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Test methods for building waterproofing coatings

建筑防水涂料试验方法

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Test methods for building waterproofing coatings

1 Scope

This document specifies the standard test conditions, coating film preparation, solid content, heat resistance, bond strength, bond strength of wet substrate, tensile properties, tear strength, aging at constant elongation, heating expansion rate of architectural waterproof coatings, low temperature flexibility, impermeability, drying time and other performance test methods.

This Standard applies to building waterproof coatings.

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 328.10-2007, *Test methods for building sheets for waterproofing - Part 10: Bitumen, plastic and rubber sheets for waterproofing - Water tightness*

GB/T 528, *Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties* (GB/T 528-1998, ISO 37:1994 eqv)

GB/T 529-1999, *Rubber, vulcanized or thermoplastic - Determination of tear strength (Trouser, angle and crescent test pieces)* (ISO 34-1:1994 eqv)

GB/T 18244, *Test methods for weathering resistance of building waterproof materials*

3 Standard test conditions

Laboratory standard test conditions: temperature is $(23\pm 2)^{\circ}\text{C}$; relative humidity is $(50\pm 10)\%$.

Strict conditions: temperature is $(23\pm 2)^{\circ}\text{C}$; relative humidity is $(50\pm 5)\%$.

6.2 Test steps

After stirring the sample evenly, apply the sample in 2~3 times according to the requirements of the manufacturer (the interval between each time shall not exceed 24h) on the cleaned aluminum plate. The coating area is 100mm×50mm. The total thickness is 1.5mm. Scrape the surface one last time. Carry out maintenance according to the conditions in Table 1. Demolding is not required. Then hang the aluminum plate vertically in an electric blast drying oven that has been adjusted to the specified temperature. The distance between the test piece and the wall of the drying box is not less than 50mm. The center of the test piece shall be at the same position as the probe of the thermometer. After standing at the specified temperature for 5h, take it out. Observe surface phenomena. Test 3 test pieces in total.

6.3 Result evaluation

After the test, all test pieces shall not flow, slide, or drip. There are no dense bubbles on the surface of the test piece.

6.4 Test report

The test report shall contain the following information:

- a) Chapter numbers of this Standard;
- b) Determination of all necessary details of the test product;
- c) Information about preparation of test piece;
- d) Test temperature and time;
- e) Test results;
- f) Differences in methods used or abnormalities encountered during the test;
- g) Test date.

7 Bond strength

7.1 Method A

7.1.1 Test apparatus

7.1.1.1 Tensile testing machine: the measured value is between (15-85)% of the range; the indication accuracy is not less than 1%; the tensile speed is (5±1)mm/min.

7.1.1.2 Electric blast oven: temperature control accuracy is ±2°C.

7.1.1.3 Special metal clamps for stretching: upper clamps, lower clamps and backing

the prepared coating to the section of the mortar block. Conduct butt joint of the cross sections of the two mortar blocks. Press them tightly. The thickness of the coating between the mortar blocks shall not exceed 0.5mm. Place under standard test conditions for 4h. Cure the prepared test pieces. The condition is at the temperature of $(20\pm 1)^{\circ}\text{C}$. The relative humidity is not less than 90%. Cure for 168h. Prepare five test pieces.

Place the cured test pieces under standard test conditions for 2h. Install the test piece on the testing machine. Keep the center line of the vertical direction of the test piece surface and the center of the fixture of the testing machine on the same line. Stretch at a speed of $(5\pm 1)\text{mm/min}$ until the test piece fails. Record the maximum tensile force of the test piece. The test temperature is $(23\pm 2)^{\circ}\text{C}$.

Result calculation and test report are according to Chapter 7.

9 Tensile properties

9.1 Test apparatus

9.1.1 Tensile testing machine: the measured value is between (15~85)% of the measuring range; the indication accuracy is not less than 1%; the elongation range is greater than 500mm.

9.1.2 Electric blast drying oven: temperature control accuracy is $\pm 2^{\circ}\text{C}$.

9.1.3 Punching machine and dumbbell type I cutter that meets the requirements of GB/T 528.

9.1.4 Ultraviolet box: 500W straight tube mercury lamp. The lamp tube is parallel to the bottom of the box. The distance from the surface of the test piece is (47~50)cm.

9.1.5 Thickness gauge: the contact surface diameter is 6mm; the pressure per unit area is 0.02MPa; the division value is 0.01mm.

9.1.6 Xenon arc lamp aging test chamber: a xenon arc lamp aging test chamber that meets the requirements of GB/T 18244.

9.2 Test steps

9.2.1 Untreated tensile properties

According to the requirements of Table 2, cut out the coating film into the dumbbell type I test piece that meets the requirements of GB/T 528. Draw parallel marking lines at a distance of 25mm. Use a thickness gauge to measure the thickness of three points in the middle and both ends of the marked line of the test piece. Take its arithmetic mean value as the thickness of the test piece. Adjust the distance between the clamps of the tensile testing machine to about 70mm. Clamp the test piece on the testing machine.

GB/T 528. Carry out the tensile test according to 9.2.1.

For water-based coatings, after soaking, take them out and wipe them dry. Then place them in an electric blast oven at $(60 \pm 2)^{\circ}\text{C}$ for $6\text{h} \pm 15\text{min}$. Take out and place under standard test conditions for $(18 \pm 2)\text{h}$. Cut out the dumbbell type I test piece that meets the requirements of GB/T 528. Carry out the tensile test according to 9.2.1.

9.2.5 Tensile properties after UV treatment

Place six ($120 \times 25\text{mm}$ rectangular test pieces) cut according to Table 2 flat on the glazed tile. To prevent sticking, talcum powder can be sprinkled on the surface of the glazed tile. Put the test piece into the UV box. The temperature of the space about 50mm away from the surface of the test piece is $(45 \pm 2)^{\circ}\text{C}$. Conduct constant temperature irradiation for 240h. Take out and place under standard test conditions for 4h. Cut out the dumbbell type I test piece that meets the requirements of GB/T 528. Carry out the tensile test according to 9.2.1.

9.2.6 Tensile properties of artificially weathered materials

Place six ($120 \times 25\text{mm}$) rectangular specimens cut according to Table 2 in a xenon arc lamp aging test chamber that meets the requirements of GB/T 18244. Take out after the cumulative irradiation energy of the test is 1500 MJ/m^2 (about 720h). Wipe dry. Place under standard test conditions for 4h. Cut out dumbbell type I test pieces that meet the requirements of GB/T 528. Carry out the tensile test according to 9.2.1.

For water-based coating, take out and wipe dry. Then place in an electric blast oven at $(60 \pm 2)^{\circ}\text{C}$ for $6\text{h} \pm 15\text{min}$. Take out and place under standard test conditions for $(18 \pm 2)\text{h}$. Cut out the dumbbell type I test piece that meets the requirements of GB/T 528. Carry out the tensile test according to 9.2.1.

9.3 Result calculation

9.3.1 Tensile strength

The tensile strength of the test piece is calculated according to formula (3):

$$T_L = P / (B \times D) \quad \dots\dots\dots (3)$$

Where,

T_L - The tensile strength, in megapascals (MPa);

P - The maximum pulling force, in Newtons (N);

B - The width of the middle part of the test piece, in millimeters (mm);

D - The thickness of the test piece, in millimeters (mm).

- e) Tensile speed;
- f) Test results;
- g) Differences in methods used or abnormalities encountered during the test;
- h) Test date.

10 Tear strength

10.1 Test apparatus

10.1.1 Tensile testing machine: the measured value is between (15~85)% of the measuring range; the indication accuracy is not less than 1%; the elongation range is greater than 500mm.

10.1.2 Electric blast drying oven: temperature control accuracy is $\pm 2^{\circ}\text{C}$.

10.1.3 Punching machine and right-angle tearing cutter that meets the requirements in 5.1.2 of GB/T 529-1999.

10.1.4 Thickness gauge: the contact surface diameter is 6mm; the pressure per unit area is 0.02MPa; the division value is 0.01mm.

10.2 Test steps

Cut the coating film, according to the requirements in Table 2, into right-angle tear test pieces without a cut that meet the requirements of GB/T 529-1999. Use a thickness gauge to measure the thickness of three points in the right-angle tear area of the test piece. Take the arithmetic mean value as the thickness of the test piece. Clamp the test piece on the testing machine. Keep the centerline of the length direction of the test piece on the same line as the center of the fixture of the testing machine. Stretch to break according to the tensile speed in Table 4. Record the maximum load when the test piece breaks (P). Test five test pieces.

10.3 Result calculation

The tear strength of the test piece is calculated according to formula (6):

$$T_s = P/d \quad \dots\dots\dots (6)$$

Where,

T_s - The tear strength, in kilonewtons per meter (kN/m);

P - The maximum pulling force, in Newtons (N);

d - The thickness of the test piece, in millimeters (mm).

Take the arithmetic mean value of five test pieces as the test result. The result is accurate to 0.1kN/m.

10.4 Test report

The test report shall contain the following information:

- a) Chapter numbers of this Standard;
- b) Determination of all necessary details of the test product;
- c) Information about preparation of test piece;
- d) Tensile speed;
- e) Test results;
- f) Differences in methods used or abnormalities encountered during the test;
- g) Test date.

11 Aging at elongation

11.1 Test apparatus

11.1.1 Electric blast drying oven: temperature control accuracy is $\pm 2^{\circ}\text{C}$.

11.1.2 Xenon arc lamp aging test chamber: a xenon arc lamp aging test chamber that meets the requirements of GB/T 18244.

11.1.3 Punching machine and dumbbell type I cutter that meets the requirements of GB/T 528.

11.1.4 Constant extension retainer: it can stretch the distance between marking lines by more than 100%.

11.2 Test steps

11.2.1 Heat aging

Cut the coating film, according to the requirements in Table 2, into dumbbell type I test pieces that meet the requirements of GB/T 528. Draw parallel marking lines at a distance of 25mm. Stretch the distance between the marking lines of the test piece from 25mm to 50mm. Place for 24hs under standard test conditions. Then put the constant

13 Low temperature flexibility

13.1 Test apparatus

13.1.1 Low-temperature freezer: temperature control accuracy is $\pm 2^{\circ}\text{C}$.

13.1.2 Round bar or bent plate: diameter is 10mm, 20mm, 30mm.

13.2 Test steps

13.2.1 Without treatment

Cut the coating film, according to the requirements in Table 2, into three (100×25)mm test pieces for testing. Put the test piece and the bent plate or round bar into the freezing liquid of the low temperature freezer that has been adjusted to the specified temperature. The thermometer probe shall be at the same level as the test piece. Keep at the specified temperature for 1h. Then the test piece is bent 180° around a round rod or a bent plate in 3s in the freezing liquid. Bend three test pieces (without distinction between upper and lower surfaces). Immediately take out the test pieces. Observe with the naked eye whether there are cracks or breaks on the surface of the test piece.

13.2.2 Heat treatment

Cut the coating film, according to the requirements in Table 2, into three (100×25)mm rectangular test pieces. Place them on the isolation material. Put them horizontally into an electric blast oven that has reached the specified temperature. The heating temperature for bituminous coatings is $(70\pm 2)^{\circ}\text{C}$. The heating temperature for other coatings is $(80\pm 2)^{\circ}\text{C}$. The distance between the test piece and the box wall shall not be less than 50mm. The test piece shall be at the same level as the probe of the thermometer. Keep the constant temperature $(168\pm 1)\text{h}$ in the electric blast oven at the specified temperature and take out. Then place under standard test conditions for 4h. Test according to 13.2.1.

13.2.3 Alkali treatment

At $(23\pm 2)^{\circ}\text{C}$, in 0.1% chemically pure NaOH solution, add $\text{Ca}(\text{OH})_2$ reagent, and reach supersaturated state.

Put three (100×25)mm test pieces cut according to Table 2 into 400mL of this solution. The liquid level shall be more than 10mm above the surface of the test piece. After continuous soaking $(168\pm 1)\text{h}$, take out. Rinse well with water. Wipe dry. Place under standard test conditions for 4h. Test according to 13.2.1.

For water-based coating, soak, take out and wipe dry. Then place it in an electric blast oven at $(60\pm 2)^{\circ}\text{C}$ for $6\text{h}\pm 15\text{min}$. Take it out and place it under standard test conditions for $(18\pm 2)\text{h}$. Test according to 13.2.1.

13.2.4 Acid treatment

At $(23\pm 2)^{\circ}\text{C}$, in 400mL of 2% chemically pure H_2SO_4 solution, put in three $(100\times 25)\text{mm}$ test pieces cut according to Table 2. The liquid level shall be more than 10mm above the surface of the test piece. After continuous soaking $(168\pm 1)\text{h}$, take out. Rinse well with water. Wipe dry. Place under standard test conditions for 4h. Test according to 13.2.1.

For water-based coating, soak, take out and wipe dry. Then place it in an electric blast oven at $(60\pm 2)^{\circ}\text{C}$ for $6\text{h}\pm 15\text{min}$. Take it out and place it under standard test conditions for $(18\pm 2)\text{h}$. Test according to 13.2.1.

13.2.5 UV treatment

Place three $(100\times 25)\text{mm}$ test pieces cut according to Table 2 flat on the glazed tile. To prevent sticking, talcum powder can be sprinkled on the surface of the glazed tile. Put the test piece into the UV box. The temperature of the space about 50mm away from the surface of the test piece is $(45\pm 2)^{\circ}\text{C}$. Carry out constant temperature irradiation for 240h. Take out and place under standard test conditions for 4h. Test according to 13.2.1.

13.2.6 Artificial weathering treatment

Put three $(100\times 25)\text{mm}$ test pieces cut according to Table 2 in a xenon arc lamp aging test chamber that meets the requirements of GB/T 18244. After the cumulative irradiation energy of the test is $1500\text{ MJ}^2/\text{m}^2$ (about 720h), take out. Wipe dry. Place under standard test conditions for 4h. Test according to 13.2.1.

For water-based coating, soak, take out and wipe dry. Then place in an electric blast oven at $(60\pm 2)^{\circ}\text{C}$ for $6\text{h}\pm 15\text{min}$. Take out and place under standard test conditions for $(18\pm 2)\text{h}$. Test according to 13.2.1.

13.3 Evaluation of results

All test pieces shall be free of cracks.

13.4 Test report

The test report shall contain the following information:

- a) Chapter numbers of this Standard;
- b) Determination of all necessary details of the test product;
- c) Information about preparation of test piece;
- d) Test temperature and rod diameter;
- e) Test results;

- 1 - Measurement point;
- 2 - Test piece.

Figure 9 -- Schematic diagram of bender

The test report shall contain the following information:

- a) Chapter numbers of this Standard;
- b) Determination of all necessary details of the test product;
- c) Information about preparation of test piece;
- d) Test treatment conditions;
- e) Test temperature;
- f) Test results;
- g) Differences in methods used or abnormalities encountered during the test;
- h) Test date.

15 Impermeability

15.1 Test apparatus

15.1.1 Impermeable meter: meet the requirements in 5.2 of GB/T 328.10-2007.

15.1.2 Metal mesh: the hole diameter is 0.2mm.

15.2 Test steps

Place three (150×150)mm test pieces cut according to Table 2 for 2h under standard test conditions. The test is carried out at (23±5)°C. Fill the device with water until it is full. Thoroughly remove air from the device.

Place the test piece on the water-permeable tray. Then add a metal mesh of the same size on the test piece. Cover with a 7-well disc. Clamp slowly until the test piece is clamped on the disc. Dry the non-facing surface of the test piece with a cloth or compressed air. Slowly increase the pressure to the specified pressure.

After reaching the specified pressure, keep the pressure for (30±2)min. During the test, observe the water permeability of the test piece (sudden drop in water pressure or water on the non-water facing surface of the test piece).

15.3 Evaluation of results

All test pieces shall be free from water penetration within the specified time.

15.4 Test report

The test report shall contain the following information:

- a) Chapter numbers of this Standard;
- b) Determination of all necessary details of the test product;
- c) Information about preparation of test piece;
- d) Test pressure;
- e) Test results;
- f) Differences in methods used or abnormalities encountered during the test;
- g) Test date.

16 Drying time

16.1 Test apparatus

16.1.1 Timer: the division is at least 1min.

16.1.2 Aluminum plate: specification is $[120 \times 50 \times (1 \sim 3)]$ mm.

16.1.3 Wire bar coater: 200 μ m.

16.2 Test steps

16.2.1 Surface drying time

Before the test, the aluminum plate, tools and coatings shall be placed under the standard test conditions for more than 24h.

Under standard test conditions, use a wire bar coater to coat the sample mixed and stirred according to the manufacturer's requirements on an aluminum plate to prepare a coating film. The coating area is (100×50)mm. Record the coating end time. For multi-component coatings record the time from mixing.

After standing for a while, wipe your fingers with absolute ethanol. Lightly touch the surface of the coating film with your finger within a range not less than 10mm from the edge of the test piece. If no coating adheres to the finger, it shall be dry. Record the time. The time from the start to the end of the test is the surface drying time.

16.2.2 Actual drying time

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