ICS 29.020
CCS K 09

National Standard of the People's Republic of China

GB 19517—2023
Replace GB 19517—2009

National technical specification for the safety of electric equipments

国家电气设备安全技术规范

(English Translation)

Issue data: 2023-05-23 **Implementation date:** 2024-06-01

Issued by General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
Standardization Administration of the People's Republic of China

Contents

Foreword

This document is drafted in accordance with the rules given in the GB/T 1.1—2020 *Directives for standardization—Part 1: Rules for the structure and drafting of standardizing documents.*

This document replaces the GB 19517—2009(*National safety technical code for electric equipments*) in whole. In addition to a number of editorial changes, the following technical deviations have been made with respect to the GB 19517—2009(*National safety technical code for electric equipments*):

—The AC rated voltage limit has been changed to "……up to 1000V(1140V) AC rated voltage" in Clause 1(see Clause 1, Clause 1 of 2009 Edition);

—Normative references has been added (see Clause 2);

—Terms and definitions has been added(see Clause 3);

—General has been added(see Clause 4);

—The Clause "Requirements for safety technology" has been adjusted to Clause 5 "Requirements for protection against electrical safety hazard", the technical content have been modified(see Clause 5, Clause 2 of 2009 Edition);

— Safety aspect requirements has been added(see Clause 6);

—The Clause "Inspection" has been adjusted to Clause 7"Inspection, test methods and conformity assessment", the technical content have been modified(see Clause 7, Clause 3 of 2009 Edition);

—"Implementation and surveillance" has been deleted(see Clause 4 of 2009 Edition);

—Normative Annex A and Normative Annex B have been deleted(see 2009 Edition).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The issuing body of this document shall not be held responsible for identifying any or all such patent rights.

This document was proposed and prepared by Ministry of Industry and Information Technology of the People's Republic of China.

The previous editions of this document are as follow:

—The first edition was issued in 2004 as GB 19517—2004, the first revision was issued in 2009;

—This is the second revised edition.

Introduction

The purpose of this document is to achieve an optimal balance of safety level among people, environment and product, and to reduce the risk of damages to the life, health and property to the greatest extend and to reach an acceptable level during design, manufacture, sale and use of electric equipment.

This document provides information on the basic safety requirements for various types of electrical equipment products.

National technical specification for the safety of electric equipments

1 Scope

This document specifies the basic safety requirements for all kinds of hand-held, mobile, and fixed electrical equipment used indoors or outdoors with a rated voltage up to AC 1000V(1140V) or DC 1500V.

This document is applicable to products or parts using electrical energy converted from chemical energy, solar energy, and wind energy.

This document is also applicable to products with internally generated untouchable voltages exceeding AC 1000 V or DC 1500 V.

This document is not applicable to:

—Material and auxiliary materials, except material and auxiliary materials of electrical equipment covered in of this document;

—Semi-manufactured products or primary products, which could not be used independently;

—Electrical equipment used for medical treatment purpose;

—Elevator;

—Energizer of electric fence;

—Particular equipment such as ship, aircraft and railway.

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.

GB/T 3805， *Extra-low voltage (ELV) —Limit values*

GB/T 4208， *Degrees of protection provide by enclosure (IP code)*

GB/T 4776， *Electrical safety terminology*

GB/T 13306， *Plates*

GB/T 14048.1， *Low-voltage switchgear and controlgear—Part 1: General rules*

GB/T 16935.1—2008， *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests*

GB/T 25296， *Guidelines on general tests for safety of electrical equipments*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in GB/T 4776-2017 apply.

4 General

4.1 Safety level

Products that comply with the requirements of this document can be considered to have reached a basic safety level.

To ensure the safety of the product, necessary safety measures may be required, including but not limited to:

—installation;

—use;

—maintenance;

—repair;

—innovation.

Product safety is influenced by the factors such as the application software, information (intelligence), and/or functional safety of the product, manufacturers shall provide corresponding requirements or constraints.

This document is only applicable to the safety conformity assessment of test sample (type test).

4.2 Relationship between Clause 5 and Clause 6

The relationship between Clause 5 and Clause 6 is as follows.

a) Clause 5 specifies the requirements for protection against electrical safety hazard, that is, the design of the product shall comply with these requirements. The measures to meet the relevant requirements are not unique and irrelevant with the function of the product;

b) Clause 6 specifies the requirements for product safety aspects. When the product passes all safety inspections and tests, it is considered qualified (see Clause 7).

5 Requirements for protection against hazard of electrical safety

5.1 General requirements

The general requirements include:

a) The product shall be designed to operate and run safely under intended use and reasonably foreseeable use, without any hazard to persons, property and environment.

b) The product with multiple functions or obvious independent operation and use shall meet the requirements of each function or special operation mode, and the hazards caused by their function combinations shall be considered.

c) The protective technical measures against potential hazards shall be adopted in the order of direct-indirect-suggestive safety technical measures.

5.2 Protection against hazard of electric shock

The requirements for protection against electric shock hazard include the followings.

a) Design category for protection against electric shock shall comply with the following requirements:

   1) Class 0 equipment, appliance in which protection against electric shock relies upon basic insulation only, there being no means for the connection of conductive accessible parts, if any, to the protective conductor in the fixed wiring of the installation, reliance in the event of a failure of the basic insulation being placed upon the environment.

   2) class Ⅰ equipment, appliance in which protection against electric shock does not rely on basic insulation only but which includes an additional safety precaution, in that conductive accessible parts are connected to the protective earthing conductor in the fixed wiring of the installation in such a way that conductive accessible parts cannot become live in the event of a failure of the basic insulation.

   3) class Ⅱ equipment, appliance in which protection against electric shock does not rely on basic insulation only but in which additional safety precautions are provided, such as double insulation or reinforced insulation, there being no provision for protective earthing or reliance upon installation conditions.

   4) class Ⅲ equipment, appliance in which protection against electric shock relies on supply at safety extra-low voltage（SELV） and in which voltages higher than those of （SELV） are not generated.

b) When the product is used according to the design purpose, the insulation protection technology, direct contact technology, indirect contact technology, etc. shall be used for sufficient protection against the hazard caused by direct action of electric energy.

c) The product shall meet the requirements for electrical insulation performance such as insulation resistance, dielectric strength, heat resistance, moisture resistance, pollution prevention, flame retardancy and resistance to tracking. Supplementary insulation or reinforced insulation shall be evaluated separately, and shall be ensured that the fault touch voltage does not cause harm if case of the basic insulation fails or the arc occurs.

d) The structure, enclosure or protective cover of the product, etc., as well as when the product is in a closed electrical workplace will not present hazard of contacts with live parts accidentally. Enclosures, protective cover or any other parts are only allowed to be disassembled or opened with tools.

e) Product powered by SELV may not adopt the above direct contact protection measures if the direct contact current is only one frequency and action time and energy of which is limited to a non-hazardous level.

f) The product shall be equipped with protective measures such as earthing protection, double insulation, or SELV supply. The protective earthing are not allowed in the protective measures of double insulation structure and SELV power supply.

g) All parts of the product whose working voltage, fault current, leakage current or similar effects will cause harm shall have enough clearance and creepage distance.

h) The product shall withstand the hazards caused by the indirect effects from electrical energy and non-electrical energy such as high temperature, arc, radiation, gas, noise, vibration and others, which would be generated from the product itself or adjacent equipment during the normal operation.

i) The product shall withstand the hazards of indirect effects from external factors such as overload, strike, stress, damp, foreign matter.

5.3 Protection against mechanical hazard

The requirements for protection against mechanical hazard include the followings.

a) The product shall have adequate mechanical strength, good enclosure protection and relevant stability, as well as the structure is suitable for transportation.

b) The product shall not have the following situations:

   1) Sharp angles, edges, and rough surfaces;

   2) Contact or access to the hazardous moving parts during the normal use;

   3) Splash of metal shavings and dust;

   4) Gas spilling;

   5) High or low temperature of enclosure.

5.4 Protection against electrical connection and mechanical connection hazard

The requirements for protection against electrical connection and mechanical connection hazard include the followings.

a) The power connection device shall be installed. The power cord shall be the rubber insulated cord or flexible cable, or PVC insulated flexible cable. The combination YELLOW-AND-GREEN insulated core in the power cord shall be connected to specialized earthing terminal. The power cord shall be connected by screws, nuts or equivalent parts and positioned by a dedicated fixed device.

b) The coupler, connector, plug or socket-outlet connecting the power supply shall cut off the line conductor before cutting off the protective earthing, and protective earthing shall be connected before connecting the power supply conductor.

c) Fasteners that may be damaged by failure for their intended use shall withstand the mechanical stress generated in normal use. The threaded connector is not allowed to use the metal material that is easy to creep, and screws for electrical connection that transfer touch pressure shall be screwed into the metal.

d) The threaded parts made of insulation material shall not be used for any electrical connections. If the screws made of insulation material are replaced by the metal one, the electrical insulation will be damaged, as a result, threaded parts cannot be made of insulation. The exposed screws of the product are replaced in the daily maintenance, if a longer one is used in its place, the protection against electric shock shall not be hazardous.

e) The connection parts, devices, connectors, terminals, conductors and others, whose functions include the electrical connections, mechanical connections and both electrical and mechanical connections in the product shall be locked reliably. Glowing, loosening, moving or other changes shall be within the allowable range during the operation, and the product shall be able to withstand the electrothermal mechanical stress.

5.5 Protection against operation hazard

The requirements for protection against operation hazard include:

a) The protective cover or chip removal device of product shall prevent the workpiece, cutting tool or component, as well as metal shavings, dust, etc. from flying out during operation;

b) The noise and vibration of the product shall be limited within the specified range;

c) The product shall not have glowing or low temperature phenomena, and no hazardous thermal radiation. The product employing liquid systems shall not spill or splash onto the user or workplace;

d) If the hazardous dust, steam or gas is inside the product, or such things are produced during the operation, they shall be sealed or released reliably.

5.6 Power control and its hazard protection

The requirements for power control and hazard protection include the followings.

a) The power of the product shall be safely and reliably connected, disconnected or controlled.

b) Control device and interlocking device shall have the functions of protection against hazard.

c) In the following situations, the product shall be equipped with an emergency switching-off power circuit:

   1) When danger occurs, the operating switch cannot be cut off quickly and safely;

   2) There are several mobile units that can cause harm and cannot be cut off by a common switch that is quick and non-hazardous;

   3) Cutting off a unit may lead to additional hazard;

   4) When the console cannot be comprehensive monitoring.

d) If the product has areas designed for installation, normal operation, maintenance (servicing) and inspection, or where the human body (such as hands) can enter, it shall be ensured that no unintended start-up and other hazards.

e) It shall ensure that the user is able to cut off the power supply of hand-held products without releasing the handle, or the switch automatically returns to the “off” position when the handle is released.

5.7 Protections against other hazards

5.7.1 Factors related to human-machine factors

The human-machine factors include, but not limited to:

a) Dimensional relationship between human body and equipment;

b) Human body’s perception and response;

c) Human psychological factors;

d) Guarantee of human life and health;

e) Human work efficiency;

f) Human caution and warning;

g) Human unsafe behavior.

5.7.2 Factors related to electrical safety information

The electrical safety information factors include, but not limited to:

a) Rated value;

b) Safety warning;

c) Manufacturer information;

d) Safety graphical symbol;

e) Line diagram;

f) Safety colour;

g) Safety marking.

The safety information-carrying forms include, but not limited to:

a) On the product;

b) On the packaging;

c) Nameplate;

d) Marking;

e) Instruction for use (operation);

f) Product technical requirements;

g) Manufacturer's declaration documentation;

h) Soft media;

i) Sample;

j) Advertisement;

k) Website.

6 Safety aspect requirements

6.1 Environmental adaptability

The requirements for environmental adaptability include but not limited to the followings:

a) Ambient air temperature

Maximum ambient temperature: The ambient air temperature does not exceed +40 ° C and its average over a period of 24 h does not exceed +35 ° C;

Minimum ambient temperature: The lower limit of the ambient air temperature is -5℃.

b) Altitude

Altitude: No higher than 2,000m.

c) Humidity

When the maximum temperature at the installation site reaches +40℃, the relative humidity not exceeding 50%; a higher relative humidity is permitted at lower temperatures, with a maximum relative humidity not exceeding 90%. Measures shall be taken against condensation on the products due to temperature changes.

d) Pollution degree

Pollution degree 3: Conductive pollution occurs that occasionally a temporary conductivity caused by condensation is to be expected;

Pollution degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

6.2 Surfaces

The surfaces in all directions (including the housing and the accessible parts during normal use) of the products shall be smooth, without sharp edges, burrs, scratches, overflow edges, etc., and without obvious cracks.

The metallic materials (including conductor materials) of the products shall be surface-coated.

The surface of insulating materials shall be even and flat, without obvious bumps, cracks, impurities, flash edges, uneven colour and other defects.

6.3 SELV

The power supply voltage of the product shall comply with the provisions in GB/T 3805.

6.4 Enclosures and degrees of protection

The requirements for enclosures and degrees of protection include the followings.

a) The requirements shall be met by the product enclosure, including but not limited to:

1) The enclosure isolates at least all live parts (except those completely insulated), or the power supply cannot be restored before the enclosure is closed or reset;

2) The moving parts and hazard parts are placed or encapsulated in the enclosure and enough protection is provided to prevent personal injury during normal operation;

3) The enclosure cannot be dismantled or removed without the aid of tools;

4) There are other hazards when using and adjusting the protective cover. If the protective cover is removed as required, the fasteners shall always be on the protective cover or product;

5) Protection against contact with live parts can also be ensured after removal of the maintenance cover;

6) Protection against contact with hazardous moving parts can also be ensured after removal of the dust collecting device (if any).

b) The requirements of the degrees of protection provided by enclosure include:

1) The degrees of protection shall comply with the provisions in GB/T 4208, and the IP code shall not be marked without test;

2) The degrees of protection provide by enclosure for preventing direct contact shall be at least IP2XC.

6.5 Protective earthing

The requirements of protective earthing include the followings.

a) The following conductive parts shall be permanently and reliably connected to the earthing terminal or earthing conductor joint in the product, or to the earthing contact of the product's leading-in socket:

1) Parts of Class Ⅰ equipment that may be live once the insulation fails;

2) Parts that are covered by the decorative cover.

b) Earthing connection:

1) If there is earthing connection on a detachable part, the earthing connection shall precede the current-carrying connection when the part is placed in position, and the current-carrying

connection shall be disconnected before the earthing connection is disconnected when the part is removed;

2) For products with power cords, the length of the wire between the wiring terminal or cord fixing device and the wiring terminal shall be set so that if the cord slides out of the cord fixing device, the current carrying wire is tightened before earthing wire.

c) Earthing terminals:

1) All parts of the earthing terminals used to connect external conductors shall be free from the risk of corrosion due to contact with copper earthing conductors or contact with other metals;

2) The earthing terminal and earthing contact shall not be electrically coupled to the neutral terminal;

3) If the body of the earthing terminal is a part of an aluminum or aluminum alloy body or enclosure, proper measures shall be taken to avoid the risk of corrosion due to contact between copper and aluminum or aluminum alloy;

4) The clamping device of the earthing terminal shall be fully locked, which shall not be loosened without the aid of tools;

5) Classes Ⅱ and Classes Ⅲ equipment shall have no provision for earthing.

d) Structural electrical connections:

1) If no electrical device exceeding the extra-low voltage limit are installed on cover plates, doors, shutters and similar parts, the usual metal screw connections and metal hinge connections are considered sufficient to ensure continuity;

2) If devices with voltage values exceeding the extra-low voltage limit are installed on cover plates, doors, shutters and similar parts, additional measures such as protective conductors (PE) or similar electrical connections specially designed and verified for this purpose shall be taken to ensure earthing continuity;

3) When a part of the product moves, the protection circuit (earthing continuity) of other parts of the product shall not be interrupted;

4) The protective circuit shall not contain any breaking device (switch, isolator, etc.) unless: movable connections are allowed in the protective conductor and they can only be moved by authorized personnel using tools; or the plug and socket-outlet devices can only disconnect the protective circuit after the live conductor has been disconnected, and the continuity of the protective circuit shall be established before the connection of live conductor is restored;

5) If the exposed conductive part of the device cannot be connected to the protective circuit by the method used for fixing the device, a conductor with a sufficiently large cross-sectional area shall be connected to the protective circuit of the product;

6) Generally, the printed conductors of printed circuit boards shall not be used to provide continuity for the protective earthing circuit;

7) Bearings may be considered to satisfy electrical continuity.

e) All conductive parts shall have anti-corrosion measures.

f) Electrical continuity shall ensure that the resistance between any easily accessible conductive parts of the product and the earthing terminal or earthing contact does not exceed 0.1Ω.

6.6 Additional fault protection

The requirements of additional fault protection include the followings.

a) For general products, additional protection against fault shall be either:

1) Automatic disconnection. For Class Ⅰ equipment, low-voltage fuses, circuit breakers, etc. shall be inserted or installed between the power supply system and Class Ⅰ equipment;

2) Electrical isolation, using isolating transformers and safety isolating transformers;

3) Residual current device (RCD).

b) Products employing liquid systems, the additional protection shall be either:

1) of Class Ⅲ construction;

2) of Class Ⅱ construction and be provide with a RCD;

3) of Class Ⅰ or Class Ⅱ construction, to be used with an isolating transformer.

c) If the product contains equipment (capacitors, etc.) that may have steady-state touch current and charge after its disconnection, a warning sign shall be installed.

6.7 Functional earthing

The functional earthing of the product shall be clearly and durably marked with a functional earthing symbol, and the functional earthing symbol shall not be mixed with the protective earthing symbol, and the functional earthing device shall not be directly connected with the protective earthing device.

For Classes Ⅱ and Classes Ⅲ equipment, live parts and functional earthing parts shall be separated by double insulation or reinforced insulation.

6.8 Noise

The noise limits (or noise limits after noise reduction measures taken) shall comply with relevant national regulations.

6.9 Restrictions on manufacturing material

The types and content limits of restricted manufacturing material shall comply with relevant national requirements.

6.10 Safe handling

The requirements of safe handling include:

a) Lifting rings or similar devices for handling shall be provided on the housing of fixed products with a mass exceeding 30 kg for fixed installation and use;

b) When lifting rings are used, the screw holes in the housing shall be of sufficient screwing length, and there is a plane matched with the lifting rings.

6.11 Clearance

Clearance shall comply with the provisions in GB/T 16935.1-2008, 5.1.

6.12 Creepage distance

Creepage distance shall comply with the provisions in GB/T 16935.1-2008, 5.2.

6.13 Insulation resistance

The insulation resistance value of basic insulation shall not be less than 2MΩ, the resistance of supplementary insulation shall not be less than 5MΩ, and that of reinforced insulation shall not be less than 7MΩ.

6.14 Leakage current

The leakage current value shall generally not exceed 3.5 mA.

6.15 Distance through insulation

6.15.1 If the product contains both supplementary insulation and reinforced insulation, 6.15 applies.

6.15.2 The insulation penetration distance at different operating voltages shall meet the following requirements:

—With working voltages up to 130 V, the insulation penetration distance between metal parts shall be not less than 1.0 mm for the metal parts separated by supplementary insulation and not less than 1.5 mm for those separated by reinforced insulation;

—With working voltages exceed than 130 V but not exceed than 250 V, the insulation penetration distance between metal parts shall be not less than 1.0 mm for the metal parts separated by supplementary insulation and not less than 2.0 mm for those separated by reinforced insulation;

—With working voltages up to 250 V, the distance through reinforced insulation between the windings and the easily accessible metal shall be not less than 1.0 mm.

6.15.3 The specified Insulation distance may be composed of the thickness of the solid insulation layer plus the thickness of multiple layers of air layer, so that the total thickness of the solid insulation layer is equal to the specified distance.

NOTE: 6.15.3 does not apply if either a) or b) below is met.

a) If the applied insulation is in thin sheets (other than mica and similar flake-like materials) and in the following situations:

1) For supplementary insulation, it consists of at least two layers, either of which is capable of withstanding the electric strength test specified for supplementary insulation;

2) For reinforced insulation, it consists of at least three layers, any two of which, in close proximity to each other, are capable of withstanding the electric strength test specified for reinforced insulation.

If applicable, the test voltage is applied between the outer surfaces of one or two layers of insulation.

b) The supplementary insulation or reinforced insulation is inaccessible and satisfies the following conditions:

After 7 d (168 h) of treatment in an oven at a temperature 50 K higher than the maximum temperature measured in the heating test, the insulation is able to withstand the electric strength test at both the oven temperature and near room temperature.

6.16 Surface resistance to tracking

The comparative tracking index (CTI) value of the insulating materials shall not be less than 175 V.

6.17 Ability to withstand impulse voltage test

For air insulation and solid insulation, it shall comply with the provisions in GB/T 16935.1-2008, 6.1.

6.18 Ability to withstand AC power frequency voltage test

For solid insulation, it shall comply with the provisions in GB/T 16935.1-2008, 6.1.

6.19 Internal temperature rise

The permissible temperature rise of internal heat dissipation devices shall be specified by the manufacturer or comply with the requirements of GB/T 14048.1.

6.20 Basic insulation protection

The requirements for basic insulation protection, including but not limited to:

a) Live parts shall be separated from inaccessible metal parts by basic insulation;

b) Inaccessible metal parts shall be separated from accessible metal parts or accessible surfaces by supplementary insulation;

c) Live parts shall be separated from accessible metal parts or accessible surfaces by double insulation or reinforced insulation;

d) Varnishes, enamels, plain paper, cotton fabrics, oxide films on metal parts, glass powders or sealants (other than self-hardening resins) shall not constitute the protection necessary to prevent contact with live parts;

e) Wood, cotton, silk, ordinary paper and similar fibrous or hygroscopic material shall not be used as insulation, unless impregnated. Insulating material is considered to be impregnated if the interstices between the fibers of the material are substantially filled with a suitable insulant;

f) Driving belts shall not be relied upon to provide the required level of insulation unless a specially designed drive belt is fitted in the product to prevent improper replacement;

g) For parts extending out of the enclosure, the handle and gripping surface shall be made of insulating materials, and the metal ones shall be fully covered with insulating materials. For rotating shafts, the accessible parts shall be separated from live parts by insulation.

6.21 Insulation structure protection

The requirements for insulation structure protection include the followings.

a) The requirements shall be met by Class Ⅰ equipment (products) include:

1) Any wires, screws, nuts, washers, springs, brushes, brush holder parts, or similar parts related to insulation shall not be easily accessible to live parts once they are loose or detached from their position;

2) At structures with requirements for creepage distance and electrical clearance, partitions or adequately fixed parts shall be installed, and once such parts become loose or detach from their positions, the creepage distance and electrical clearance on supplementary insulation or reinforced insulation shall not be reduced to less than 50% of the specified value;

3) The handle, lever, and knob shall be reliably connected to the earthing terminal or contact, or separated from live parts by grounded metal parts.

b) The requirements shall be met by Class Ⅱ equipment (products) include:

1) It shall be sufficient to prevent accidental contact with basic insulation and metal parts separated only by basic insulation and live parts.

2) Parts used for supplementary insulation or reinforced insulation shall be fixed so that they are not severely damaged and cannot be removed, or they cannot be placed in incorrect positions when reinstalled. If omitted, the product cannot operate or is clearly incomplete (if the partition is fixed so that it can only be removed by breaking or cutting it open).

3) Structures fixed by bonding shall not fall off when subjected to mechanical strength verification.

4) Non fully insulated Class Ⅱ equipment or the structure of Class Ⅱ equipment shall be equipped with insulation barriers between easily accessible metal parts, motor parts, and other live parts.

5) The insulation coating inside the insulation lining or metal shell shall not be easily scraped off. Ordinary varnish, impregnated yellow wax cloth, soft resin adhesive paper, and similar materials on the inner wall of the metal shell cannot be used as insulation layers.

6) The internal wire insulation of flexible cables or wires used for wiring can only be removed when they are damaged or cut open, or if their two ends are clamped and fixed, it can be considered as an appropriate insulation layer. Otherwise, sleeves, pipes, or layers that meet insulation requirements shall be added.

7) Non dense sintered ceramic materials and similar materials, as well as individual glass beads, shall not be used as additional or reinforced insulation.

8) Parts made of natural rubber or synthetic rubber used as supplementary insulation shall undergo aging verification, and their size and placement shall be such that even in the event of cracks on the component, the creepage distance will not decrease below the specified value.

9) Insulating materials with buried heating conductors shall only be used as basic insulation and not as reinforced insulation.

10) Due to the deposition of dirt or dust caused by internal component wear of the product, the creepage distance or electrical gap of supplementary insulation and reinforced insulation is reduced to below the specified value.

11) Capacitors shall not be connected to easily accessible metal parts, and if the capacitor casing is metal, the casing shall be separated from easily accessible metal parts by supplementary insulation. Except for capacitors that meet the requirements of safe ultra-low voltage power supply and protection impedance.

c) The requirements shall be met by class Ⅲ equipment (products) include:

The insulation between parts operating at SELV and other live parts shall meet the requirements of double insulation or reinforced insulation.

6.22 Heat resistance

The following materials used for manufacturing products shall have enough thermal deformation resistance ability:

—External parts of non-metallic materials;

—Thermoplastic material parts supporting current carrying parts;

NOTE: “supporting” means that the retention of the current carrying part by the insulating material is relied upon to fulfil requirements. Contact alone does not constitute support.

—Provide thermoplastic material parts with supplementary insulation and reinforced insulation.

The above requirements do not apply to:

—Ceramic materials;

—The insulation parts of the motor, such as shaft insulation, end plates, slot insulation, wedges, commutators, etc.

6.23 Flame retardant

The non-metallic material parts on the product shall have sufficient flame resistance and flame spread prevention capabilities.

6.24 Ability to withstand impact test

The product shall be able to withstand the specified impact test.

Test severity level is specified by the manufacturer.

6.25 Ability to withstand collision test

The product shall be able to withstand the specified collision test.

Test severity level is specified by the manufacturer.

6.26 Ability to withstand free fall test

The product shall be able to withstand the specified free fall test.

Test severity level is specified by the manufacturer.

6.27 Ability to withstand vibration (sinusoidal) test

The product shall be able to withstand the specified vibration (sinusoidal) test.

Test severity level is specified by the manufacturer.

6.28 Mechanical stability

The requirements of mechanical stability, including but not limited to:

a) Both transportable and fixed products shall have sufficient stability;

b) For products with doors, opening or closing the door (whichever is the most unfavorable) shall meet the corresponding stability test;

c) Movable products equipped with wheels shall have sufficient stability during movement.

6.29 Mechanical structures for protection

The requirements of mechanical structure for protection, including but not limited to:

a) Mechanical structures used for protection cannot be removed without the use of tools;

b) A protective mechanical structure that can be disassembled by hand, and when removed, the shell protection level shall at least meet IP20;

c) When removing (disassembling or opening) a protected mechanical structure that may meet live parts (or parts), the power supply shall be disconnected before removing the protected mechanical structure (earthing the power input if necessary), and the mechanical structure that does not restore the protection cannot be connected to the power supply (interlocking);

d) The mechanical structure used for protection shall always be installed on the product in its normal state and undergo all inspections.

6.30 Screws and connectors for electrical connections

The requirements of screws and connectors for electrical connections include the followings:

a) The requirements that screws shall be meet include:

1) Soft or liable to creep prone metals such as zinc or aluminum shall not be used;

2) Screws made of insulating materials shall have a nominal diameter of at least 3 mm, and shall not be used for any electrical connection or connections providing earthing continuity;

3) Screws transmitting electrical contact pressure shall screw into metal;

4) Screws shall not be of insulating material if their replacement by a metal screw could impair supplementary insulation or reinforced insulation. Screws which may be removed when replacing a supply cord having a type X attachment, or when undertaking user maintenance, shall not be of insulating material if their replacement by a metal screw could impair basic insulation;

5) Space-threaded (sheet metal) screws shall not be used for the connection of current-carrying parts, unless they clamp these parts directly in contact with each other, and are provided with a suitable means of locking;

6) Thread-cutting (self-tapping) screws shall not be used for the electrical connection of current carrying parts, unless they generate a full-form standard machine screw thread. Such screws shall not, however, be used if they are likely to be operated by the user, unless the thread is formed by a swaggering action;

7) Thread-cutting and space-threaded screws may be used to provide earthing continuity, provided that it is not necessary to disturb the connection in normal use, and that at least two screws are used for each connection;

8) Screws, which make a mechanical connection between different parts of equipment, shall be secured against loosening, if they also make electrical connections. This requirement does not apply to screws in the earthing circuit if at least two screws are used for the connection, or if an alternative earthing circuit is provided;

9) Spring washers and similar parts shall be used to provide good locking.

b) The requirements that electrical connectors meet include:

1） Contact pressure shall not be transmitted through insulation materials that are prone to shrinkage or deformation, unless the metal parts have sufficient elasticity to compensate for any possible shrinkage or deformation of the insulation material;

2）Rivets used for electrical connections shall be secured against loosening if these connections are subject to torsion in normal use. A non-circular shank or an appropriate notch may be sufficient to comply with this requirement;

3） Screwless connectors shall be equipped with measures to prevent disconnection during normal use, and the screw connector wire shall be fixed by more than one means or shall not impair safety in the event of detachment.

6.31 Internal wiring

The requirements of internal wiring include the followings:

a) Protective measures for conductors:

1) Wireways shall be smooth and free from sharp edges;

2) Ensure that the insulated wire does not come into contact with burrs, cooling fins, etc., which may cause damage to the insulation of conductors;

3) Holes in metal through which insulated wires pass shall be provided with bushings or, shall have smooth, well-rounded edges (the rounding radius shall be greater than 1.5 mm);

4) Wiring shall be effectively prevented from coming into contact with moving parts;

5) Fl Flexible metallic tubes shall not cause damage to the insulation of the conductors contained within them. Open-coil springs shall not be used to protect the wiring. If adjacent tightly wound coil spring coils are used to protect internal wiring, adequate insulation lining shall be attached in addition to the insulation of the conductors;

6) The clamps and similar devices used for bundling flexible wires shall have smooth, well-rounded edges.

b) Requirements for the use of wires:

1) Internal wiring shall be either so rigid and so fixed or insulated that creepage distances and clearances cannot be reduced below the specified values;

2) Conductors identified by the colour combination YELLOW-AND-GREEN shall not be connected to terminals other than earthing terminals;

3) Aluminum wires shall not be used for internal wiring.

c) Requirements for wire connection:

1) Stranded conductors shall not be consolidated by lead-tin soldering where they are subjected to contact pressure, unless the clamping means is so designed that there is no risk of bad contact due to cold flow of the solder. Soldering of the tip of a stranded conductor is allowed;

2) Consolidation of a stranded conductor by lead-tin soldering is allowed if spring terminals are used; securing the clamping screws alone is not considered adequate.

d) During normal use, adjustment operation, or user maintenance, the different parts on the product that can move relative to each other shall not cause undue stress to electrical connections and internal conductors, including those providing earthing continuity.

e) When replacing flexible cables or cords, if it is necessary to move the switch that is also used as an external wire terminal, the internal wiring shall not be subjected to excessive stress. After the switch is repositioned and before the electrical equipment is reassembled, it shall be possible to verify that its internal wiring is correctly seated.

f) Internal wiring, windings, commutators, slip rings, and similar parts, as well as insulation, shall not meet oil, grease, or other similar substances.

6.32 Terminals for external conductors

The requirements of connecting terminal for external wires include the followings:

a) The wiring terminals shall only be accessible with the aid of a tool;

b) The screws and nuts shall not serve to fix any other component, except that they may also clamp internal conductors, if these are so arranged that they are unlikely to be displaced when fitting the supply conductors;

c) Conductors connected by soldering are not considered to be adequately fixed, unless they are held in place near to the termination, independently of the solder; but "hooking in" before soldering is, in general, considered to be a suitable means for maintaining the conductors of a power supply cord other than a tinsel cord in position, provided the hole through which the conductor is passed is not unduly large;

d) The terminals of a component (such as a switch) built into the tool may be used as terminals intended for external conductors;

e) Conductors connected to terminals or terminations by other means are not considered to be adequately fixed, unless an additional fixing is provided near the terminal or termination; this additional fixing, in the case of stranded conductors, clamps both the insulation and the conductor.

6.33 Supply connection and external cords

The requirements of supply connection and external cords include the followings:

a) Products provided with connection to the supply shall:

1）A supply cord with a minimum length of 1,8 m and with a plug;

2） A supply cord with a minimum length of 1,8 m and without a plug, the information for connection shall be given in the instructions;

3）An appliance inlet having at least the same degree of protection against moisture as required for the tool；

4） A supply cord with a length between 0,2 m and 0,5 m and fitted with a plug or other connector having at least the same degree of protection against moisture as required for the tool;

5） Plugs, connectors and inlets shall be suitable for the ratings of the tool；

6） Plugs shall not be fitted with more than one flexible cord;

7） For class Ⅰ equipment, the supply cord shall be provided with a YELLOW-AND-GREEN core; it shall be connected to the internal earthing terminal of the tool, and to the earthing contact of the plug.

b) The nominal cross-sectional area of the power cord shall not be less than that shown in Table 1.

Table 1 Nominal cross-sectional area of power lines

Rated current of equipment I A	Nominal cross-sectional area mm^2
I≤0.2	Foil wire
0.2＜I≤3	0.5
3＜I≤6	0.75
6＜I≤10	1
10＜I≤16	1.5
16＜I≤25	2.5
25＜I≤32	4
32＜I≤40	6
40＜I≤63	10

c) In addition to informing that only the specified connectors can be used, the manufacturer shall also inform the followings in the user manual:

1） Live parts are not easily accessible; live parts are not accessible during insertion or removal of the connector

2） The connector can be inserted without difficulty;

3） After insertion of the connector, the equipment is not supported by the connector when in any position of normal use on a horizontal flat surface.

d) Fixation of supply cords and cords:

1）Conductors of supply cords or cords shall not be consolidated by lead-tin soldering where they are subject to contact pressure, unless the clamping means is so designed that there is no risk of a bad contact due to cold flow of the solder;

2）For all types of attachment, molding together the supply cord to the enclosure or part of it shall not affect the insulation of the cord;

3）If the power cord or cord may bend during operation, a cord guard made of insulating material shall be used for protection;

4） The cord guard shall be fixed in a reliable manner, and the distance beyond the inlet opening shall be at least five times the overall diameter of the cable or cord delivered with the equipment. It shall either be only accessible with the aid of a tool, or the cord shall only be fitted with the aid of a too;

5） For Class Ⅰ equipment, the cord anchorage are of insulating material or are provided with an insulating lining complying with the requirements for basic insulation, unless there is a sheath of the cord;

6） For Class Ⅱ equipment, the cord anchorage are of insulating material or are insulated from accessible metal parts by insulation complying with the requirements for supplementary insulation, unless there is a sheath of the cord;

7）The cord anchorage shall relieve conductors from strain (including twisting) at the terminals, protect the insulation of the conductors from abrasion, and must not push the cord into the equipment;

8） The cord cannot touch the clamping screws of the cord anchorage, if these screws are accessible, unless they are separated from accessible metal parts by supplementary insulation; the cord is not clamped by a metal screw which bears directly on the cord;

9） The gland shall not be used as cord anchorages.

e) The cord inlet shall be equipped with a bushing, and:

1） Its shape can prevent damage to the supply cord;

2） Reliably fixed;

3） It cannot be removable without the aid of a tool.

f) The space for the supply cord provided inside or power cords as part of the product shall:

1） As to permit checking, before fitting the cover, if any, that the conductors are correctly connected and positioned;

2） That covers, if any, can be fitted without risk of damage to the supply conductors or their insulation;

3）That the uninsulated end of the conductor, should it become free from a terminal, cannot come into contact with accessible parts, unless the cord is provided with terminations that are unlikely to slip free of the conductor.

g) Interconnecting cords shall comply with the requirements for the supply cord, except that:

1） The cross-sectional area of the conductors of the cord is determined on the basis of the maximum current carried by the conductor during the heating test;

2） The insulation of the conductor shall be adequate for its working voltage.

h) Interconnection cords shall not be detachable without the aid of a tool.

6.34 Power control

The requirements shall be met by product equipped with power control, including but not limited to:

a) The closing and opening of switches or the connecting and breaking of switches shall be fast, reliable, and safe. The performance of no-load closing and opening or on load closing and opening shall be checked when necessary.

b) Switches with functions such as interlocking, disconnection locking, and automatic disconnection, the functional position shall be accurate and reliable.

c) The product installed with emergency power-off lines shall be met the following requirements:

1) Function switch cannot be cut rapidly and non-dangerously in hazardous situation;

2) There are several movement units that can cause danger and cannot be cut off by a common rapidly and non-dangerous operating switch;

3) Product cannot be monitored totally from the controlling table.

d) Product that has requirements to observe the maintained areas or to extend part of the human being (e.g., hands) into the maintained areas during installation, maintenance, inspection, and servicing must make sure not to be started by fault.

e) Hand-held product shall be able to switch off the power by the operator while grip the handle or turned to the “off” automatically when release the handle. The product shall be equipped with a power switch, and the operating components of the switch shall be visible and easily accessible.

6.35 Starting and running

The requirements of starting and running, including but not limited to.

a) The requirements shall be met by product with electric motors include the followings:

   1) It shall be stated and run at all normal voltages that may occur during use.

   2) Excessive input current shall not be generated during starting to avoid abnormal operation of the overcurrent protection device of the power supply equipment.

   3) If overheating occurs, the interval between consecutive starts shall be long enough.

   4) Overload protection devices, centrifugal switches, and other automatic start switches shall not act during starting and normal running.

   5) The contact shall not vibrate during normal running.

b) The setting point of the product control device shall be stable and unlikely to change unexpectedly.

c) Hand-held products shall have at least one handle or grip surface that ensures safe grip during normal use.

6.36 Surface temperature

Manufacturer shall provide the allowable temperature rise of touchable surface of product, in accordance with relevant national standards.

6.37 Structural protection for running

The requirements of structural protection for running, including but not limited to.

a) The parts on the product with the specific degrees of protection can only be disassembled with the help of tools.

b) The sufficient protection against physical injury shall be provided by product, and

   1) As long as it is suitable for the use and working mode of the product, the moving parts and other dangerous parts on it shall be securely placed or sealed.

   2) All operational parts, including specialized parts or accessories that are part of the product, shall be fixed.

c) The exposed hazardous parts required for product functionality shall not only meet the requirements of b), but also provide necessary safety measures and safety instructions in the product user manual.

d) When hazardous dust, steam, or gas is loaded into the product for application, or such substances are generated during the working process, they shall be reliably sealed or discharged without causing danger.

e) The liquid media used in products shall not spill or splash onto the user or workplace.

f) Product shall be protected from scorching or low temperatures during operation, as well as dangerous thermal radiation.

6.38 EMC of electronic circuits

Electronic circuits the provide safety critical function (SCF) shall at least meet the following tests.

a) Electrostatic discharge immunity test.

b) Electrical fast transient/burst immunity test.

c) Voltage surge test.

d) Immunity to conducted disturbances, induced by radio-frequency fields.

e) Voltage dips and short interruptions tests.

6.39 Safety colours

The requirements for safety colours, including but not limited to.

a) The requirement for safety colours is to use four colors: red, blue, yellow, and green to convey safety information, and to use black and white as contrasting colors in conjunction with the use of safety colours.

b) The color of the switch operating parts or their covers for mobile and fixed products shall not be combination YELLOW-AND-RED for emergency stop functions.

c) If there is a cover that only covers the start button, the cover's colour shall not be black, red, or yellow.

d) If there is a cover and it covers the stop button, the cover's colour shall be red or black.

6.40 Graphical symbols

The requirements for graphic symbols include but are not limited to the following:

a) Requirements for the use of graphical symbol "○".

   1) The "off" position of the multi-stable power switch shall be marked with the graphic symbol "○". Instantaneous power switches that can be locked in the "on" position are not considered multi-stable switches.

   2) The switch button that only serves as a "disconnect" function shall be marked or positioned with a graphical symbol "○", and the button color shall be red or black.

   3) The graphic symbol "○" shall not be used as any other marking;

   4) If numbers are used to represent different gears, the "disconnected" gear shall be represented by the graphical symbol "○", while other gears shall be represented by numbers that reflect larger output power, input power, speed, etc.

b) Requirements for the use of graphic symbols "+" and "-".

   1) The control device that needs to be adjusted during operation shall be marked with "+" and "-" to indicate the direction in which the adjusted characteristic quantity shall be adjusted up or down;

   2) When the control device is in the opposite extreme positions of the fully "on" and "off" positions of the adjustment component, the "+" and "-" markings shall not be applied.

6.41 Safety signs

The requirements for safety signs Include but are not limited to the following:

a) Safety signs.

   1) Safety signs shall not be placed on detachable parts or power lines of the product, and signs such as nameplates shall be placed in the same area on electrical equipment that is easy to install.

   2) The safety signs shall be clearly distinguishable from the outside of the product.

   3) The markings of switches and controllers shall be placed on or near the component, not on components that can change position, nor in positions that may cause misunderstandings about the markings.

b) Warning signs.

1) If using the word 'warning', it shall be in black font not less than 2.4 mm high and shall not be separated from the sentence of warning.

2) If using the sentences of warning, the content shall be written word for word in the prescribed order.

6.42 Nameplates

The nameplate contains at least the following.

a) The nameplate shall comply with the provisions in GB/T 13306 and at least identify the following.

1) Manufacturer or its authorized representative information, including business name and address (provided address shall be valid);

2) Origin;

3) Product name;

4) Model number;

5) Manufacturing date;

6) For products assembled by end-users from their bulk parts, each component or packaging shall be labeled with a unique identification;

7) Product usage conditions, etc.

b) The product conditions that shall be identified on the nameplate at least include:

1) The unit of rated voltage or rated voltage range is volts (V); for electrical equipment with star—delta connection, two rated voltages shall be clearly indicated.

2) The symbol for the type of power supply can be omitted if it is marked with the rated frequency or rated frequency range. The symbol for the type of power supply shall be placed immediately after the rated voltage symbol, except for three-phase products applicable to single-phase power supplies.

3) The unit of rated input power is watts or kilowatts (W or kW); The unit of rated current is ampere(A).

4) The symbol of Class Ⅱ (only used for Class Ⅱ equipment).

5) Degrees of protection provide by enclosure (IP code).

6.43 Instruction

6.43.1 The instruction shall at least include the followings.

a) The instruction before use shall include the followings.

1) Installation information, including installation location, fixing method, etc.

2) Assembly Information.

3) Information on power connections, cables, fuse links, socket types, and earthing.

4) Illustration of necessary functions.

5) Limitations of environmental conditions.

6) Fixing and adjusting of the shield (if any).

b) The operating instructions shall include the followings.

1) Setting and testing.

2) Clamping and replacing peripheral components and components (such as workpieces and cutting tools).

3) Identification of handle and grip surface.

4) Instructions for lifting and transporting of transportable and fixed products.

c) The maintenance and after-sales service instructions shall include the followings.

1) User maintenance information.

2) Manufacturer or agent's after-sales service and address information.

3) User replaceable parts list and replacement instructions.

4) Special tools that may be required.

d) The products employing liquid systems shall include the followings.

1) Connection of liquid systems.

2) To avoid the influence of liquid on electrical equipment, the use of liquid and accessories.

3) Inspection of hoses and other critical components that may deteriorate.

4) Maximum allowable pressure of liquid source.

e) The products equipped with RCD shall include the followings.

1) If the RCD provided by the product is not installed, a warning of “prohibiting use “is given.

2) Instructions state that the RCD shall be tested for normal operation before work, unless it is a self-checking type.

f) The products used with isolation transformer shall include the followings.

Warning against using products that are not connected to transformers delivered with the product or of the type specified in its instructions.

g) Safety warnings may be separated from the operation instructions. The format of all 'safety warnings' shall be distinguished from the content of the article using prominent fonts or similar methods.

6.43.2 To ensure the safety of product, users may be required to cooperate with necessary safety measures, including but not limited to:

—installation;

—use;

—maintenance;

—repair;

—innovation.

6.43.3 Product safety is influenced by factors such as the application software, information (intelligence), and/or functional safety of the product, manufacturers shall provide corresponding requirements or constraints.

7 Inspection, test methods and conformity assessment

7.1 General

This document is permitted two or more inspection and test methods for one aspect, but the inspection and test methods specified in this document is the arbitration method.

If the test sequence and environmental temperature of the inspection aspect will affect the test result, the inspection and testing institution shall formulate test rules based on the specific situation of the product.

The accuracy level and traceability of apparatus, appliances, and equipment, etc., which are used in the testing, are specified by the inspection and testing institutions according to the test requirements.

7.2 Inspection rules

The inspection and testing, and conformity assessment specified in this document are type examination.
The inspection and testing for product are according to the provisions in GB/T 25296.After the safety aspects related to the product specified in this document have been inspected and tested as qualified, the product may be confirmed to comply with this document.
All inspection and testing shall be conducted on one test sample**,** in principle. If more test samples are needed, the inspection and testing agency makes corresponding regulations.