

Requirements for electrical installations

Part 1:

Scope, object and fundamental principles

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Part 1:

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KENYA BUREAU OF STANDARDS (KEBS)

Head Office: P.O. Box 54974, Nairobi-00200, Tel.: (+254 020) 605490, 602350, Fax: (+254 020) 604031
E-Mail: info@kebs.org, Web: <http://www.kebs.org>

Coast Region

P.O. Box 99376, Mombasa-80100
Tel.: (+254 041) 229563, 230939/40
Fax: (+254 041) 229448

Lake Region

P.O. Box 2949, Kisumu-40100
Tel.: (+254 057) 23549, 22396
Fax: (+254 057) 21814

Rift Valley Region

P.O. Box 2138, Nakuru-20100
Tel.: (+254 051) 210553, 210555

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Foreword

This Kenya Standard was prepared by the **Electrical Installations and Distribution Systems** Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

Kenya Bureau of Standards (KEBS) has established Technical Committees (TCs) mandated to develop Kenya Standards (KS). The Committees are composed of representatives from the public and private sector organizations in Kenya.

Kenya Standards are developed through Technical Committees that are representative of key stakeholders including government, academia, consumer groups, private sector and other interested parties. Draft Kenya Standards are circulated to stakeholders through the KEBS website and notifications to World Trade Organization (WTO). The comments received are discussed and incorporated before finalization of the standards, in accordance with the Procedures for Development of Kenya Standards.

Kenya Standards are subject to review, to keep pace with technological advances. Users of the Kenya Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

This **third** edition cancels and replaces the **second** edition (KS 662-1:2018), which has been technically revised.

The revision of this standard is based on BS 7671:2018 (18th Edition) with its several amendments and the different parts of IEC 60364 and is split into the following parts:

- Part 1, Scope, object and fundamental principles.
- Part 2. Definitions.
- Part 3. Assessment of general characteristics.
- Part 4: Protection for safety.
- Part 5. Selection and erection of electrical equipment.
- Part 6. Verification.
- Part 7. Requirements for special installations or locations.

These parts are in line with those of IEC 60364 and they also match the chapters and sections of BS 7671:2018.

During the preparation of this standard, reference was made to the following documents:

- IEC 60364 (All parts): Low-voltage installations.
- BS 7671:2018. (18th Edition) Requirements for electrical installations.

Acknowledgement is hereby made for the assistance derived from these sources.

NOTES ON THE PLAN OF THIS EDITION

The edition is based on the plan agreed internationally for the arrangement of safety rules for electrical installations.

In the numbering system used, the first digit signifies a Part, the second digit a Chapter, the third digit a Section and the subsequent digits the Regulation number. For example, the Section number 413 is made up as follows:

PART 4- PROTECTION FOR SAFETY

Chapter 41 (first chapter of Part 4) - PROTECTION AGAINST ELECTRIC SHOCK.

Section 413 (third section of Chapter 41) - PROTECTIVE MEASURE: ELECTRICAL SEPARATION

Part 1 sets out the scope, object and fundamental principles.

Part 2 defines the sense in which certain terms are used throughout the Regulations, and provides a list of symbols used.

The subjects of the subsequent parts are as indicated below:

Part	Subject
Part 3	Identification of the characteristics of the installation that will need to be taken into account in choosing and applying the requirements of the subsequent Parts. These characteristics may vary from one part of an installation to another and should be assessed for each location to be served by the installation.
Part 4	Description of the measures that are available for the protection of persons, livestock and property, and against the hazards that may arise from the use of electricity.
Part 5	Precautions to be taken in the selection and erection of the equipment of the installation.
Part 6	Inspection and testing.
Part 7	Special installations or locations- particular requirements.

The sequence of the plan should be followed in considering the application of any particular requirement of the Regulations. The general index provides a ready reference to particular regulations by subject, but in applying any one regulation the requirements of related regulations should be borne in mind. Cross-references are provided, and the index is arranged to facilitate this.

In many cases, a group of associated regulations is covered by a side heading which is identified by a two-part number, e.g. 544.2. Throughout the Regulations where reference is made to such a two-part number, that reference is to be taken to include all the individual regulation numbers which are covered by that side heading and include that two-part number.

Requirements for electrical installations

Part 1:

Scope, object and fundamental principles

1 General

110.1 The standard apply to the design, erection and verification of electrical installations such as those of:

- Residential premises
- Commercial premises
- Public premises
- Industrial premises
- Prefabricated buildings;
- Low voltage generating sets
- Highway equipment and street furniture
- Locations containing a bath or shower
- Swimming pools and other basins
- Rooms and cabins containing sauna heaters
- Construction and demolition sites
- Agricultural and horticultural premises;
- Conducting locations with restricted movement
- Caravan, camping parks and similar locations;
- Marinas similar locations
- Medical locations
- Exhibitions, shows and stands
- Solar photovoltaic (PV) power supply systems
- Outdoor lighting
- Extra low voltage lighting
- Mobile or transportable units
- Caravans and motor caravans
- Electric vehicle charging
- Operating and maintenance gangways.

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- Temporary installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses including professional stage and broadcast applications
- Floor and ceiling heating systems
- onshore units of electrical shore connections for inland navigation vessels.

NOTE "Premises" covers the land and all facilities including buildings belonging to it

110.2 The standard includes requirements for:

- a) Circuits supplied at nominal voltages up to and including 1 000 V a.c. or 1 500 V d.c. For a.c., the preferred frequencies which are taken into account in these regulations are 50 Hz, 60 Hz and 400 Hz. The use of other frequencies for special purposes is not excluded;
- b) Circuits, other than the internal wiring of apparatus, operating at voltages exceeding 1 000 V and derived from an installation having voltage not exceeding 1 000 V a.c., e.g. discharge lighting, electrostatic precipitators;
- c) wiring systems and cables not specifically covered by the standards for appliances;
- d) All consumer installations external to buildings;
- e) fixed wiring for information and communication technology, signaling, control and the like (excluding internal wiring of equipment)
- f) additions and alterations to installations and also parts of the existing installation affected by an addition or alteration.

110.3 The standard is generally intended to be applied to electrical installations generally but, in certain cases, they may need to be supplemented by the requirements or recommendations of other Kenyan Standards or by the requirements of the person ordering the work.

Such cases include the following.

- a) Electric signs and high voltage luminous discharge tube installations
- b) Emergency lighting
- c) Explosive atmospheres
- d) Electrical apparatus for use in the presence of combustible dust
- e) Fire detection and fire alarm systems in buildings
- f) Telecommunications systems
- g) Electric surface heating systems
- h) Electrical installations for open-cast mines and quarries
- i) Temporary electrical systems for entertainment and related purposes
- j) Life safety and fire fighting applications

110.4 The standard is not intended to apply to the following installations

- a) Systems for the distribution of electricity to the public

- b) Railway traction equipment, rolling stock and signalling equipment
- c) Equipment of motor vehicles, except those to which the requirements of the Regulations concerning caravans or mobile units are applicable
- d) Equipment on board ships
- e) Equipment of mobile and fixed offshore installations
- f) Equipment of aircraft
- g) Those aspects of mines and quarries specifically covered by Statutory Regulations
- h) Radio interference suppression equipment, except so far as it affects safety of the electrical installation
- i) Lightning protection systems for buildings and structures covered by other relevant Kenyan standards
- j) Aspects of lift installations covered by other relevant Kenyan standards
- k) Electrical equipment of machines covered by other relevant Kenyan standards
- l) Electric fences covered by other relevant Kenyan standards
- m) The d.c side of cathodic protection systems complying with other Kenyan standards

113 Equipment

113.1 The standard applies to items of electrical equipment only so far as selection and application of the equipment in the installation are concerned. The standard does not deal with requirements for the construction of assemblies of electrical equipment, which are required to comply with appropriate standards.

114 Relationship with statutory regulations

114.1 The standard shall be used together with The Energy (Electricity Supply) Regulations.

115 Installations in premises subject to licensing

115.1 For installations in premises over which a licensing or other authority exercises a statutory control, the requirements of that authority shall be ascertained and complied with in the design and execution of the installation.

Chapter 12: Object

120 General

120.1 This standard contain the requirements for the design and erection of electrical installations so as to provide safety and proper functioning for the use intended.

120.2 Chapter 13 of this standard state the fundamental principles. It does not include detailed technical requirements which may be subject to modifications on account of technical developments.

120.3.1 Parts 3 to 7 of these standards deal with technical requirements, the observance of which is intended to ensure that electrical installations conform to the fundamental principles of Chapter 13, as follows

Part 3 Assessment of general characteristics

Part 4 Protection for safety

Part 5 Selection and erection of equipment

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Part 6 Inspection and testing

Part 7 Special installations or locations.

120.3.2 Any difference which may arise between a consumer and the authorized distributor of electrical energy shall be determined by an inspector appointed in accordance with the electric power act.

Chapter 13: Fundamental principles

131 Protection for safety

131.1 General

The requirements of this chapter are intended to provide for the safety of persons, livestock and property against dangers and damage which may arise in the reasonable use of electrical installations. The requirements to provide for the safety of livestock are applicable in locations intended for them.

In electrical installations, risk of injury may result from:

- a) shock currents
- b) excessive temperatures likely to cause burns, fires and other injurious effects.
- c) ignition of a potentially explosive atmosphere
- d) under voltages, overvoltages and electromagnetic disturbances likely to cause or result in injury or damage
- e) mechanical movement of electrically actuated equipment, in so far as such injury is intended to be prevented by electrical emergency switching or by electrical switching for mechanical maintenance of non-electrical parts of such equipment
- f) power supply interruptions and/or interruption of safety services
- g) arcing or burning, likely to cause blinding effects, excessive pressure and/or toxic gases.

131.2 Protection against electric shock

131.2.1 Basic protection (protection against direct contact)

NOTE For low voltage installations, systems and equipment, 'basic protection' generally corresponds to protection against 'direct contact'.

Persons and livestock shall be protected against dangers that may arise from contact with live parts of the installation.

This protection can be achieved by one of the following methods:

- a) preventing a current from passing through the body of any person or any livestock;
- b) Limiting the current which can pass through a body to a value lower than the shock current.

131.2.2 Fault protection (protection against indirect contact)

NOTE For low voltage installations, systems and equipment, 'fault protection' generally corresponds to protection against 'indirect contact', mainly with regard to failure of basic insulation.

Persons and livestock shall be protected against dangers that may arise from contact with exposed conductive-parts during a fault.

This protection can be achieved by one of the following methods:

- a) preventing a fault current from passing through the body of any person or any livestock;

- b) limiting the fault current which can pass through a body to a non-hazardous value;
- c) Limiting the duration of a current resulting from a fault, which can pass through a body, to a non-hazardous time period

NOTE In connection with fault protection, the application of the method of protective equipotential bonding is one of the most important principles for safety.

131.3 Protection against thermal effects

The electrical installation shall be so arranged that the risk of ignition of flammable materials due to high temperature or electric arc is minimized. In addition, during normal operation of the electrical equipment, there shall be minimal risk of persons or livestock suffering burns.

131.3.2 Persons, livestock, fixed equipment and fixed materials adjacent to electrical equipment shall be protected against harmful effects of heat or thermal radiation emitted by electrical equipment, and in particular the following:

- a) Combustion, ignition, or degradation of materials
- b) Risk of burns
- c) Impairment of the safe function of installed equipment.

Electrical equipment shall not present a fire hazard to adjacent materials.

131.4 Protection against over current

Persons or livestock shall be protected against injury and property shall be protected against damage due to excessive temperatures or electromechanical stresses caused by any over currents likely to arise in live conductors.

NOTE Protection can be achieved by limiting the overcurrent to a safe value and/or duration

131.5 Protection against fault currents

Conductors, other than live conductors, and any other parts intended to carry a fault current shall be capable of carrying that current without attaining an excessive temperature. Electrical equipment, including conductors, shall be provided with mechanical protection against electromechanical stresses of fault currents as necessary to prevent injury or damage to persons, livestock or property.

131.6 Protection against voltage disturbances and measures against electromagnetic disturbances

131.6.1 Persons and livestock shall be protected against injury, and property shall be protected against any harmful effects, as a consequence of a fault between live parts of circuits supplied at different voltages, in accordance with Section 442 (protection of low voltage installations against temporary overvoltages due to earth faults in the high voltage system and due to faults in the low voltage)

131.6.2 Persons and livestock shall be protected against injury, and property shall be protected against damage, as a consequence of overvoltages such as those originating from atmospheric events or from switching, in accordance with Section 443.

NOTE For protection against lightning strikes, refer to the IEC 62305 series.

131.6.3 Persons and livestock shall be protected against injury, and property shall be protected against damage, as a consequence of under voltage and any subsequent voltage recovery, in accordance with Section 445 (protection against under voltage).

131.6.4 The installation shall have an adequate level of immunity against electromagnetic disturbances so as to function correctly in the specified environment, in accordance with Section 444 (measures against electromagnetic disturbances). The installation design shall take into consideration the

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anticipated electromagnetic emissions, generated by the installation or the installed equipment, which shall be suitable for the current-using equipment used with, or connected to, the installation.

131.7 Protection against power supply interruption

Where danger or damage is expected to arise due to an interruption of supply, suitable provisions shall be made in the installation or installed equipment.

132 design

132.1 General

For the design of the electrical installation, the following factors shall be taken into account to provide:

- the protection of persons, livestock and property in accordance with 131;
- the proper functioning of the electrical installation for the use intended;

The information required as a basis for design is listed in 132.2 to 132.5. The requirements with which the design should comply are stated in 132.6 to 132.16.

132.2 Characteristics of Available Supply or Supplies

Information on the characteristics of the available supply or supplies shall be determined by calculation, measurement, enquiry or inspection.

The following characteristics shall be included in the documentation referred to in KS 662-1 to show conformity with the Regulations:

132.2.1 Nature of Current — a.c. and/or d.c.

132.2.2 Purpose and number of conductors

- a) For a.c.: line conductor(s);
 - i) neutral conductor;
 - ii) protective conductor.
 - iii) PEN conductor
- b) For d.c.: conductors equivalent to those listed above (outer/middle/earthed live conductors, protective conductor, and PEN conductor)

132.2.3 Values and tolerances

- a) nominal voltage and voltage tolerances;
- b) nominal frequency and frequency tolerances;
- c) maximum current allowable;
- d) prospective fault current
- e) external earth fault loop impedance

132.2.4 Protective measures inherent in the supply, e.g. earthed neutral or mid-wire.

132.2.5 Particular requirements of the distributor.

NOTE If the distributor changes the characteristics of the power supply this may affect the safety of the installation

132.3 Nature of demand

The number and type of the circuits required for lighting, heating, power, control, signalling, communication and information technology etc. shall be determined from knowledge of:

- a) location of points of power demand;
- b) loads to be expected on the various circuits;
- c) daily and yearly variation of demand;
- d) any special conditions, such as harmonics
- e) requirements for control, signalling, communication and information technology, etc.
- f) Anticipated future demand if specified

132.4 Electrical supply systems for safety services or standby electrical supply systems

Where a supply for safety services or standby electrical supply systems is specified the following shall be determined:

- a) Characteristics of the supply
- b) Circuits to be supplied by the safety source.

132.5 Environmental conditions

132.5.1 The design of the electrical installation shall take into account the environmental conditions to which it will be subjected.

NOTE See Chapter 32 of KS 662-3 Requirements of Electrical Installations Part 3, Assessment of general characteristics and IEC 60721 Classification of Environmental Conditions.

132.5.2 Equipment in surroundings susceptible to risk of fire or explosion shall be so constructed or protected, and such other special precautions shall be taken, as to prevent danger.

132.6 Cross-sectional area of conductors

The cross-sectional area of conductors shall be determined for both normal operating conditions and, where appropriate, for fault conditions according to:

- a) the admissible maximum temperature
- b) the admissible voltage drop
- c) the electromechanical stresses likely to occur due to short-circuit and earth fault currents
- d) other mechanical stresses to which the conductors are likely to be exposed
- e) the maximum impedance for correct operation of short-circuit and earth fault protection
- f) the method of installation
- g) harmonics
- h) thermal insulation.

132.7 Type of wiring and method of installation

The choice of the type of wiring system and the method of installation shall include consideration of the following:

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- a) The nature of the location
- b) The nature of the structure supporting the wiring
- c) Accessibility of wiring to persons and livestock
- d) Voltage
- e) The electromechanical stresses likely to occur due to short-circuit and earth fault currents
- f) Electromagnetic interference
- g) Other external influences (e.g. mechanical, thermal and those associated with fire) to which the wiring is likely to be exposed during the erection of the electrical installation or in service.

132.8 Protective equipment

The characteristics of protective equipment shall be determined with respect to their function, including protection against the effects of:

- a) Overcurrent (overload and/or short-circuit)
- b) Earth fault current
- c) Overvoltage
- d) Undervoltage and no-voltage

The protective devices shall operate at values of current, voltage and time which are suitably related to the characteristics of the circuits and to the possibilities of danger.

132.9 Emergency control

An interrupting device shall be installed in such a way that it can be easily recognized and effectively and rapidly operated where, in the case of danger, there is a necessity for immediate interruption of the supply.

132.10 Disconnecting devices

Disconnecting devices shall be provided so as to permit disconnection of the electrical installation, circuits or individual items of equipment as required for maintenance, testing, fault detection, or repair.

132.11 Prevention of mutual detrimental influence

The electrical installation shall be arranged in such a way that no mutual detrimental influence will occur between electrical installations and non-electrical installations.

Electromagnetic interference shall be taken into account.

132.12 Accessibility of electrical equipment

Electrical equipment shall be arranged so as to afford as may be necessary:

- a) Sufficient space for the initial installation and later replacement of individual items of electrical equipment
- b) Accessibility for operation, inspection, testing, fault detection, maintenance and repair.

132.13 Documentation for the electrical installation

Every electrical installation shall be provided with appropriate documentation, including that required by section 514 (Identification and Notices), part 6 and where applicable part 7.

132.14 Protective devices and switches

132.14.1 A single-pole fuse, switch or circuit-breaker shall be inserted in the line conductor only.

132.14.2 No switch or circuit-breaker, except where linked, or fuse, shall be inserted in an earthed neutral conductor. Any linked switch or linked circuit-breaker inserted in an earthed neutral conductor shall be arranged to break all the related line conductors

132.15 Isolation and switching

132.15.1 Effective means, suitably placed for ready operation, shall be provided so that all voltage may be cut off from every installation, from every circuit thereof and from all equipment, as may be necessary to prevent or remove danger.

132.15.2 Every fixed electric motor shall be provided with an efficient means of switching off, readily accessible, easily operated and so placed as to prevent danger.

132.16 Additions and alterations to an installation

No addition or alteration, temporary or permanent, shall be made to an existing installation, unless it has been ascertained that the rating and the condition of any existing equipment, including that of the distributor, will be adequate for the altered circumstances. Furthermore, the earthing and bonding arrangements, if necessary for the protective measure applied for the safety of the addition or alteration, shall be adequate.

133 Selection of electrical equipment**133.1 General**

133.1.1 Every item of electrical equipment used in electrical installations shall comply with the relevant Kenya standards, in the absence of such a standard reference shall be made to the appropriate international standard.

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

133.1.3 Where equipment to be used is not in accordance with 133.1.1 or is used outside the scope of its standard, the designer or other person responsible for specifying the installation shall confirm that the equipment provides at least the same degree of safety as that afforded by compliance with the standard.

133.2 Characteristics

Every item of electrical equipment selected shall have suitable characteristics appropriate to the values and conditions on which the design of the electrical installation (see 132) is based and shall, in particular, fulfil the following requirements:

133.2.1 Voltage

Electrical equipment shall be suitable with respect to the maximum steady voltage (r.m.s. value for a.c.) likely to be applied, as well as over voltages likely to occur.

NOTE For certain equipment, it may be necessary to take account of the lowest voltage likely to occur.

133.2.2 Current

All electrical equipment shall be selected with respect to the maximum steady current (r.m.s. value for a.c.) which it has to carry in normal service, and with respect to the current likely to be carried in abnormal conditions and the period (e.g. operating time of protective devices if any) during which it may be expected to flow.

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133.2.3 Frequency

Equipment shall correspond to the frequency likely to occur in the circuit.

133.2.4 Power

All electrical equipment, which is selected on the basis of its power characteristics, shall be suitable for the duty demanded of the equipment, taking into account the load factor and the normal service conditions.

133.3 Conditions of installation

All electrical equipment shall be selected so as to withstand safely the stresses and the environmental conditions (see 132.5) characteristic of its location. An item of equipment which does not by design have the properties corresponding to its location may be used where adequate further protection is provided as part of the completed electrical installation.

133.4 Prevention of harmful effects

All electrical equipment shall be selected so that it will not cause harmful effects on other equipment or impair the supply during normal service including switching operations.

In this context, the factors which can have an influence include, e.g.:

- Transient overvoltage
- Undervoltage
- Unbalanced loads
- Rapidly fluctuating loads
- Starting currents
- harmonic currents
- Earth leakage currents
- Excessive PE conductor current not due to a fault
- d.c feedback
- high frequency oscillations
- necessity for additional connections to earth
- power factor

133.5 New materials and inventions

Where the use of a new material or invention leads to departures from the standard, the resulting degree of safety of the installation shall be not less than that obtained by compliance with the standard.

134 Erection and initial verification of electrical installations

134.1 Erection

134.1.1 Good workmanship by competent persons or persons under their supervision and proper materials shall be used in the erection of the electrical installation. The installation of electrical equipment shall take account of manufacturer's instructions.

134.1.2 The characteristics of the electrical equipment, as determined in accordance with 133 shall not be impaired in the process of erection.

134.1.3 Conductors shall be identified in accordance with Section 514. Where identification of terminals is necessary, they shall be identified in accordance with Section 514. Conductors shall also be identified in accordance with IEC 60446,

134.1.4 Every electrical joint and connection shall be of proper construction as regards conductance, insulation, mechanical strength and protection.

134.1.5 All electrical equipment shall be installed in such a manner that the design temperatures are not exceeded.

134.1.6 All electrical equipment likely to cause high temperatures or electric arcs shall be placed or guarded so as to eliminate the risk of ignition of flammable materials.

Where the temperature of an exposed part of electrical equipment is likely to cause injury to persons or livestock, that part shall be as located or guarded as to prevent accidental contact therewith.

Where necessary for safety purposes, suitable warning signs and/or notices shall be provided.

134.2 Initial verification

134.2.1 During erection and on completion of an installation or an addition or alteration to an installation, and before it is put into service, appropriate inspection and testing shall be carried out by skilled competent persons to verify that the requirements of this Standard have been met.

Appropriate certification shall be issued in accordance with KS 662-6 Chapter 64.

134.2.2 The designer of the installation shall make a recommendation for the interval to the first periodic inspection and test as detailed in KS 662-6, Chapter 64.

NOTE: The requirements of Chapter KS 662-3,34 (maintainability) should be taken into consideration.

135 PERIODIC INSPECTION AND TESTING

135.1 It is recommended that every electrical installation is subjected to periodic inspection and testing, in accordance with Chapter KS 662-6,65.