	Free-falling drops	Possibility of vertically falling drops Location in which water vapour occasionally condenses as drops or where steam may occasionally be present IPX1 or IPX2	IEC 60721-3-3, class 3Z7 IEC 60529
AD3	Sprays	Possibility of water falling as a spray at an angle up to 60° from the vertical Locations in which sprayed water forms a continuous film on floors and/or walls IPX3	IEC 60721-3-3, class 3Z8 IEC 60721-3-4, class 4Z7 IEC 60529
AD4	Splashes	Possibility of splashes from any direction Locations where equipment may be subjected to splashed water; this applies, for example, to certain external luminaires, construction site equipment IPX4	IEC 60721-3-3, class 3Z9 IEC 60721-3-4, class 4Z7 IEC 60529
AD5	Jets	Possibility of jets of water from any direction Locations where hot water is used regularly (yards, car-washing bays) IPX5	IEC 60721-3-3, class 3Z10 IEC 60721-3-4, class 4Z8 IEC 60529
AD6	Waves	Possibility of water waves Seashore locations such as piers, beaches, quays, etc. IPX6	IEC 60721-3-4, class 4Z9 IEC 60529
AD7	Immersion	Possibility of intermittent partial or total covering by water Locations which may be flooded and/or where the equipment is immersed as follows: • Equipment with a height of less than 850 mm is located in such a way that its lowest point is not more than 1 000 mm below the surface of the water • Equipment with a height equal to or greater than 850 mm is located in such a way that its highest point is not more than 150 mm below the surface of the water IPX7	 IEC 60529
AD8	Submersion	Possibility of permanent and total covering by water Locations such as swimming pools where electrical equipment is permanently and totally covered with water under a pressure greater than 10 kPa. IPX8	 IEC 60529

[a] May necessitate certain supplementary precautions (e.g. special lubrication).

[b] This means that ordinary equipment will operate safely under the described external influences.

[c] This means that special arrangements need to be made, for example, between the designer of the installation and the equipment manufacturer, e.g. for specially designed equipment.