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Temperature controller for laboratory resistance furnaces

实验电阻炉温度控制器

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Temperature controller for laboratory resistance furnaces

1 Scope

This Standard specifies various requirements for KSB, KSD, KSG, KSJ and KSY series temperature controllers for laboratory resistance furnaces (hereinafter referred to as temperature controllers), including product classification, technical requirements, test methods, inspection rules, technical classification and ordering and supply.

This Standard applies to temperature controllers matched with SX, SK and SG series laboratory box-type, tube-type and pot-type resistance furnaces.

For other temperature controllers used in laboratory resistance furnaces, this Standard is for reference only.

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 1094.11-2007 Power transformers - Part 11: Dry-type transformers

GB/T 2900.23-2008 Electrotechnical terminology - Industrial electroheat

GB/T 4025-2010 Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators

GB/T 4026-2010 Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and conductor terminations

GB 4208-2008 Degrees of protection provided by enclosure(IP code)

GB 4884-1985 Marking of insulated conductors

GB 7947-2010 Basic and safety principles for man machine interface, marking and identification - Identification of conductors by colours or alphanumerics

GB/T 10066.1-2004 Test methods for electroheat installations - Part 1: General

GB/T 10067.1-2005 Basic specifications for electroheat installations - Part 1: General

GB/T 13324-2006 Terminology of heat treatment equipment

- h) temperature control accuracy, °C;
- i) overall dimensions of the control box (width × depth × height), mm;
- j) weight, kg.

5 Technical requirements

5.1 General requirements

The temperature controller shall comply with the relevant provisions of Clause 5 of GB/T 10067.1-2005. When there is a difference between the provisions of that standard and this Standard, this Standard shall prevail.

5.2 Supplementary requirements for design and manufacturing

5.2.1 Overall design

The temperature controller for laboratory resistance furnaces refers to the assembly of software and hardware units such as electrical control components and instruments that are centrally installed in the temperature control box to achieve heating temperature measurement, control and recording functions. Because the heating capacity of laboratory resistance furnaces is small and generally not partitioned, it is different from the temperature control cabinet for industrial resistance furnaces, and is called a temperature controller. The temperature controller can be in a separate box or integrated with the furnace.

The temperature controller can be composed of a box (station) body, a frame and various electrical components, devices and instruments. The design of the temperature controller shall be able to ensure that the heat, arc, impact, vibration, magnetic field or electric field generated by the operation of each electrical component must not interfere with each other's normal functioning.

5.2.2 Box (station) body

The temperature controller is generally a separate box (station) body, connected to the heating body in the furnace through a cable, or it can be directly connected to the furnace body as a whole. The door or top cover of the temperature controller shall have hidden buckles or internal pins and shall be able to rotate flexibly. Its opening angle shall not be less than 90°. Electrical components and instruments shall not be impacted during the opening process.

Separate holes shall be made on the box (station) body for signal wiring and lead-out wiring such as thermocouples, actuators, detection switches, etc.

5.2.3 Installation requirements

All components, devices and instruments installed in the temperature controller must be inspected and qualified before installation. During installation, sufficient distance for disassembly and repair shall be left according to design requirements. The contactors and instruments in the temperature controller shall be equipped with appropriate anti-vibration measures (for example, adding spring washers or rubber pads) according to the actual working conditions. The wire outlet holes shall be equipped with insulating outlet rings.

5.2.4 Painting requirements

The paint film surface of the temperature controller must not have defects such as wrinkles, flow marks, pinholes and blisters.

The paint film on the outer surface of the temperature controller shall be uniform in color, flat and smooth, and no brush marks, scars, correction marks, obvious mechanical impurities, spots, etc. that can be seen with the naked eye; the paint film on the inner surface of the temperature controller shall have a certain anti-corrosion ability.

The outer surface of Class C temperature controller shall be painted or epoxy powder sprayed, etc. If there are special requirements (see 9.2), they can be agreed upon by both parties.

5.2.5 Electrical system

5.2.5.1 Power supply

The power supply parameters of the temperature controller are determined according to the relevant contents in Table 1.

5.2.5.2 Wires

The connecting wires in the temperature controller shall be wired correctly, firmly, reliably, and arranged neatly and beautifully. The cross-sectional area of the conductor shall be selected according to the specified carrying capacity. It is generally not less than 0.75 mm^2 for single-core copper insulated wires, and generally not less than 0.5 mm^2 for multi-core copper insulated wires.

The connecting wires to each connector shall have copper bare crimp terminals. There shall be no plugged or soldered transition connections in the middle of each conductor.

The insulated wire markings inside the temperature controller shall comply with the provisions of GB 4884-1985. The markings shall be printed with a printing machine, and the writing shall be clear and durable to facilitate use and maintenance.

The color of the wires in the temperature controller shall comply with the provisions of GB 7947-2010.

5.2.5.3 Terminal blocks

The identification and alphanumeric symbols of the terminal blocks in the temperature controller shall comply with the provisions of GB/T 4026-2010.

5.2.5.4 Indicators and buttons

The colors of the indicator lights and buttons used on the temperature controller shall comply with the relevant provisions of GB/T 4025-2010.

5.2.5.5 Temperature control instruments

Class C temperature controllers shall be equipped with digital display programmable temperature control instruments with a microprocessor, of which the temperature indication accuracy is not less than $\pm 0.25\%$, the setting accuracy is not less than $\pm 0.5\%$, and the resolution is not less than $1\text{ }^{\circ}\text{C}$ (excluding display error). The digital display shall be clearly legible and its height shall not be less than 15 mm. The instrument shall be equipped with a data interaction interface so that a recorder or printer can be connected when necessary.

Class B and Class A temperature controllers shall be equipped with temperature control instruments, of which the temperature indication accuracy is not less than $\pm 0.5\%$ and the setting accuracy is not less than $\pm 1\%$.

When otherwise specified (see 9.2), Class A temperature controllers may also be equipped with temperature control instruments, of which the temperature indication accuracy is not less than $\pm 1\%$ and the setting accuracy is not less than $\pm 1\%$.

5.2.5.6 Electrical instruments

The temperature controller shall be equipped with necessary voltmeters and ammeters. When required (see 9.2), it can also be equipped with other electrical instruments. The accuracy level of the electrical instruments shall not be lower than level 2.5.

5.2.5.7 Over-temperature control system

When required (see 9.2), the temperature controller shall be equipped with an over-temperature control system.

The over-temperature control system shall comply with the relevant provisions of 5.2.7 in JB/T 8195.7-2007, JB/T 8195.8-2007 and JB/T 8195.9-2007.

5.2.5.8 Transformers

The transformers used with KSB series temperature controllers shall comply with the provisions of GB 1094.11-2007.

5.2.5.9 Others

5.4.2 Degree of protection provided by enclosure

The protection provided by enclosure of the temperature controller shall not be lower than the requirements of IP31 degree in GB 4208-2008.

5.4.3 Interlocking

As needed, the temperature controller shall be interlocked with the furnace door opening and over-temperature control system of the laboratory resistance furnace, to prevent accidents that endanger personal or equipment.

5.5 Requirements for complete set

The supply scope of complete set of the temperature controller specified by the supplier shall be listed in the enterprise product standards. These include:

- a) box (station) body (including temperature control instruments, electrical components, actuators, etc.);
- b) transformer (applicable to KSB series);
- c) instructions for use;
- d) spare parts (including fuses, etc.).

In the enterprise product standards, the specific contents of the above items shall be listed, including model, specification and quantity.

If the purchaser has different requirements for the items specified by the supplier, it may be submitted in accordance with 9.2.

6 Test methods

6.1 General

The test methods for temperature controllers shall comply with the relevant provisions of GB/T 10066.1-2004 and the following supplementary provisions.

During the test, the special temperature controller shall be connected to the corresponding special laboratory furnace. For a standard temperature controller, the rated power of the box-type laboratory furnace it connected to shall be equal to 70 % ~ 100 % of the maximum control power of the temperature controller, and the maximum operating temperature shall be equivalent to the maximum temperature of the temperature controller. The laboratory furnace used for measurement shall be a qualified product that has been inspected by the inspection department. The use of temperature-controlled thermocouples shall be the same as the temperature

measurement conditions of the laboratory furnace during normal operation, and generally shall have a protective cover.

6.2 Measurement of insulation resistance

Use a 500 V megger to measure between different charged objects in the temperature controller and between each charged object and the metal shell.

Components that cannot withstand the 500 V megger voltage shall be disconnected or short-circuited before the measurement.

6.3 Dielectric strength test

The dielectric strength test is carried out after the measurement of insulation resistance. The dielectric test voltage is a power frequency sinusoidal waveform, which is applied between different charged objects and between each charged object and metal when the temperature controller is working normally. The latter shall be connected at together and grounded.

The dielectric test voltage shall start from half of the voltage value specified in Table 3, gradually increase to the full value within 10 seconds, and then maintain for 1 minute. Flash explosion or breakdown shall not occur.

Instruments and components that cannot withstand the above dielectric test voltage shall be disconnected or short-circuited before the test.

6.4 Power-on test

During the test, the temperature controller shall be connected to a resistor of which the rated power is 50 % ~ 100 % of the maximum output power of the temperature controller. After the power is turned on, check whether the electrical components and instruments operate normally.

6.5 Measurement of surface temperature rise

The measurement of surface temperature rise shall be carried out after the temperature controller operates normally and reaches the thermal equilibrium state.

Surface temperature rise shall be measured using a surface thermometer or surface thermocouple with an accuracy of not less than level 4.

6.6 Measurement of temperature control accuracy

30 minutes after the laboratory resistance furnace reaches its maximum operating temperature, the temperature of the temperature-controlled thermocouple shall be continuously tracked and monitored for at least 30 minutes, and the maximum and minimum temperature values of each temperature adjustment or fluctuation period during the entire monitoring period shall be recorded, respectively. The average of the

five larger maximum values and the average of the five smaller minimum values are used as the maximum and minimum measured temperature values.

During the above tracking and monitoring period, the temperature of the temperature-controlled thermocouple shall be recorded regularly every 3 minutes to obtain the average temperature during the period (which is the average of at least 11 temperature recording values).

The largest value among the absolute values of the differences between the maximum (average value) and minimum (average value) measured temperature values AND the average value of the control temperature is the temperature control accuracy of the temperature controller.

6.7 Power adjustment test

Applicable to KSG series temperature controllers.

After the temperature controller is connected to the no-load laboratory resistance furnace specified in this Clause and powered on, manually adjust the output power through the potentiometer or manual output button of the instrument, so that the indicated value of the main circuit ammeter goes from minimum to maximum, and then decreases smoothly to zero. Repeat this three times and there shall be no abnormality.

6.8 Output voltage regulation test

Applicable to KSB and KSY series temperature controllers.

After the temperature controller is connected to the no-load laboratory resistance furnace specified in this Clause and powered on, manually adjust the output voltage through the potentiometer or manual output button of the instrument. Its value shall be adjustable within the range specified in 5.3.7.

6.9 Main circuit waveform inspection

After connecting the control circuit and the main circuit, use an oscilloscope to check the voltage and current waveforms of the main circuit. The waveforms shall meet the requirements of 5.3.8. If necessary, for a temperature controller used for inductive loads, take photos of the voltage and current waveforms at the moment when the main circuit is turned on.

6.10 Protection system inspection

6.10.1 Overcurrent protection inspection

Applicable to KSG and KSY series temperature controllers.

Set the overcurrent setting value of the overcurrent system of the temperature controller to the specified value, and then make the main circuit pass a current equal to the setting value, check whether the overcurrent protection system can operate normally.

6.10.2 Short-circuit protection test

Applicable to KSG and KSY series temperature controllers.

If the main circuit output line is artificially short-circuited, the quick fuse shall be blown and the components in the temperature controller shall not be damaged.

6.10.3 Overvoltage protection inspection

Applicable to KSG and KSY series temperature controllers.

The overvoltage of the temperature controller comes from the on-off and overcurrent of the switching element, the disconnection of the short-circuit protection, etc. Therefore, this inspection shall be carried out at the same time as the tests and inspections of 6.3, 6.10.1 and 6.10.2, and the components in the temperature controller after the inspection shall not be damaged.

7 Inspection rules and technical classification

7.1 The inspection and technical classification of temperature controllers shall be carried out in accordance with the provisions of Clause 7 of GB/T 10067.1-2005 and the following clauses.

7.2 The factory-exit inspection items of temperature controllers shall include the following items:

- a) General inspection;
- b) Measurement of insulation resistance;
- c) Dielectric strength test;
- d) Power-on test;
- e) Output voltage regulation test (applicable to KSB and KSY series);
- f) Overcurrent protection check (applicable to KSG and KSY series);
- g) Inspection of accessories, including inspection of models, specifications and factory-exit certificates;
- h) Inspection of the scope of supply, including inspection of the completeness of factory-exit technical documents;

- d) number of phases;
- e) maximum control power, kW;
- f) weight, kg;
- g) serial number of the product;
- h) date of manufacture;
- i) name of the manufacturer (the name of the country shall be indicated for exported products).

9 Ordering and supply

9.1 The ordering and supply of temperature controllers shall be in accordance with the provisions of Clause 9 of GB/T 10067.1-2005.

9.2 If the purchaser has the following special requirements, it may submit them to the supplier:

- a) Different requirements for unit system, power supply voltage, power frequency, etc. (see 5.1.1.1 in GB/T 10067.1-2005);
- b) Different requirements for the use environment (see 5.1.2 in GB/T 10067.1-2005);
- c) Additional requirements for safety and environmental protection (see 5.1.5.1 in GB/T 10067.1-2005);
- d) Different requirements for paint (see 5.2.7 in GB/T 10067.1-2005 and 5.2.4 of this Standard);
- e) Special requirements for packaging (see 8.2.4 in GB/T 10067.1-2005);
- f) Different requirements for temperature control instruments (see 5.2.5.5);
- g) Different requirements for electrical instruments (see 5.2.5.6);
- h) Requirement of providing an over-temperature control system (see 5.2.5.7);
- i) Different requirements for the supply items specified by the supplier (see 5.5).

The supplier shall try its best to meet the special requirements of the purchaser. However, the actual special requirement items that can be selected by the purchaser are determined by the supplier with reference to this Standard. Some of them can be listed in the enterprise product standards, and the other parts can be agreed upon by both parties when ordering.

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