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NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA

ICS 190.040

N 04

GB 10586-2006

Replacing GB/T 10586-1989

Specifications for Damp Heat Testing Chambers

湿热试验箱技术条件

Issued on: April 03, 2006

Implemented on: October 01, 2006

**Issued by: General Administration of Quality Supervision, Inspection and
Quarantine;**

Standardization Administration of PRC.

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Specifications for Damp Heat Testing Chambers

1 Scope

This Standard specifies the terms and definitions, conditions of use, technical requirements, test methods, inspection rules and marking, packaging, and storage of damp heat test chambers (hereinafter referred to as "test chambers").

This Standard is applicable to test chambers that conduct damp heat tests on electrical, electronic and other products, parts and materials.

2 Normative References

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) 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 191-2000 Packaging - Pictorial Marking for Handling of Goods (eqv ISO 780:1997)

GB/T 2423.3-1993 Basic Environmental Testing Procedures for Electric and Electronic Products - Test Ca: Damp Heat, Steady State (eqv IEC 60068-2-3:1984)

GB/T 2423.4-1993 Basic Environmental Testing Procedures for Electric and Electronic Products - Test Db: Damp Heat, Cyclic (eqv IEC 60068-2-30:1980)

GB/T 2423.9-2001 Environmental Testing for Electric and Electronic Products - Part 2: Test Methods - Test Cb: Damp Heat, Steady State, Primarily for Equipment (idt IEC 60068-2-56:1998)

GB/T 14048.1-2000 Low-Voltage Switchgear and Controlgear - General Rules (eqv IEC 60947-1:1999)

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

3.10 Temperature extremes

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

3.11 Saturation vapour pressure

At a constant temperature, the water vapor pressure when the moisture in a given volume of air can no longer increase.

3.12 Partial vapour pressure

At a constant temperature, in a given volume of air, the part of water vapor pressure in the atmospheric pressure.

3.13 Relative humidity (RH)

At a constant temperature, in a given volume of air, the ratio of partial vapour pressure to saturated saturation vapour pressure, which is expressed by a percentage.

NOTE: Relative humidity is the most common way to express the moisture content in the air.

3.14 Humidity stabilization

The humidity of all points in the working space reaches the humidity setting value and is maintained within a given tolerance range.

3.15 Achieved humidity

After stabilization, the humidity at any point in the working space of the test chamber.

3.16 Relative humidity variation in space

After stabilization, in any time interval, the difference between the average value of the relative humidity in the centre of the working space and the average value of the relative humidity of other points in the working space.

4 Conditions of Use

4.1 Environmental conditions

- a) Temperature: 15°C~35°C;
- b) Relative humidity: no more than 85%;
- c) Atmospheric pressure: 80 kPa~106 kPa;

placed.

5 Technical Requirements

5.1 Product performance

The test chamber is divided into two types: Class-I and Class-II according to its performance. See Table 1 for its performance indicators.

5.2 Product structure and appearance requirements

5.2.1 The inner wall of the working chamber shall be made of corrosion-resistant materials; and the surface shall be easy to clean.

5.2.2 Condensed water is not allowed to drip into the working space. It shall be removed continuously; and shall not be used as humidification water without treatment.

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

5.2.4 Lead through-holes shall be provided.

5.2.5 There should be a sample rack for placing or hanging samples.

5.2.6 The cabinet, ventilation ducts and refrigeration system shall be sealed reliably; and shall not leak air, water or oil.

5.2.7 The door of the chamber shall be well sealed; and the sealing strip shall not easily become sticky and deformed under humid and hot conditions, and be easy to replace.

5.2.8 Appearance coating layer shall be flat and smooth, with uniform colour, and there shall be no traces of exposed bottom, blistering, layering or scratching.

5.3 Safety and environmental protection requirements

5.3.1 The insulation resistance value between the terminal and the metal shell of the chamber shall satisfy: more than $2M\Omega$ in cold state, more than $1M\Omega$ (measured by 500V megohmmeter with accuracy of Grade-1.0) in hot state; and can withstand the voltage-withstand test with 50Hz AC voltage 1500V and the voltage time of 5s.

The expanded uncertainty of the temperature measurement system ($k=2$): no more than 0.4°C .

6.1.3 Hygrometer

A wet bulb thermometer or a humidity measuring system composed of other sensors may be used.

The expanded uncertainty ($k = 2$) of the humidity measurement system shall be no greater than $1/3$ of the measured humidity tolerance.

6.2 Test conditions

6.2.1 The test conditions shall meet the requirements of 4.1, 4.2 and 4.3.

6.2.2 The test is carried out under no-load conditions.

6.3 Location and number of test points

6.3.1 Three horizontal test surfaces, called upper, middle and lower layers, are set in the working room of the test chamber. The distance between the upper layer and the top surface of the working room is $1/10$ of the height of the working room; the middle layer passes through the geometric centre of the working room; and the lower layer is 10mm above the sample rack of the lowest layer.

NOTE: When the working room has a sloped roof or a spire, the top surface is an imaginary horizontal plane passing through the intersection of the slope and the vertical wall.

6.3.2 The test points are located on the three test surfaces; the central test point is located at the geometric centre of the working room; and the distance between the remaining test points and the wall of the working room is $1/10$ of their respective side lengths (see Figure 1). But for the test chamber with the working room volume no more than 1m^3 , the distance is no less than 50mm.

6.3.3 The relationship between the number of test points and the volume of the working chamber is:

- a) When the volume of the working room is no greater than 2m^3 , there are 9 temperature test points and 3 relative humidity test points; and the placement position is shown in Figure 1.

6.4.1.1 Determine the temperature and humidity test points according to the provisions of 6.3 and the volume of the working room of the test chamber, and install temperature and humidity test sensors.

6.4.1.2 Test the wind speed at the humidity test point (when used in test Ca of GB/T 2423.3-1993) or at all test points (when used in test Cb of GB/T 2423.9-2001), see 6.5 for the wind speed test methods.

6.4.1.3 Slowly raise the temperature to the specified test temperature (40°C). During the temperature rise period, the temperature of the centre point shall be measured once every 1min. The temperature rise rate shall not exceed 1°C/min.

6.4.1.4 Within 2h, make the relative humidity reach the specified value ($93\%_{-3}^{+2}$ %) of the relevant standard.

6.4.1.5 The temperature and humidity at the centre point of the working space reach the specified value and stabilize for 2h. Then within 30min, the temperature and humidity values of all test points are tested once every 1min for a total of 30 times.

6.4.2 Type-II (alternating) damp heat test chamber

6.4.2.1 Determine the temperature and humidity test points according to the provisions of 6.3 and the volume of the working room of the test chamber; then install the sensors measuring the temperature and humidity.

6.4.2.2 Measure the wind speed at the relative humidity test points (see 6.5).

6.4.2.3 Make the temperature of the working space reach $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$; and keep the relative humidity between 45% and 75%.

6.4.2.4 Within 1h, make the relative humidity of the working space no less than 95%.

6.4.2.5 Make the temperature and humidity of the working space continuously change, according to the procedure given in Figure 2 of GB/T 2423.4-1993, in four stages of "temperature rise - high temperature and high humidity – temperature fall - low temperature and high humidity"; and the test is carried out according to the following requirements:

- a) During the temperature rise phase, measure the temperature and humidity at the centre point at least once every 1min;
- b) After entering the high temperature and high humidity phase, measure the values of all temperature and humidity points once every 1min; measure 30 times in 30 min. At the end of the high temperature and high humidity phase, that is, measure 30 times in 30min again before the start of temperature fall.
- c) From the beginning of the temperature fall phase, measure the temperature and

- b) Depict the value measured during the temperature rise phase as a temperature rise characteristic curve;
- c) According to the provisions of Figure 2 in GB/T 2423.4-1993, draw the temperature and humidity range diagram during the temperature fall phase (including 30min before the start of the temperature fall and 30min after the end of temperature fall);
- d) Depict the value measured during the temperature fall as a temperature fall characteristic curve.

6.4.3.10 The above calculation results shall meet the requirements of relevant standards. The temperature-rise and -fall characteristic curves shall be within the temperature and humidity range diagram required by 6.4.3.9.

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

6.5 Test methods of wind speed

6.5.1 This test is carried out under no-load and room temperature conditions.

6.5.2 The number and location of test points are the same as in 6.3.

6.5.3 Test procedures

6.5.3.1 Hang the fine cotton yarn or other light objects at the test points; close the door of the chamber; turn on the fan; and find out the prevailing wind direction at each test point.

6.5.3.2 Hang the wind speed sensor at the test point; close the door of the chamber; turn on the fan; and measure the wind speed value of the dominant wind direction at each test point.

6.5.4 Calculation and judgment of test results

6.5.4.1 Correct the measured wind speed value according to the correction value of the anemometer.

6.5.4.2 Calculate the average wind speed of all test points according to Formula (6):

$$V = (V_A + V_B + \dots + V_M) / n \quad \dots\dots\dots (6)$$

Where:

V – wind speed of the test chamber, in m/s;

$V_A, \dots, V_M$ – wind speed of the test point, in m/s;

6.10 Appearance quality inspection and evaluation method

6.10.1 This inspection shall be carried out once before and after the test of 6.4, respectively.

6.10.2 Visually inspect the quality of the coating on the appearance of the test chamber, and the result shall meet the requirements of 5.2.8.

7 Inspection Rules

7.1 The inspection of the test chamber is divided into two categories: type inspection and exit-factory inspection.

7.2 Type inspection

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

- a) When conducting the new product trial formulation appraisal;
- b) When formally produced products have major changes in structure, materials, technology, production equipment and management, which may affect product performance;
- c) When the national quality supervision and inspection agency conducts quality supervision and inspection;
- d) When there is a big difference between the exit-factory test results and the last type test results;
- e) When the product is stopped for more than one year and then reproduced;
- f) When making mass production of products, regular sampling inspections shall be conducted at least once every two years.

7.2.2 Type inspection items and test methods

The type inspection items and test methods are shown in Table 2.

7.3.4.1 The exit-factory sampling quantity of temperature gradient and temperature tolerance is calculated based on 10% of the product batch size, but no less than 2 sets.

7.3.4.2 All inspection items should be qualified. If one set is unqualified, the sampling inspection shall be doubled. When the second sampling is qualified, only the unqualified products in the first sampling shall be returned for repair; and they can leave the factory after all of them are qualified. If there is still one unqualified set in the second sampling inspection, then the batch of products shall be inspected one by one.

8 Marking, Packaging and Storage

8.1 Marking

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

8.1.2 The contents of the nameplate shall include:

- a) Product model and name;
- b) weight;
- c) Voltage, frequency and total power;
- d) Product serial number and manufacturing date;
- e) The name of the manufacturer.

8.2 Packaging

8.2.1 The text and marking of the packing box shall comply with the provisions of GB/T 191-2000.

8.2.2 The packing box shall be firm and reliable.

8.2.3 The packing box shall be protected from rain and moisture accumulation.

8.2.4 The accessories, spare parts and special tools of the test chamber shall be packed separately and firmly fixed in the packing box.

8.2.5 The technical documents of the test chamber, such as packing list, product instruction manual, product certificate, etc., shall be sealed and moisture-proof; and fixed in an obvious place in the packing box.

8.3 Storage

Appendix B

(Informative)

Evaluation on the Measurement Uncertainty of Temperature Deviation

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

B.2 The main process of the measurement uncertainty evaluation of temperature deviation 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) Standard uncertainty component evaluation: Type-A evaluation and Type-B evaluation;
- e) Calculate the uncertainty of the composite standard;
- f) Evaluate the expanded uncertainty;
- g) Uncertainty report.

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

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

The best value of T_i is the arithmetic average value $\bar{T}_i$ of the temperature measurement values at other points in the working space within 30 min. The best value of T_0 is the arithmetic average value $\bar{T}_0$ of the temperature measurement values at the center-point of the working space within 30 min; all shall be calculated according to the Formula (1).

Therefore, the best value of temperature deviation ΔT_i is Formula (4).

- c) List the sources of measurement uncertainty

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