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Guidelines on general tests for safety of electrical equipment

电气设备安全通用试验导则

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Guidelines on general tests for safety of electrical equipment

1 Scope

This document gives general test methods for safety to which electrical equipment shall be subjected after it has been designed.

This document applies to the testing related to electrical equipment including type test and routine (exit-factory) test.

NOTE: Due to the different types of electric shock protection for electrical equipment, the testing items will be different. For example, there are power supply systems with double insulation structure and extra-low safety voltage.

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 1002-2008, *Single phase plugs and socket-outlets for household and similar purposes - Types, basic parameters and dimensions*

GB/T 1003-2016, *Three phases plugs and socket-outlets for household and similar purposes - Types, basic parameters and dimensions*

GB/T 1031-2009, *Geometrical product specifications (GPS) - Surface texture: Profile method - Surface roughness parameters and their values*

GB/T 2099 (all parts), *Plugs and socket-outlets for household and similar purposes*

GB/T 2423.1-2008, *Environmental testing for electric and electronic products - Part 2: Test methods - Tests A: Cold*

GB/T 2423.2-2008, *Environmental testing for electric and electronic products - Part 2: Test methods - Tests B: Dry heat*

GB/T 2423.3-2016, *Environmental testing - Part 2: Testing method - Test Cab: Damp heat, steady state*

GB/T 2423.5-2019, *Environmental testing - Part 2: Test methods - Test Ea and guidance: Shock*

GB/T 17626.2, *Electromagnetic compatibility - Testing and measurement techniques - Electrostatic discharge immunity test*

GB/T 17626.4, *Electromagnetic compatibility - Testing and measurement techniques - Electrical fast transient/burst immunity test*

GB/T 17626.5, *Electromagnetic compatibility - Testing and measurement techniques - Surge immunity test*

GB/T 17626.6, *Electromagnetic compatibility - Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields*

GB/T 17626.11, *Electromagnetic compatibility - Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests*

GB/T 17627-2019, *High-voltage test techniques for low-voltage equipment - Definitions, test and procedure requirements, test equipment*

GB/T 25295-2010, *Guidelines on safety designs for electric equipment*

GB/T 26125-2011, *Electrical and electronic products - Determination of six regulated substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers)*

GB/T 26572-2011, *Requirements of concentration limits for certain restricted substances in electrical and electronic products*

GB/T 29481-2013, *Signs for electrical safety*

GB/T 33980-2017, *Guide on inclusion of electrical safety aspects in electrotechnical product instructions*

GB/T 34662-2017, *Electrotechnical equipment - Temperatures of touchable hot surfaces*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 4776-2017 as well as the followings apply.

3.1 testing

The activity of procedurally determining one or more characteristics of a product or service.

3.2 checking

The activity of relying on professional judgment to compare one or more characteristics

of a product or service with specified requirements to determine its compliance.

3.3 inspection

The activity of comparing one or more characteristics of a product or service with specified requirements by performing measurements, tests, or metrics to determine its compliance.

3.4 test

The activity of conducting some or various special tests on one or more characteristics of a product or service according to a prescribed procedure.

[Source: GB/T 2900.83-2008, 151-16-13, modified.]

3.5 verification

The activity confirmed by test.

4 General

4.1 General principle

The testing rules proposed in this document are generic to electrical safety items. Electrical equipment can generally be tested according to product or professional standards. In the absence of product or professional standards, this document may be relied upon.

4.2 Testing methods

The testing methods used in this document include checking and inspection.

4.3 Testing rules

4.3.1 Type test

Type inspection shall be carried out in any of the following situations:

- When a new product is completed;

- When changes in design, materials or workmanship are sufficient to cause changes in certain properties;

- When there is an unacceptable deviation between the results of the exit-factory inspection and the previous type inspection results.

5.3 Altitude and correction factor

It is generally stipulated that the altitude shall not exceed 2000m.

The correction of temperature rise and dielectric strength when the altitude is above 2000m is in accordance with the provisions of GB/T 25295-2010.

5.4 Influence of other factors

Other factors during the test include the rate of change of environmental parameters, air quality (including harmful gases, various particles), no water (condensation, rain, seepage), vibration, electromagnetic environment and sunlight radiation.

6 Testing of safety item

6.1 Environmental suitability test

Carry out the low temperature test according to the provisions of GB/T 2423.1-2008.

Carry out high temperature test according to GB/T 2423.2-2008.

When evaluating the ability of the test sample to withstand temperature changes and the allowable ability under the environment of temperature changes, it shall be carried out in accordance with the provisions of GB/T 2423.22-2012.

The constant damp heat test is carried out according to the provisions of GB/T 2423.3-2016. The severity level is: test temperature is (30±2)°C, relative humidity is (85 ± 3)%, and duration is at least 16h.

6.2 Surface checking

The surface roughness shall be inspected according to the provisions of GB/T 1031-2009. Check the surface for sharp edges, burrs, scratches, overflows, obvious cracks and so on.

The requirements for surface roughness do not apply to surface defects. Surface defects (such as grooves, pores, scratches) are not included in the determination. If necessary, the requirements for surface defects are specified separately.

6.3 Safety extra-low voltage inspection

The inspection shall be carried out according to the provisions of Chapter 6 in GB/T 3805-2008.

6.4 Enclosure protection level test

The acceptance conditions for the test when the equipment has drain holes and ventilation holes are specified by the relevant products or professional standards. If there are no such regulations, the inspection shall be carried out according to the regulations of GB/T 4208-2017, including the tests for the protection of access to dangerous parts (see Chapter 12 in GB/T 4208-2017), tests for preventing the entry of solid foreign objects (see Chapter 13 in GB/T 4208-2017), and tests for preventing the entry of water (see Chapter 14 in GB/T 4208-2017).

6.5 Protective grounding checking

The requirements for protective earthing are inspected by checking (such as visual inspection, check wrench).

6.6 Fault additional protection testing

Test according to the relevant regulations of fault additional protection products.

6.7 Functional grounding inspection

The inspection contents are as follows:

The functional grounding sign of the product is clear and durable. The functional grounding sign cannot be mixed with the protective grounding sign. The functional grounding device cannot be directly connected to the protective grounding device.

For Class II and Class III equipment, live parts and functional grounding parts are separated by double insulation or reinforced insulation.

6.8 Noise test

According to the relevant provisions of the state on the noise limit (or the noise limit after noise reduction measures), it can be carried out in accordance with the provisions of GB/T 3222.2-2009.

6.9 Manufacturing material limit inspection

It can be carried out according to the provisions of GB/T 26125-2011 and GB/T 26572-2011.

6.16 Surface tracking resistance test

The test is carried out as specified by product or professional standards. If the product or professional standard does not specify, it can be carried out according to the provisions of Chapter 6 in GB/T 4207-2012.

6.17 Test of ability to withstand impulse voltage test

The test is generally carried out according to product or professional standards.

The test adopts 1.2μs/50μs waveform, voltage value, test polarity and number of tests specified in the product or professional standard. The test simulates the atmospheric overvoltage. It is also suitable for over-voltages caused by the operation of low-voltage equipment. The verification of solid insulation can be carried out according to the provisions of 6.1 in GB/T 16935.1-2008.

Pay attention to product or professional standards for temperature and relative humidity.

During the test, the solid insulation has no breakdown or partial breakdown, but partial discharge is allowed. The local breakdown phenomenon, which occurs early in successive pulses, will show up on the voltage steps on the waveform graph of the recorded results. The breakdown of the first pulse is an indication of complete damage to the insulation system. It can also indicate that the overvoltage limiting device in the equipment operates.

NOTE 1: If an overvoltage limiting device is installed in the equipment, pay attention to checking the waveform to confirm that the overvoltage limiting device in the equipment operates and not the insulation damage. Impulse voltage distortion (no change from pulse to pulse) may be caused by the action of such overvoltage limiting devices and does not indicate a (local) breakdown of solid insulation.

NOTE 2: Partial discharges in air gaps can cause very short localized dents. And it may happen repeatedly during the pulse.

6.18 Test of ability to withstand AC power frequency voltage test

The test is carried out as specified by product or professional standards. If the product or professional standard is not specified, it can be carried out according to the provisions of 6.1 in GB/T 16935.1-2008.

The sinusoidal power frequency test voltage is basically a sinusoidal waveform. This requirement is met when the ratio of peak value to effective value is $\sqrt{2}(1\pm3\%)$.

Increase the AC test voltage uniformly from 0V to the specified voltage value within

no more than 5s. Maintain the specified time at this voltage. The test equipment is selected according to the provisions of GB/T 17627-2019.

6.19 Internal temperature rise test

The test is carried out as specified by product or professional standards. If the product or professional standard is not specified, it can be carried out according to the provisions of 6.1 in GB/T 14048.1-2012.

6.20 Basic insulation protection test

The test is carried out as specified by product or professional standards. Or test basic insulation protection by checking.

6.21 Insulation structure protection inspection

The test is carried out as specified by product or professional standards, or by checking.

6.22 Heat resistance test

The test is carried out as specified by product or professional standards. If the product or professional standard is not specified, it can be carried out according to the ball pressure test specified in GB/T 5169.21-2017.

6.23 Flame retardant properties test

When the test is carried out on electrical equipment, it shall be carried out in accordance with the provisions of GB/T 5169.11-2017.

When the test is carried out on materials, they are carried out as specified in the product or professional standard.

6.24 Test of ability to withstand shock test

Test according to GB/T 2423.5-2019. The test severity level is agreed upon between the manufacturer and the user.

6.25 Test of ability to withstand impact test

Test according to GB/T 2423.5-2019. The test severity level is agreed upon between the manufacturer and the user.

6.33 Power connection and external cord inspection

Verify power connections and external cords using appropriate external force intervention or tools.

The type, size and parameters of the power cord plug shall be tested in accordance with the provisions of GB/T 1002-2008 and GB/T 1003-2016. The technical requirements shall be tested according to the provisions of GB/T 2099 (all parts) or GB/T 11918 (all parts).

6.34 Power control test

According to the provisions of the product or professional standard, test the on-off and control performance of electric energy, the performance of automatic power cut off, the switch or system performance of emergency power cut off.

6.35 Checking of startup and operation

Check according to product or professional standards.

6.36 Surface temperature test

Carry out the test as specified by product or professional standards. If the product or professional standard is not specified, according to GB/T 34662-2017, use thermometers and other instruments to test the allowable temperature rise of various accessible surfaces of electrical equipment.

6.37 Operational structural protection inspection

The inspection contents include, but are not limited to:

- Inspect the hazard protection measures of the exposed moving parts of the product as specified by the product or professional standard. Check the reliability of safety measures, such as the strength and stability of mechanical barriers. Check the protective measures and reliability of the fugitives generated when the product is working. Check the reliability of the measures to prevent danger with the protection system or the speed-limiting system, that is, the reliability of the circuit.

- Inspect whether the discharge or discharge device of product dust, vapor and gas has corresponding safety measures and whether it will directly contact the human body. Check whether the dust, steam and gas discharged or discharged from the product reach the inspection qualified level of the corresponding substance discharge standard;

- According to product or professional standards, check whether the liquid spilled during operation has an effective collection device, or whether it is effectively isolated from the insulation, or whether it will form a conductive circuit in the environment, or whether it will cause corrosion and rust to metal parts. will come into direct contact with the human body;

- According to the regulations of the product or professional standards, check whether the shell of the product and the parts that are easily touched by people have overheating and low temperature that are harmful to the human body. Inspect that there are safety measures in places where overheating and low temperature occur.

6.38 EMC characteristic test of electronic circuit

Considering the diversification of equipment and environmental conditions, according to product or professional standards, the electronic circuits providing safety-critical functions (SCF) must pass at least the following tests:

- Electrostatic discharge immunity test, which is carried out according to the requirements of GB/T 17626.2;

- Electrical fast transient burst immunity test, which is carried out according to the requirements of GB/T 17626.4;

- Surge test, which is carried out according to the requirements of GB/T 17626.5;

- Conducted disturbance immunity test induced by radio frequency field, which is carried out according to the requirements of GB/T 17626.6;

- Voltage dips and short-term interruption tests, which are carried out according to the requirements of GB/T 17626.11.

6.39 Safety color checking

Check the safety color according to the chromaticity and other requirements specified in GB/T 2893.1-2013.

Other requirements regarding the color of switch actuators, covers are checked by visual inspection.

6.40 Graphical symbol checking

Check according to the corresponding national standards and product regulations.

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