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**GA**

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**Super fine powder fire extinguishing agent**

**超细干粉灭火剂**

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# Super fine powder fire extinguishing agent

## 1 Scope

This standard specifies the definition, classification, requirements, test methods, inspection rules, labeling, packaging, transportation, and storage of super fine powder fire extinguishing agents.

This standard applies to BC super fine powder fire extinguishing agent and ABC super fine powder fire extinguishing agent.

## 2 Normative references

The provisions in the 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 to this standard.

GB/T 3864-1996 Industrial nitrogen

GB 4066(all parts) Powder extinguishing agent

GB 4351 General specifications for portable fire extinguishers (neq ISO 7165:1995)

GB/T 4509-1998 Bitumen - Determination of penetration (eqv ASTM D5-95)

SH 0004-1990 Solvent oil for the rubber industry

## 3 Terms and definitions

The terms and definitions defined in GB 4066 (all parts) and the followings apply to this standard.

### 3.1 90% grain diameter

The mass percentage of particles that is less than or equal to a certain particle size is 90%, then this particle size is called 90% grain diameter.

### 3.2 super fine powder fire extinguishing agent

- a) Balance: the sense quantity shall be 0.2 g;
- b) Stoppered measuring cylinder: the measurement range shall be 250 mL, and the division value shall be 2.5 mL;
- c) Stopwatch: the division value shall be 0.1 s.

### 6.1.2 Test procedure

**6.1.2.1** Weigh 35 g of super fine powder fire extinguishing agent sample, accurate to 0.2 g, and place it in a stoppered measuring cylinder.

**6.1.2.2** Turn the measuring cylinder upside down for 10 cycles at a rate of 2 s per cycle.

**6.1.2.3** After letting the stoppered cylinder stand vertically to the horizontal plane for 3 min, record the volume of the sample.

### 6.1.3 Test results

The bulk density is calculated according to formula (1), and the average value of the two test results with a difference not exceeding 0.04 g/mL is taken as the measurement result:

$$D_b = m_0/V \quad \dots\dots\dots(1)$$

where:

$D_b$  -- bulk density, the unit is gram/milliliter (g/mL);

$m_0$  -- the mass of the super fine powder fire extinguishing agent sample, in grams (g);

$V$  -- the volume occupied by the super fine powder fire extinguishing agent sample, in milliliter (mL).

## 6.2 Moisture content

### 6.2.1 Instruments

- a) Balance: the sense quantity shall be 0.2 mg;
- b) Weighing bottle:  $\Phi 50$  mm $\times$ 30 mm;
- c) Desiccator:  $\Phi 220$  mm;
- d) Vacuum drying oven: the precision shall be  $\pm 2$  °C,  $\pm 0.002$  MPa.

## 6.2.2 Test procedure

6.2.2.1 In the weighing bottle with constant weight, weigh 2 g of super fine powder fire extinguishing agent sample, accurate to 0.2 mg.

6.2.2.2 Place the weighing bottle without the cap in a vacuum drying oven at a temperature of  $(50 \pm 2)$  °C and a vacuum degree of  $(0.095-0.096)$  MPa for 1 h.

6.2.2.3 Take out the weighing bottle, put the cap on it and place it in a desiccator, let it stand for 15 minutes, and then weigh it with an accuracy of 0.2 mg.

## 6.2.3 Test results

Moisture content  $x_1$  is calculated according to formula (2), and the average value of the two test results with a difference not exceeding 0.02% is taken as the measurement result:

$$x_1 = (m_1 - m_2) / m_1 \times 100\% \quad \dots\dots\dots ( 2 )$$

where:

$m_1$  -- the mass of the super fine powder fire extinguishing agent sample before drying, in grams (g);

$m_2$  -- the mass of the super fine powder fire extinguishing agent sample after drying, in grams (g).

## 6.3 Moisture absorption rate

### 6.3.1 Reagents, instruments, and equipment

- a) Ammonium chloride: chemically pure;
- b) Balance: the sense quantity shall be 0.2 mg;
- c) Weighing bottle:  $\Phi 50$  mm $\times$ 30 mm;
- d) Desiccator:  $\Phi 220$  mm;
- e) Constant temperature and humidity system: a saturated ammonium chloride constant humidity system (used in arbitration inspection) or temperature and humidity regulator; see Figure 1 for the saturated ammonium chloride constant humidity system; the air (humidity is 78%) flowing through the humidistat is controlled at 5 L/min, and the lower part of the humidistat is filled with saturated ammonium chloride solution.

moisture absorption, in grams (g).

## **6.4 Water repellency**

### **6.4.1 Reagents and instruments**

- a) Sodium chloride: chemically pure;
- b) Petri dish:  $\Phi 70$  mm;
- c) Pipette: 0.5 mL;
- d) Desiccator:  $\Phi 220$  mm.

### **6.4.2 Test procedure**

**6.4.2.1** Put an excessive amount of super fine powder fire extinguishing agent sample in the petri dish, and make the surface flat with a scraper.

**6.4.2.2** Use a pipette to drop 0.3 mL of distilled water at three different points on the surface of the fire extinguishing agent.

**6.4.2.3** Place the petri dish in a desiccator with a temperature of  $(20\pm 5)$  °C and filled with saturated sodium chloride solution (relative humidity 75%) for 1 h.

**6.4.2.4** Take out the petri dish and tilt it gradually to make the water droplets roll down.

### **6.4.3 Test results**

Observe the super fine powder fire extinguishing agent sample for obvious water absorption and caking phenomenon.

## **6.5 Caking resistance (penetration)**

### **6.5.1 Reagents, instruments, and equipment**

- a) Ammonium chloride: chemically pure;
- b) Constant temperature and humidity system: according to the provisions in e) of 6.3.1;
- c) Electrothermal constant temperature drying oven: the precision shall be  $\pm 2$  °C;
- d) Penetrometer (according to the provisions of GB/T 4509-1998): the precision shall be 0.1 mm, and the sum of the mass of the standard needle and the needle shaft shall be  $(50.00\pm 0.05)$  g;
- e) Beaker: 100 mL;

- f) Stopwatch: the division value shall be 0.1 s;
- g) Vibration screen machine: the swing frequency shall be (4.58~4.92) Hz, the vibration frequency shall be (0.52~0.55) Hz, and the vibration height shall be 4.0 mm.

### **6.5.2 Test procedure**

**6.5.2.1** In a dry and clean beaker, fill the super fine powder fire extinguishing agent sample, and make the surface flat with a scraper.

**6.5.2.2** Place the beaker on the vibration screen machine, clamp it with a clamp, and vibrate for 5 minutes; remove the beaker, and humidify it at a temperature of (21±3) °C and relative humidity of 78% for 24 hours; then, move it into an electrothermal constant temperature drying oven at a temperature of (48±2) °C and dry for 24 hours.

**6.5.2.3** Determination of penetration: When measuring, the needle tip shall be close to the surface of the sample, and the distance between the needle penetration points, and between the needle penetration points and the cup wall shall not be less than 10 mm. After the needle freely falls into the sample for 5 seconds, record the depth (in mm) of the needle inserted into the sample, and measure three needle penetration points for the sample in each beaker.

### **6.5.3 Test results**

Take the average value of the results of three tests (nine needle penetration points in total) as the measurement result.

## **6.6 Low-temperature resistance**

### **6.6.1 Instruments and equipment**

- a) Low-temperature tester: the precision shall be ±2 °C;
- b) Test tube:  $\varnothing 20$  mm×150 mm;
- c) Balance: the sense quantity shall be 0.2 g;
- d) Stopwatch: the division value shall be 0.1 s.

### **6.6.2 Test procedure**

**6.6.2.1** Weigh 8 g of super fine powder fire extinguishing agent sample, accurate to 0.2 g, and place it in a dry and clean test tube.

**6.6.2.2** After corking the test tube, put it in the -55 °C environment for 1 h.

Before the fire extinguishing test, fix the electrodes in the test room at a distance of 50 mm from the bottom and not more than 1 m from the fire model. After spraying, adjust the transformer to apply a voltage of 4 kV to the electrodes for 5 minutes.

### 6.8.3 Test results

Apply a voltage of 4 kV and keep for 5 min to record whether there is a breakdown.

## 6.9 Extinguishing effectiveness to Class B and C fires

### 6.9.1 Test conditions

#### 6.9.1.1 Fire extinguishing test room

- a) The net volume of the test room shall not be less than 100 m<sup>3</sup>, its length and width shall not be less than 4 m, and the height  $H$  shall be 3.7 m $\pm$ 0.2 m;
- b) Before each test, the temperature of each temperature measuring point in the test room shall be 15 °C~35 °C. The fire extinguishing process should be observed with an infrared camera.

#### 6.9.1.2 Test instruments and materials

- a) Oxygen concentration meter: the precision shall be  $\pm$ 0.1%. The instrument shall be capable of continuously monitoring and recording the oxygen concentration in the enclosure throughout the test. The height of M1 from the ground shall be equal to the height of the fire model, and the horizontal distance from the fire model shall be 600 mm to 1000 mm. M2 shall be located above M1, perpendicular to M1, with a height of 0.9  $H$ . M3 shall be located below M1, perpendicular to M1, with a height of 0.1  $H$  (see Figure 2);
- b) Temperature measuring device: K-type thermocouple with a diameter of 1 mm. M4 shall be located 100 mm above the center of the fire model, and M5 shall be located 50 mm above the four fuel tanks (See Figure 2);
- c) Pressure transmitter: the precision shall be 0.5 grade; it shall be able to continuously monitor and display the outlet pressure of the nozzle;
- d) Fuel tray (fire model): a square steel tray with an area of 0.25 m<sup>2</sup> $\pm$ 0.02 m<sup>2</sup>, a height of 120 mm, a wall thickness of 6 mm; 12.5 L of fuel is added to the tray, and the fuel surface is at least 50 mm away from the upper edge of the tray. The bottom of the fuel tray shall be 600 mm from the ground, and it can be placed anywhere in the room where the fire extinguishing agent will not directly spray;
- e) Fuel tanks: four steel circular test tanks. The diameter shall be 80 mm $\pm$ 5 mm, the height shall not be less than 100 mm, and the wall thickness shall not be



- c) Pipeline: it shall be made of DN40 seamless steel pipe;
- d) Nozzle: The nozzle diameter shall be 10 mm.

#### **6.9.1.4 Installation of fire extinguishing devices**

The fire extinguishing agent storage tank and nitrogen cylinder are placed outside the wall of the test room, and the nozzle is placed in the center of the top of the test room, 300 mm from the top, and sprays downward. The fire extinguishing agent storage tank and the nozzle are connected by pipelines.

#### **6.9.2 Test procedure**

**6.9.2.1** Put the super fine powder fire extinguishing agent at  $-20\text{ }^{\circ}\text{C}\pm 2\text{ }^{\circ}\text{C}$  for 24 h, then immediately move it to an environment of  $50\text{ }^{\circ}\text{C}\pm 2\text{ }^{\circ}\text{C}$  for 24 h; then, take it out and place it at room temperature for at least 2 h.

**6.9.2.2** Weigh the super fine powder fire extinguishing agent treated as steps in 6.9.2.1 according to the amount of fire extinguishing agent provided by the manufacturer, and put it into the fire extinguishing agent storage tank.

**6.9.2.3** Fill the fuel tray and fuel tanks with fuel according to regulations, first ignite the four fuel tanks, then ignite the fuel tray; the pre-combustion shall be 30 seconds.

**6.9.2.4** Close the door of the test room (at this time, the oxygen concentration in the room shall not be lower than the oxygen concentration in the normal atmosphere by exceeding 0.5%), and start the fire extinguishing device. During the process of spraying, the pressure regulating valve of the steel cylinder shall be adjusted to keep the outlet pressure of the nozzle at  $0.50\text{ MPa}\pm 0.05\text{ MPa}$ . Close the nitrogen cylinder after the release of the extinguishing agent stops.

#### **6.9.3 Test results**

If the flame is completely extinguished within 30 seconds after the release of the fire extinguishing agent stops, and there is residual fuel in the fuel tray and fuel tanks, then the test for extinguishing a Class B fire is successful.

**NOTE:** If the super fine powder fire extinguishing agent has the fire extinguishing effectiveness to class B fires, it is considered to have the fire extinguishing effectiveness to class C fires.

### **6.10 Extinguishing effectiveness to Class A fires**

#### **6.10.1 Wood crib fire**

##### **6.10.1.1 Fire extinguishing test room**

It is the same as 6.9.1.1.

combustion. The wood crib is located on the metal support 600 mm above the ground and can be placed in any place in the room that is not directly sprayed by the fire extinguishing agent.

**6.10.1.5.5** When the pre-combustion reaches 6 minutes, close the door of the room (at this time, the oxygen concentration in the room shall not be lower than the oxygen concentration in the normal atmosphere by exceeding 0.5%) and start the fire extinguishing device. During the process of spraying, the pressure regulating valve of the steel cylinder shall be adjusted to keep the outlet pressure of the nozzle at  $0.50 \text{ MPa} \pm 0.05 \text{ MPa}$ .

**6.10.1.5.6** After the release of the fire extinguishing agent stops, close the nitrogen cylinder, keep the room sealed for 10 minutes, and then remove the wood crib.

#### **6.10.1.6 Test results**

Extinguish the open fire within 60 seconds after the release of the fire extinguishing agent stops; keep the room sealed for 10 minutes, then remove the wood crib, and continue to observe it for 3 minutes. If the wood crib does not re-burn, the fire extinguishing test is successful.

### **6.10.2 Polypropylene fire**

#### **6.10.2.1 Fire extinguishing test room**

It is the same as 6.9.1.1.

#### **6.10.2.2 Test instruments and materials**

- a) Oxygen concentration meter: it is the same as 6.9.1.2 a);
- b) Temperature measuring device: it is the same as 6.9.1.2 b);
- c) Pressure transmitter: it is the same as 6.9.1.2 c);
- d) Polypropylene fuel sheet (fire model): The fire model consists of four polypropylene fuel sheets (white, density:  $905 \text{ kg/m}^3$ ) fixed vertically on a fixed frame; each piece has a length of  $(405 \pm 5) \text{ mm}$ , a width of  $(200 \pm 5) \text{ mm}$ , and a thickness of  $(9.0 \pm 0.5) \text{ mm}$ ; see Figure 3 for the distance between each piece. The bottom of the fuel sheet is 203 mm from the ground. The fuel sheet shall be mechanically fixed with the fixed frame so that it cannot bend during the test;
- e) Fuel tray: with a length of 112 mm, a width of 51 mm, a height of 21 mm, and a thickness of 2 mm, it is located directly under the polypropylene fuel sheet, and the 51 mm side of the fuel tray is parallel to the 200 mm side of the

#### **6.10.2.4 Installation of fire extinguishing devices**

It is the same as 6.9.1.4.

#### **6.10.2.5 Test procedure**

**6.10.2.5.1** It is the same as 6.9.2.1.

**6.10.2.5.2** It is the same as 6.9.2.2.

**6.10.2.5.3** Add 40 mL of water to the fuel tray, and then add 6 mL of fuel. Ignite the fuel, ignite the polypropylene fuel sheet, and pre-burn for 210 s.

**6.10.2.5.4** When the pre-combustion reaches 210 s, close the door of the room (at this time, the oxygen concentration in the room shall not be lower than the oxygen concentration in the normal atmosphere by exceeding 0.5%) and start the fire extinguishing device. During the process of spraying, the pressure regulating valve of the steel cylinder shall be adjusted to keep the outlet pressure of the nozzle at 0.50 MPa±0.05 MPa.

**6.10.2.5.5** After the release of the fire extinguishing agent stops, close the nitrogen cylinder, keep the room sealed for 10 minutes, and then open the door for observation.

#### **6.10.2.6 Test results**

If the flame is completely extinguished within 180 seconds after the release of the fire extinguishing agent stops, and the polypropylene fuel sheet does not re-burn after the door is opened, the extinguishing test for the polypropylene fire is successful.

## **7 Inspection rules**

### **7.1 Inspection classification and items**

#### **7.1.1 Factory inspection**

The bulk density, moisture content, moisture absorption rate, water repellency, 90% grain diameter, and anti-caking property (penetration) of this standard are the factory inspection items.

#### **7.1.2 Type inspection**

All the inspection items in Table 1 of this standard are type inspection items. In case of any of the following situations, type inspection shall be carried out.

- a) When a new product is evaluated or an old product is transferred to another factory for production;

- b) When there are major changes in raw materials and processes during formal production;
- c) Periodic inspection every 3 years during formal production;
- d) When the production is resumed after suspension of production for more than one year;
- e) When the national quality supervision agency proposes a type inspection requirement.

## **7.2 Group and batch**

A batch is a homogeneous substance made by feeding the processing equipment at one time.

A group refers to products produced with the same raw materials and processes under the same environmental conditions, including one or more batches.

## **7.3 Sampling**

**7.3.1** Samples for type inspection shall be taken from products that have passed the factory inspection. The products shall be mixed evenly before sampling, and the samples shall also be mixed evenly before inspection for each item.

**7.3.2** For sampling according to "group" and "batch", no less than 40 kg samples shall be randomly taken. The samples taken must be stored in clean, dry, and sealed special containers.

## **7.4 Judgment of test results**

The inspection results of the factory inspection and type inspection items shall meet the technical requirements specified in Table 1 of this standard. If any item does not meet the requirements of this standard, the product shall be judged as unqualified.

# **8 Labeling, packaging, transportation, and storage**

## **8.1 Labeling**

Each package shall clearly and firmly indicate the manufacturer's name, address, product name, trademark, standard number, production date or production batch number, the mark of conformity, quality and applicable fire class, and simple storage requirements, etc.

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