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Specifications for low temperature test chambers

低温试验箱技术条件

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Specifications for low temperature test chambers

1 Scope

This standard specifies the terms and definitions, conditions of use, technical requirements, test methods, inspection rules, markings, packaging, storage related to low temperature test chambers (referred to as test chambers").

This standard applies to test chambers that conduct low-temperature tests for electrical, electronic and other products, parts, materials.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 191-2008 Packaging - Pictorial marking for handling of goods (ISO 780:1997, MOD)

GB 14048.1-2006 Low-voltage switchgear and controlgear - Part 1: General rules (IEC 60947-1:2001, MOD)

JB/T 9512-1999 Climate environmental testing equipment and cabinet-determination of sound power level of noise emitted

JJF 1059-1999 Evaluation and expression of uncertainty in measurement

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Test chamber

An enclosed chamber and space the part of which can meet the specified test conditions.

Temperature variation

After stabilization, the difference between the average temperature of the center of the working space and the average temperature of other points in the working space in any time interval.

3.10

Temperature extremes

After stabilization, the highest and lowest temperature reached in the working space.

4 Conditions of use

4.1 Environmental conditions

- a) Temperature 5 °C ~ 35 °C;
- b) Relative humidity: Not more than 85%RH;
- c) Atmospheric pressure 80 kPa ~ 106 kPa;
- d) There is no strong vibration around;
- e) No direct sunlight or direct radiation from other heat sources;
- f) There is no strong airflow around: When the surrounding air needs to flow forcibly, the airflow shall not be directly blown onto the chamber;
- g) There is no strong electromagnetic field around;
- h) There is no high concentration of dust and corrosive substances around.

4.2 Power supply conditions

- a) AC voltage: 220V ± 22V or 380V ± 38V;
- b) Frequency: 50 Hz ± 0.5 Hz.

4.3 Water supply conditions

Tap water or circulating water that meets the following conditions can be used;

- a) Water temperature: Not higher than 30 °C;
- b) Water pressure: 0.1 MPa ~ 0.3 MPa;
- c) Water quality: In line with industrial water standards.

layer shall have sufficient thickness, to ensure that there shall be no condensation in the test chamber when the test chamber is at low temperature and the ambient temperature is 5 °C ~ 35 °C and the relative humidity is $\leq 85\%$.

5.2.3 The heating and cooling of heating and cooling devices shall not be directly radiated on the test sample.

5.2.4 The working chamber shall be equipped with observation windows and lighting devices.

5.2.5 The door of the chamber shall be well sealed; the sealing strip shall have good resistance to high temperature aging and low temperature hardening.

5.2.6 The refrigeration system shall not have any defects such as air leakage, water leakage and oil leakage.

5.2.7 There shall be a sample holder for placing or hanging test samples. The sample holder shall have sufficient low temperature resistance.

5.2.8 It shall be provided with leading holes.

5.2.9 The appearance coating layer shall be flat and smooth, with uniform color; there shall be exposed bottom, blistering, layering or scratches.

5.3 Safety and environmental protection requirements

5.3.1 Between the power supply terminal and the metal shell of the chamber

- Insulation resistance value shall meet the following requirements: cold state resistance $\geq 2 \text{ M}\Omega$, hot state resistance $\geq 1 \text{ M}\Omega$;
- It shall be able to withstand a voltage withstand test of 50 Hz, 1500 V AC voltage and a voltage application duration of 5 s.

5.3.2 The protective grounding terminal shall have a good electrical connection with the test chamber's shell and be able to be easily and securely wired, which shall meet the requirements of 7.1.9 in GB 14048.1-2006.

5.3.3 There shall be protection and alarm devices for over temperature, over current, water shortage, etc.

5.3.4 The A-weighted sound power level of the complete machine noise shall not be greater than 80 dB.

6 Test method

6.1 Main test instruments and devices

c) When the working chamber's volume is greater than 50 m³, the number of temperature test points shall be appropriately increased.

6.3.2 Test procedure

6.3.2.1 Within the adjustable temperature range of the test chamber, select the highest nominal temperature and the lowest nominal temperature.

6.3.2.2 Make the test chamber run according to the program of first low temperature and then high temperature. After the temperature of the center point of the working space reaches the test temperature and stabilizes for 2 hours, the temperature of all test points is tested once every 1 min within 30 minutes, a total of 30 tests are performed.

6.3.3 Data processing and test results

6.3.3.1 Correct the measured temperature data according to the correction value of the test instrument.

6.3.3.2 Eliminate suspicious data (refer to Appendix A).

6.3.3.3 For the data measured in the constant temperature phase (i.e., the data measured in 6.3.2.2), calculate the average temperature of 30 measured values at each point according to formula (1):

$$\bar{T} = \frac{1}{n} \sum_{i=1}^n T_i \quad \dots\dots\dots (1)$$

Where:

$\bar{T}$ - The average temperature, in degrees Celsius (°C);

T_i - The i^{th} test value, in degrees Celsius (°C);

n - Number of measurements.

6.3.3.4 Calculate the temperature gradient according to formula (2):

$$\Delta T_j = \bar{T}_h - \bar{T}_L \quad \dots\dots\dots (2)$$

Where:

ΔT_j - Temperature gradient, in degrees Celsius (°C);

$\bar{T}_h$ - The maximum value of the average temperature, in degrees Celsius

degrees Celsius (°C);

T_s - The temperature setting value, in degrees Celsius (°C).

6.3.3.8 All the above calculation results shall meet the requirements of Table 1.

6.3.3.9 According to actual needs, evaluate the uncertainty of the measurement results (refer to Appendix B).

6.4 Method of testing the temperature difference between the inner wall of the working chamber and the working space

6.4.1 Location and number of test points

6.4.1.1 Place one temperature sensor at the geometric center of the working space, and one surface temperature sensor at the geometric center of the six inner walls of the working chamber.

6.4.1.2 If there is a leading hole or other device in the center of the working chamber, the distance between the test point and the hole wall or other device shall not be less than 100 mm.

6.4.2 Test procedure

6.4.2.1 Within the adjustable temperature range of the test chamber, select the highest nominal temperature and the lowest nominal temperature as the test temperature.

6.4.2.2 The temperature at the geometric center point of the working space reaches the test temperature for the first time and is stable for 2 h. The temperature values of all test points are tested every 2 min, for a total of 5 tests.

6.4.3 Calculation and evaluation of test results

6.4.3.1 Correct the measured temperature value according to the correction value of the test instrument.

6.4.3.2 Calculate the arithmetic mean of the temperature of each test point.

6.4.3.3 Substitute the average value of the temperature of the inner wall of the working chamber and the temperature of the geometric center of the working space into the formula (6):

$$A = \frac{|\overline{T_n} - \overline{T_0}|}{\overline{T_0}} \times 100\% \quad \dots\dots\dots (6)$$

Where:

A - The percentage of the difference between the thermodynamic

Where:

V - The wind speed of the test chamber, in meters per second (m/s);

$V_A, \dots, V_M$ - The wind speed at the measuring point, in meters per second (m/s);

n - The number of measuring points.

The calculation results shall meet the requirements of Table 1.

6.7 Test method of thermal insulation performance

Observe the condition of the outer surface of the test chamber after it has stabilized the lowest operating temperature for 2 hours. The above results shall meet the requirements of 5.2.2 (except for the 100 mm range of the observation window frame, leading hole and door frame edge).

6.8 Test method for sealing performance of chamber door

6.8.1 Before and after the tests of 6.3 ~ 6.9 of this standard, it shall be checked each.

6.8.2 Put a 0.1 mm thick, 50 mm wide, 200 mm long paper strip vertically on any part between the door frame and the door sealing strip. After closing the door, pull the paper gently with hands. If it cannot slide freely, it meets the requirements of 5.2.5.

6.9 Test methods for the sealing performance of refrigeration system

Use halogen lamps or other methods to check the joints of the refrigeration system pipes and there shall be no signs of leakage.

6.10 Test method of safety protection performance

6.10.1 Test of electrical insulation and terminal blocks

6.10.1.1 The withstanding voltage test between the power terminal and the metal shell of the chamber shall be carried out by a 5 kV withstanding voltage tester before the test of 6.3. The results shall meet the requirements of 5.3.1.

6.10.1.2 Tests of insulation resistance and protective grounding terminals shall be conducted by a 500 V insulation resistance measuring instrument which has an accuracy of grade 1.0, each before and after the test of 6.3. The results shall meet the requirements of 5.3.1 and 5.3.2.

6.10.2 Test of safety protection device

6.10.2.1 Within the adjustable temperature range of the test chamber, select 3

The quality inspection department of the manufacturer is responsible for exit-factory inspection.

7.4.2 Inspection conditions

This inspection is carried out under no-load conditions.

7.4.3 Inspection items and inspection methods

7.4.3.1 Inspection items and inspection methods are as shown in Table 2.

7.4.3.2 Except for sampling inspection for temperature gradient and temperature variation, other items shall be inspected one by one; all inspection items shall be qualified.

7.4.4 Sampling and evaluation rules

7.4.4.1 The exit-factory sampling quantity of temperature gradient and temperature variation is calculated based on 10% of the product batch, but not less than 2 units.

7.4.4.2 All the inspection items shall be qualified. If one unit fails, the random inspection shall be doubled; when the second sampling inspection is qualified, only the unqualified product in the first sampling inspection shall be returned for repair, which is allowed to exit-factory only after passing the inspection. In the second sampling inspection, if there is still 1 unqualified unit, then the batch of products shall be inspected one by one.

8 Markings, packaging, storage

8.1 Marking

8.1.1 The nameplate of the test chamber shall be clear and durable, fastened firmly.

8.1.2 The content of the product nameplate shall include:

- a) Product model and name;
- b) Temperature range;
- c) Power supply voltage, frequency and total power;
- d) Manufacturing date or manufacturing batch number;
- e) Name of manufacturer.

8.2 Packaging

Appendix B

(Informative)

Evaluation of measurement uncertainty of temperature variation

B.1 The evaluation basis of measurement uncertainty of temperature variation is JJF 1059-1999.

B.2 The main process of the measurement uncertainty evaluation of temperature variation is as follows:

- a) Establish a mathematical model, to determine the relationship between the measured quantity Y and the input quantity $X_1, \dots, X_n$;
- b) Find the best value, get the best value y of Y from the best value x_i of X_i ;
- c) List the sources of measurement uncertainty;
- d) Evaluation of standard uncertainty components: Category A evaluation and category B evaluation;
- e) Calculate the composite standard uncertainty;
- f) Assess the expanded uncertainty;
- g) Uncertainty report.

B.3 The main steps for evaluating the measurement uncertainty of temperature variation are as follows:

- a) According to the definition of temperature variation, the mathematical model of the measurement process is the formula (4).
- b) Find the best value

The best value of T_i is the arithmetic mean value $\overline{T_i}$ of the temperature measurement values at other points in the working space within 30 min, T , the best value of T_0 is the arithmetic mean value $\overline{T_0}$ of the temperature measured values at the center point of the working space within 30 min, which are calculated according to formula (1).

Therefore, the optimal value of temperature variation ΔT is the formula (4).

- c) List the sources of measurement uncertainty

The main sources of measurement uncertainty of temperature variation

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