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Point Type Ultraviolet Flame Detectors

点型紫外火焰探测器

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Point Type Ultraviolet Flame Detectors

1 Scope

This Standard specifies the general requirements, requirements and test methods, inspection rules and markings for point type ultraviolet flame detectors.

This Standard is applicable to point type ultraviolet flame detectors with a wavelength range below 300 nm installed in general industrial and civil buildings. For point type ultraviolet flame detectors with special properties installed in other environments, this standard shall be implemented except that the special properties are specified separately by the relevant standards.

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 9969.1 General Principles for Preparation of Instructions for Use of Industrial Products

GB 12978 Rules for Test of Fire Electronic Products

GB 16838 Environmental Test Methods and Severities for Fire Electronic Products

GB/T 17626.2-1998 Electromagnetic Compatibility - Testing and Measurement Techniques - Electrostatic Discharge Immunity Test (idt IEC 61000-4-2:1995)

GB/T 17626.3-1998 Electromagnetic Compatibility - Testing and Measurement Techniques - Radiated, Radio-Frequency, Electromagnetic Field Immunity Test (idt IEC 61000-4-3:1995)

GB/T 17626.4-1998 Electromagnetic Compatibility - Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test (idt IEC 61000-4-4:1995)

GB/T 17626.5-1998 Electromagnetic Compatibility - Testing and Measurement

tools, ciphers or disconnection between probes and bases, and the like measures.

- b) When the manufacturer declares that a setting does not meet the requirements of this Standard, such setting shall only be implemented by means of special tools and ciphers; and it shall be clearly indicated on the detector or related documents that such setting cannot meet the requirements of this Standard.

3.6 Detachable detector

When the probe of the detachable detector is separated from the base, it shall provide identification means for the control and indication equipment to send out fault signals.

3.7 Requirements for control software

3.7.1 General

For detector that rely on software control and meet the requirements of this Standard, it shall meet the requirements of 3.7.2, 3.7.3, and 3.7.4.

3.7.2 Software files

3.7.2.1 The manufacturer shall submit software design information. The information shall have sufficient content to prove that the software design meets the requirements of this Standard and shall include at least the following:

- a) Functional description of main program (such as flow chart or structure diagram), including:
 - Main description of each module and its function;
 - The way in which the modules interact;
 - All levels of the program;
 - The way the software interacts with the detector hardware;
 - The way the module is called, including the interrupt process.
- b) Memory address allocation (such as program, specific data and operation data).
- c) The unique identification of the software and its version.

3.7.2.2 If the inspection requires, the manufacturer shall be able to provide detailed design documents containing at least the following:

- a) Overview of the overall system configuration, including all software and hardware components.

4.1.1 Atmospheric conditions of the test

Unless otherwise stated in the relevant provisions, all tests are conducted under the following atmospheric conditions:

- Temperature: 15°C ~ 35°C;
- Humidity: 25% RH ~ 75% RH;
- Atmospheric pressure: 86 kPa ~ 106 kPa.

4.1.2 Normal monitoring status of the test

If the test method requires the detector to work under normal monitoring status, the sample shall be connected to the control and indication equipment provided by the manufacturer; when there are no special requirements in the relevant provisions, the working voltage of the detector should be guaranteed to be rated working voltage, and keep the working voltage stable during the test.

NOTE: The test report of the detector shall indicate the type and manufacturer of the control and indication equipment that the detector is connected to during the test.

4.1.3 Installation of the detector

The detector shall be installed according to the normal installation method specified by the manufacturer. If the instruction manual gives a variety of installation methods, the most unfavorable installation method shall be used in the test.

4.1.4 Tolerance

Unless otherwise stated in the relevant provisions, the tolerance of each test data is $\pm 5\%$; the deviation of environmental condition parameters shall meet the relevant provisions of GB 16838.

4.1.5 Test sample (hereinafter referred to as sample)

10 sets of detectors, which are numbered before the test.

4.1.6 Inspect before test

4.1.6.1 The sample shall be conducted the appearance inspection before the test, and shall meet the following requirements:

- a) No corrosion, peeling and blistering on the surface, no obvious scratches, cracks, burrs and other mechanical damage;
- b) There is no looseness in the fastening part.

4.2 Measurement of response threshold

4.2.1 Purpose

Measure the response threshold of the detector.

4.2.2 Equipment

The ultraviolet flame sample detection device is a special equipment, which is composed of optical orbit, ultraviolet light source, dimmer glass, shutter, modulator, sample holder and other related components (as shown in Figure 1). The equipment should meet the test requirements of 4.2, 4.4 ~ 4.8.

4.2.2.1 Optical orbit

The main technical parameters:

Length: 2m;

Straightness: less than 0.04mm.

4.2.2.2 Ultraviolet light source

The ultraviolet light source uses a flame produced by the combustion of methane with a purity of no less than 99.9%. During the test, the variation of the radiant energy of the light source shall be no greater than $\pm 5\%$.

4.2.2.3 Dimmer glass

The dimmer glass plays the role of attenuating ultraviolet radiation. Neutral ultraviolet dimmer glass is used in this detection device, which can pass ultraviolet radiation with a wavelength greater than 200nm and less than 300nm, and its transmittance depends on the specific test requirements.

4.2.2.4 Modulator (optional)

The modulator is composed of a chopper and a DC motor. The DC motor drives the chopper to rotate at a desired frequency to modulate the radiation generated by the flame combustion (as shown in Figure 2).

this point and the light source, that is, the Value- D of the sample response point.

According to optical principles, the square of the distance D between the sample response point and the light source is inversely proportional to the effective power S radiated by the light source to the sample sensing surface, namely:

$$S = K/D^2 \text{ (} K \text{ is transformation constant)}$$

For samples with random response characteristics, the response threshold must be measured repeatedly for at least 6 times until the next change in the response threshold does not exceed 10% of the average value of the response thresholds of the previous measurements.

For samples with flicker frequency requirements, the modulator must be adjusted to the flicker frequency specified by the manufacturer (including 0).

4.2.3.3 Calculation of the response threshold ratio

Compare the two measured response thresholds, the maximum value is $S_{\max}$, the minimum value is $S_{\min}$; they correspond to $D_{\max}$ and $D_{\min}$, respectively. The response threshold ratio is $S_{\max} : S_{\min} = D_{\max}^2 : D_{\min}^2$.

4.3 Conformance test

4.3.1 Purpose

Check the conformance of the response threshold distribution of the detector.

4.3.2 Test methods

According to the method specified in 4.2.3, measure the Value- D of the response points of 10 samples, respectively; thereof, the maximum value is $D_{\max}$ and the minimum value is $D_{\min}$; calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.3.3 Requirements

The response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 2.0.

4.3.4 Equipment

Ultraviolet flame sample detection device.

4.4 Repeatability test

4.4.1 Purpose

Check the stability of the detector for continuous operation.

measure the Value- D of the response point of the sample according to the method specified in 4.2.3; and compare it with the Value- D of the response point of the sample in the consistency test; thereof, the maximum value is $D_{\max}$, while the minimum value is $D_{\min}$; and calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.6.3 Requirements

During the test, the sample shall not emit a fire alarm signal or a fault signal; after the test, the response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.3.

4.6.4 Test equipment

Ultraviolet flame sample detection device

4.7 Power parameter fluctuation test

4.7.1 Purpose

Check the adaptability of the detector to changes in power supply parameters.

4.7.2 Test method

Respectively, reduce 15% and increase 10% of the working voltage of the sample against the rated voltage; and measure the Value- D of response point according to the method specified in 4.2.3; compare it with the Value- D of the response point of the sample in the conformance test, among the three of which, the maximum value is $D_{\max}$ and the minimum value is $D_{\min}$; and calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.7.3 Requirements

During the test, the sample shall not emit a fire alarm signal or a fault signal; after the test, the response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.6.

4.7.4 Equipment

Ultraviolet flame sample detection device.

4.8 Environmental light interference test

4.8.1 Purpose

Check the stability of the detector performance under environmental light.

4.8.2 Test method

4.8.2.1 Installation of sample

Place the environmental light interference simulation device between the light source

response threshold ratio of $S_{\max} : S_{\min}$.

4.8.3 Requirements

During the test, the sample shall not emit a fire alarm signal or a fault signal; the response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.6; after the test, the sample response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.3.

4.8.4 Test equipment

Ultraviolet flame sample detection device, environmental light interference simulation device.

4.9 High temperature (operation) test

4.9.1 Purpose

Check the adaptability of the detector used under high temperature conditions.

4.9.2 Test method

4.9.2.1 Place the sample and its base in the high-temperature test chamber, and switch on the control and indication equipment to make it in the normal monitoring status.

4.9.2.2 Under the condition of a temperature at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, raise the temperature to $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ at a temperature-rise rate of no more than $0.5^{\circ}\text{C}/\text{min}$; and keep it under this condition for 2h. During the test, observe and record the working state of the sample.

4.9.2.3 After the test, take out the sample and place it under normal atmospheric conditions for 1h. Then measure the Value- D of the response point according to the method specified in 4.2.3, and compare it with the Value- D of the sample in the conformance test; thereof, the maximum value is $D_{\max}$, and the minimum value is $D_{\min}$; calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.9.3 Requirements

During the test, the sample shall not emit a fire alarm signal or a fault signal; after the test, the sample shall be free of coating damage and corrosion; and the response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.3.

4.9.4 Test equipment

The test equipment shall comply with the relevant provisions of GB 16838.

4.10 Low temperature (operation) test

4.10.1 Purpose

conformance test; thereof, the maximum value is $D_{\max}$, and the minimum value is $D_{\min}$; and calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.11.3 Requirements

During the test, the sample shall not emit a fire alarm signal or a fault signal; after the test, the sample shall be free of coating damage and corrosion; and the response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.3.

4.11.4 Test equipment

The test equipment shall comply with the relevant provisions of GB 16838.

4.12 Constant damp heat (durability) test

4.12.1 Purpose

Check the ability of the detector to withstand high humidity environment.

4.12.2 Test method

4.12.2.1 Place the sample and its base in the damp heat test chamber.

4.12.2.2 Adjust the damp heat test chamber, and keep the sample for 21d under the conditions of temperature at $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and relative humidity $93\% \pm 3\%$.

4.12.2.3 After the test, take out the sample and place it under normal atmospheric conditions for 1h. Then measure the Value- D of the response point according to the method specified in 4.2.3; and compare it with the Value- D of the sample in the conformance test; thereof, the maximum value is $D_{\max}$, and the minimum value is $D_{\min}$; calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.12.3 Requirements

The sample shall meet the following requirements:

- a) When returning to the normal monitoring state, the sample shall not issue a fire alarm signal or a fault multiple;
- b) After the test, the sample shall be free of coating damage and corrosion; and the response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.6.

4.12.4 Test equipment

The test equipment shall comply with the relevant provisions of GB 16838.

4.13 Corrosion test

DC voltage between the short-circuit position and the metal plate for $60\text{s} \pm 5\text{s}$. Then measure the insulation resistance.

4.14.2.2 Place the sample in a drying cabinet at a temperature of $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and dry it for 6h; Keep it in the damp heat test chamber for 4d at the temperature of $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and relative humidity of $93\% \pm 3\%$. Then place it under normal atmospheric conditions for 1h, and measure the insulation resistance as described above.

4.14.3 Requirements

The insulation resistance between the externally charged terminal of the sample and the enclosure shall be no less than $100\text{M}\Omega$ under normal atmospheric conditions; and it shall be no less than $1\text{M}\Omega$ in an environment with a temperature of $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and a relative humidity of $93\% \pm 3\%$.

4.14.4 Test equipment

Main technical parameters of insulation resistance test device are as follows:

- a) Test voltage: $\text{DC } 500 \times (1 \pm 0.1) \text{ V}$ (the ground is a metal plate);
- b) Measuring range: $0 \sim 500\text{M}\Omega$;
- c) Minimum division: $0.1\text{M}\Omega$;
- d) Timing time: $60\text{s} \pm 5\text{s}$.

NOTE: When there is no special test device, it may also be measured by a megohmmeter or a megger.

4.15 Withstand voltage test

4.15.1 Purpose

Check the withstand voltage performance of the detector.

4.15.2 Test method

4.15.2.1 Place the sample in a damp heat test chamber with a temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and a relative humidity of no more than 70% for 24 h.

4.15.2.2 After taking out, install the sample and its base on a metal plate (voltage ground) of the withstand voltage test equipment; and then short-circuit all the contacts of the sample to each other; and apply test voltage between the short-circuit position and the metal plate according to the following requirements:

- a) When the effective value of the rated working voltage of the sample does not exceed 50V: the test voltage rises from 0V to $500 \times (1 \pm 0.1) \text{ V}$ at a boost rate of

4.16.4 Test equipment

The test equipment shall comply with the provisions of GB 16838

4.17 Vibration (sinusoidal) (durability) test

4.17.1 Purpose

Check the ability of the detector to withstand the effects of vibration for a long time.

4.17.2 Test method

4.17.2.1 Fix the sample and its base on the vibration test bench.

4.17.2.2 Separately conduct 20 times of sweep-frequency cycle on three mutually perpendicular axes in turn, within the frequency cycle range of 10Hz~150Hz, with an acceleration amplitude of 10 m/s² and a sweep rate of 1 oct/min.

4.17.2.3 After the test, measure the Value-*D* of the response point according to the method specified in 4.2.3; compare it with the Value-*D* of the sample in the conformance test; thereof, the maximum value is $D_{\max}$, and the minimum value is $D_{\min}$; and calculate the response threshold ratio of $S_{\max} : S_{\min}$.

4.17.3 Requirements

The sample shall meet the following requirements:

- a) When returning to the normal monitoring state, the sample shall not emit a fire alarm signal or a fault signal;
- b) After the test, the sample shall be free of mechanical damage and looseness of the fastening parts. The response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.3.

4.17.4 Test equipment

The test equipment shall comply with the provisions of GB 16838.

4.18 Shock test

4.18.1 Purpose

Check the anti-interference ability of the detector against non-recurring mechanical shock.

4.18.2 Test method

4.18.2.1 Fix the sample and its base on the impact test bench, and switch on the control

4.19.4 Test equipment

The main body of the collision test device (shown in Figure 4) is a pendulum mechanism. The hammer head of the pendulum is made of hard aluminum alloy AlCu_4SiMg (after solid solution and aging treatment); and the shape is a hexahedron with an inclined collision surface. The swing bar of the hammer head is fixed on a steel hub with a ball bearing; and the ball bearing is mounted on a fixed steel shaft of a hard steel frame. The structure of the hard steel frame shall ensure that the pendulum may rotate freely when the sample is not installed.

The external dimensions of the hammer head are 94mm long, 76mm wide and 50mm high; and the mass is about 0.79kg. The angle between the diagonal plane of the hammer head and the longitudinal axis is $60^\circ \pm 1^\circ$. The outer diameter of the swing bar of the hammer head is $25\text{mm} \pm 0.1\text{mm}$, and the wall thickness is $1.6\text{mm} \pm 0.1\text{mm}$.

The radial distance of the longitudinal axis of the hammer head from the rotation axis is 305mm; and the axis of the swing rod of the hammer head must be perpendicular to the axis of rotation. Steel wheel hubs with an outer diameter of 102mm and a length of 200mm are assembled concentrically on a steel shaft with a diameter of 25mm. The accuracy of the steel shaft diameter depends on the dimensional tolerances of the used bearings.

Two steel counterweight arms with an outer diameter of 20mm and a length of 185mm are installed in the opposite direction of the steel wheel hub and the swing bar; and the extension length is 150mm. Install an adjustable counterweight block on the two counterweight arms to balance the hammer head and the counterweight arm. Install an aluminum alloy pulley with a thickness of 12mm and a diameter of 150mm on one end of the steel wheel hub. Wrap a cable around the pulley. One end of the cable is fixed to the pulley and the other end is attached with a working hammer; the mass of the working hammer is about 0.55 kg.

The horizontal mounting plate for mounting the sample is supported by the steel frame; and the mounting plate can be adjusted up and down, so that the center of the collision surface of the hammer head hits the sample from the horizontal direction.

When using the test equipment, first adjust the positions of the sample and mounting plate according to Figure 4. After adjustment, fix the mounting plate on the steel frame; then take off the working hammer; and balance the pendulum mechanism by adjusting the counterweight block. After adjusting the balance, pull the swing bar to a horizontal position and attach a working hammer. When the pendulum mechanism is released, the working hammer rotates the hammer head by 270° to hit the sample.

During the test, the sample shall not emit an alarm signal or an unrecoverable fault signal; after the test, the sample response threshold ratio of $S_{\max} : S_{\min}$ shall be no greater than 1.3.

4.24.4 Test equipment

The test equipment shall meet the relevant provisions of GB/T 17626.5-1999.

4.25 Fire sensitivity test

4.25.1 Purpose

Check the response performance of the detector under test fire conditions.

4.25.2 Test method

4.25.2.1 Fix the four samples in parallel at a height of $1.5\text{m} \pm 0.1\text{m}$, and isolated from the test fire; switch on the control and indicating equipment to make them under normal monitoring state.

Ignite the test fire, after a period of stable radiation, remove the spacer and start timing.

The distance between the sample and the test fire center, during the test, is 12m, 17m and 25m, respectively.

4.25.2.2 N-heptane fire

- a) Fuel: N-heptane (analytical reagent grade), add 3% (V / V) toluene;
- b) Mass: 650g;
- c) Arrangement: Place the fuel in a container made of 2mm-thick steel plate, with a bottom size of 33 cm × 33 cm and a height of 5 cm.
- d) Ignition method: flame or electric spark.

4.25.2.3 Open flame of ethanol

- a) Fuel: Industrial ethanol (ethanol content above 90%, with a small amount of methanol);
- b) Mass: 2000g;
- c) Arrangement: Place the fuel in a container made of 2-mm thick steel plate, with a bottom size of 33 cm × 33 cm and a height of 5 cm;
- d) Ignition method: flame or electric spark.

4.25.3 Requirements

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