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National Technical Specification for the Safety of Electric Equipment

国家电气设备安全技术规范

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National Technical Specification for the Safety of Electric Equipment

1 Scope

This document specifies the basic safety requirements for various types of hand-held, movable and fixed electric equipment for indoor and outdoor application with a rated AC voltage below 1,000 V (1,140 V) and a rated DC voltage below 1,500 V (hereinafter referred to as “the products”).

This document is applicable to products or components within the application range of electric energy converted from chemical energy, light energy and wind energy, etc.

Products with internally generated inaccessible AC voltages higher than 1,000 V and DC voltages higher than 1,500 V also fall within the scope of application of this document.

This document does not apply to:

---Materials and auxiliary materials, other than those for the products specified in this document;

---Semi-finished products or primary products that cannot be independently used;

---Electric equipment for medical purposes;

---Elevators;

---Electric fence actuators;

---Special products, such as: ships, aircrafts and railways, etc.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 3805 Extra-low Voltage (ELV) - Limit Values

GB/T 4208 Degrees of Protection Provided by Enclosure (IP code)

GB/T 4776 Electrical Safety Terminology

6.2 Surfaces

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

Metal materials (including conductor materials) shall be treated with surface coating.

The surface of the insulating materials shall be uniform and flat, and without obvious defects, such as: unevenness, cracks, impurities, trimmings and uneven colors, etc.

6.3 Safety Extra-low Voltage

The power supply voltage of the products shall comply with the stipulations of GB/T 3805.

6.4 Enclosure and Protection Degrees

The requirements for the enclosure and protection degrees include the following aspects.

a) The requirements that the product enclosure shall satisfy include, but are not limited to:

   1) At least isolate all live parts (except those that are completely insulated), or the power supply cannot be restored before the enclosure is closed or reset;

   2) Locate or enclose moving and hazardous parts, so that sufficient protection against personal injury can be provided during normal operation;

   3) Cannot be dismantled or removed without the aid of tools;

   4) There shall be no other dangers when using or adjusting the protective guard. If the fixed guard is removed in accordance with the stipulations, then, the fasteners shall always be on the guard or the product;

   5) After removal of the maintenance cover, the protection against access to live parts can also be ensured;

   6) After the dust collection device (if any) is removed, it can also be ensured that hazardous moving parts cannot be accessed.

b) The requirements for the protection degrees of the enclosure include:

   1) Comply with the stipulations of GB/T 4208, and the IP degree code must not be marked without testing;

   2) The protection degree of the enclosure used to protect against direct contact is at least IP2XC.

2) If devices with voltages exceeding the extra-low voltage limit are installed on covers, doors and shutters, etc., then, additional measures, such as protective conductors (PE) or similar electrical connections specially designed and verified for this purpose shall be adopted to ensure the grounding continuity;

3) When a part of the products is moved, the protective circuit (grounding continuity) of the remaining of the products shall not be interrupted;

4) Disconnecting devices (switches and isolators, etc.) shall not be included in the protective circuit, unless: removable connections are allowed in the protective conductor, and they can only be moved by authorized personnel with the aid of tools; alternatively, the plug and socket devices can only cut off the protective circuit after the live conductor is cut off, and before the live conductor is reconnected, the continuity of the protective circuit shall be established;

5) If the exposed conductive part of the devices cannot be connected to the protective circuit by the fixing method of the devices, then, a conductor with a sufficiently large cross-sectional rea shall be used to connect to the protective circuit of the products;

6) The printed wires of the printed circuit boards shall not generally be used to provide the continuity of the protective grounding circuit;

7) Bearings can be considered to satisfy the electrical continuity.

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

f) The electrical continuity shall be such that the resistance between any accessible conductive part on the products and the grounding terminal or grounding contact shall not be greater than 0.1 Ω.

6.6 Additional Fault Protection

The requirements for additional fault protection include the following aspects.

a) For general products, the additional fault protection is at least one of the following three types:

1) Automatic cut-off, for Category I equipment, low-voltage fuses and circuit breakers, etc. shall be plugged or installed between the power supply system and Category I equipment;

2) Electrical isolation shall adopt isolation transformers and safety isolation transformers;

3) Residual current device (RCD).

b) For products with a liquid source system, the additional protection mode shall be one

of the follow:

1) Type III structure;

2) For Type II structure, portable residual current device (PRCD) shall be adopted;

3) Type I or Type II structure is used together with the isolation transformer.

c) If the products contain equipment (for example, capacitors) that may have a steady-state touch current and charge after they are disconnected, then, a warning sign shall be installed.

6.7 Functional Grounding

The functional grounding of the products shall be clearly and durably marked with the functional grounding symbol, and the functional grounding symbol cannot be mixed with the protective grounding symbol; the functional grounding device cannot be directly connected to the protective grounding device

For Category II and Type III equipment, the live parts and functional grounding parts shall be separated by double insulation or reinforced insulation.

6.8 Noise

The noise limit value (or the noise limit value after adopting noise reduction measures) shall comply with the relevant national regulations.

6.9 Limits of Manufacturing Materials

The varieties and content limits of manufacturing materials restricted for use shall comply with the relevant national regulations.

6.10 Safe Handling

The requirements for safe handling include:

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

b) When the lifting rings are used, the screw holes of the enclosure shall have sufficient screwing length, and there shall be a plane matching the lifting rings.

6.11 Electrical Clearances

The electrical clearances shall comply with the stipulations of 5.1 in GB/T 16935.1-2008.

6.12 Creepage Distance

The creepage distance shall comply with the stipulations of 5.2 in GB/T 16935.1-2008.

b) The supplementary insulation or reinforced insulation is not easily accessible, and the following conditions are satisfied:

After 7 d (168 h) of treatment in an oven where the temperature is maintained at a temperature 50 K higher than the highest temperature rise measured during the specific heating test, the insulation can withstand the electric strength test, which is carried out both at oven temperature and approximate to room temperature.

6.16 Surface Tracking Resistance

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

6.17 Resistance to Impulse Voltage Test

For air insulation and solid insulation, they shall comply with the stipulations of 6.1 in GB/T 16935.1-2008.

6.18 Resistance to AC Power Frequency Voltage Test

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

6.19 Internal Temperature Rise

The allowable temperature rise of internal heating components shall be specified by the manufacturer, or in accordance with the requirements of GB/T 14048.1.

6.20 Basic Insulation Protection

The requirements for the basic insulation protection include, but are not limited to:

a) The live parts and not easily accessible metal parts shall be separated by basic insulation;

b) The not easily accessible metal parts and the accessible metal parts or accessible surfaces shall adopt supplementary insulation barriers;

c) The live parts and accessible metal parts or accessible surfaces shall adopt double insulation or reinforced insulation barriers;

d) Varnishes, enamels, plain papers, cotton fabrics, oxide films on metal parts, glass powder or sealants (except self-hardening resin) shall not constitute the protection required against access to live parts;

e) Wood, cotton, silk, plain paper and similar fibrous or hygroscopic materials, if not impregnated, shall not be used as insulation. If the spaces between the fibers of the materials are filled with a suitable insulating substance, then, the insulating material is considered to be impregnated;

f) Belts shall not be relied upon to provide the required insulation, unless a specially designed belt is incorporated in the products to prevent improper replacement;

g) The parts protruding from the enclosure shall be made of insulating materials for handles and gripping surfaces, or shall be adequately covered with insulating materials if they are metallic. For rotating shafts, the accessible parts and live parts shall be separated by insulation.

6.21 Insulation Structure Protection

The requirements for the insulation structure protection include the following aspects.

a) The requirements for Category I equipment (products) include:

1) When any wires, screws, nuts, washers, springs, electric brushes, brush holder assemblies or similar parts related to insulation are loose or fall off from their positions, they shall not be accessible to the live parts;

2) Where there are structural requirements for creepage distance and electrical clearance, partitions shall be provided, or the parts shall be adequately fixed, and once such parts become loose or fall off from their positions, the creepage distance and electrical clearance on the supplementary insulation or reinforced insulation shall not be reduced below 50% of the specified values;

3) Handles, operating rods and operating buttons shall be reliably connected to the grounding terminal or grounding contact, or the grounding metal parts shall be sued to separate the live parts.

b) The requirements for Category II equipment (products) include:

1) It shall be sufficient to prevent accidental contact with the basic insulation and the metal parts, which are separated from the live parts by basic insulation only;

2) The parts used as supplementary insulation or reinforced insulation shall be so fixed that they cannot be removed without serious damage, or cannot be repositioned in an incorrect position, if missing, the products will be inoperable or manifestly incomplete (as long as the partitions are so fixed that they cannot be removed unless being broken or cut apart);

3) The structure fixed by bonding shall not fall off when subjected to mechanical strength verification;

4) For non-fully insulated Category II equipment or Type II structure, insulation barriers shall be provided between the accessible metal parts and motor parts and other live parts;

5) The insulating linings or insulating coatings within metal enclosures shall not be easily scratched off. Ordinary varnishes, impregnated yellow wax cloth, soft

---Components of thermoplastic materials providing supplementary insulation and reinforced insulation.

For the following materials, the thermal deformation resistance may not be required:

---Ceramic materials;

---Insulation parts of motors, such as: shaft insulation, end plates, slot insulation, slot wedges and commutators, etc.

6.23 Flame Retardant Properties

The non-metallic material parts on the products shall have sufficient resistance to flame and flame spread.

6.24 Resistance to Impact Test

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

The severity level of the test is specified by the manufacturer.

6.25 Resistance to Crash Test

The products shall be able to withstand the specified crash test.

The severity level of the test is specified by the manufacturer.

6.26 Resistance to Free Drop

The products shall be able to withstand the specified free drop test.

The severity level of the test is specified by the manufacturer.

6.27 Resistance to Vibration (sine) Test

The products shall be able to withstand the vibration (sine) test.

The severity level of the test is specified by the manufacturer.

6.28 Mechanical Stability

The requirements for the mechanical stability include, but are not limited to:

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

b) For products with doors, the doors, opened or closed (whichever is the more unfavorable), shall be able to satisfy the corresponding stability test;

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

6.29 Mechanical Structure Used for Protection

The requirements for the mechanical structure used for protection include, but are not limited to:

a) The mechanical structure used for protection cannot be removed without the aid of tools;

b) For the protective mechanical structure that can be disassembled by hands, when it is removed, the protection degree provided by the enclosure shall at least reach the requirements of IP20;

c) When the protective mechanical structure is removed (disassembled or opened) and the live parts (or components) are touched, then, the power supply shall be disconnected (if necessary, the power input terminal shall be grounded) before the protective mechanical structure is removed, and the power supply cannot be reconnected (interlocking) unless the protective mechanical structure is restored;

d) The mechanical structure used for protection shall always be installed on the products in accordance with the state of normal use and undergo all the inspections.

6.30 Screws and Connectors Used for Electrical Connections

The requirements for the screws and connectors used for electrical connections include the following aspects.

a) The requirements for the screws include:

1) They shall not be made of soft or prone to creep metals, such as: zinc and aluminum;

2) The 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 connection providing grounding continuity;

3) The screws transmitting electrical contact pressure shall be screwed into the metal;

4) If the replacement of the screws made of insulating materials by metal screws would impair the supplementary insulation or reinforced insulation, or when replacing the power supply cords with Type X connection, or the removal during user maintenance would impair the basic insulation, then, the screws shall not be made of insulating materials;

5) Wide-thread screws shall not be used for the connection of current-carrying parts, unless the current-carrying parts clamped by these screws are directly connected to each other and there are suitable locking measures;

parts;

5) The flexible metal pipes shall not damage the insulation of the conductors contained within them. The loose spring coils shall not be used to protect the internal wiring. If twined spring coils with adjacent coils closely spaced are used to protect the internal wiring, then, sufficient insulating liners shall be attached to the wire insulation;

6) The clasps and similar devices for binding cords shall be smooth and rounded.

b) The requirements for the use of wires:

1) The internal wiring shall be rigid, or so fixed or insulated that the creepage distance and electrical clearance cannot be reduced below the specified values in normal use. The insulation shall not be impaired;

2) The wires marked with green / yellow combination colors shall not be connected to non-grounded terminals;

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

c) The requirements for wire connection:

1) Unless the clamping device is so designed that there is no risk of poor contact due to welding cold deformation, stranded conductors shall not be consolidated by tin solder where they are subjected to contact pressure. Soldering together of the ends of stranded conductors is allowed;

2) If elastic terminals are used, then, it is allowed to consolidate the stranded conductors with tin solder. Merely tightening the clamping screws is considered insufficient.

d) During normal use or adjustment operation or user maintenance, the different parts of the products that can move relative to each other shall not trigger affecting stress to the electrical connectors and internal wires (including wires providing grounding continuity).

e) When replacing flexible cables or cords, if it is necessary to move switches which also serve as the terminals for external wires, then, the internal wiring shall not be subjected to undue stress. After the switches are repositioned and before the electric equipment is reassembled, it shall be possible to verify that the internal wiring is properly in place.

f) The internal wiring, windings, commutators, slip rings and the like, as well as insulation shall not come into contact with oil, grease or other similar substances.

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