GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 91.120.30
Q 17

GB/T 18244-2000

Test Methods for Resistance to Weathering of Building Water Proofing Materials

建筑防水材料老化试验方法

Issued on: October 27, 2000 **Implemented on: May 1, 2001**

Issued by: State Bureau of Technical Supervision

Table of Contents

Foreword

This Standard was formulated on the basis of adopting international standards and advanced standards of other countries, combining national conditions, and according to the characteristics of building water proofing materials. Hot air aging non-equivalently adopts JIS K 7212:1995 "Plastics - Determination of Thermal Stability of Thermoplastics - Oven method"; ozone ageing non-equivalently adopts ISO 1431.1:1989 "Vulcanized or Thermoplastic Rubber-Resistance to Ozone- Part 1: Static Tensile Test "; artificial accelerated ageing non-equivalently adopts the relevant parts of ISO 4892:1994 "Plastics - Methods of Exposure to Laboratory Light Sources".

During formulation of this Standard, the size, quantity and sampling method of the samples are specified according to the characteristics of building water proofing materials and test requirements; the test conditions and procedure which are applicable to water proofing materials are recommended in the test methods; and the evaluation method is formulated.

Appendixes A, B, C and D of this Standard are normative; Appendixes E, F and G are informative.

This Standard was proposed by the State Bureau of Building Materials Industry.

This Standard shall be under the jurisdiction of the National Technical Committee on Constructional Materials and Decorative Materials of Standardization Administration of China.

Drafting organizations of this Standard: Standardization Research Institute of State Bureau of Building Materials Industry, and China Chemical Building Material Company Suzhou Waterproof Material Research and Design Institute.

Participating drafting organizations of this Standard: Panjin Yuwang Waterproof Building Material Group, Shaoxing County Wanli Rubber Factory, Changshu Sanheng Building Materials Co., Ltd., Beijing-Oakland Water Proof Building Materials Co., Ltd., Baoding Beifang Waterproofing Work Company, Shanghai Beicai Water Proof Material Co., Ltd., Wujin Waterproof Material Factory, and Liaoyang No.1 Rubber Factory.

Chief drafting staffs of this Standard: Zhu Zhiyua, Yang bin, Zhan Fumin, Meng Yuezhen, Li Jiahao, Zhang Haoxiang, Li Xinquan, and Yu Zuiying.

This Standard is issued for the first time.

Test Methods for Resistance to Weathering of Building Water Proofing Materials

1 Scope

This Standard specifies the test methods for hot air aging, ozone aging and artificial weathering accelerated aging (xenon arc lamp, carbon lamp and UV fluorescence lamp).

This Standard is applicable to the comparison between the aging-resistant performance of pitch-based rolls and paints, high polymer rolls and paints used for building water proofing work. Other building water proofing materials may also adopt by reference.

2 Normative References

The following normative documents contain provisions which, through reference in this Standard, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All the standards will be revised and all parties who reach an agreement according to this Standard are encouraged to study whether the latest editions of the following standards are applicable.

GB 250-1995 Gray Scale for Assessing Change in Colour

GB 730-1998 Textiles-Tests for Colour Fastness - Blue wool Standards for Colour Fastness to Light and Weathering (eqv ISO 105-B:1994)

GB/T 3511-1983 Rubber Vulcanized - The Test Method of Resistance to Natural Weathering

GB/T 16777-1997 Test Methods for Building Waterproofing Coatings

3 General Requirements

3.1 Standard test conditions in laboratory

Temperature: 23°C±2°C;

Relative humidity: 45% ~ 70%.

3.2 Sample

Where,

W - Tensile property change rate, %;

P_1 - Arithmetic mean value of tensile property of aged specimen;

P_2 - Arithmetic mean value of tensile property of reference specimen.

Tensile property retention rate (X) shall be calculated according to Formula (2):

$$X=P_1/P_2 \times 100 \quad \ldots\ldots (2)$$

X - tensile property retention rate, %.

As for tensile property test result calculation, the arithmetic mean value of data in the same direction shall be taken.

3.3.2 Low temperature

Flexibility test method shall be in accordance with the method stated in product standard; the test temperature shall meet the product standard requirement or shall not be lower than the temperature at which the products do not crack.

Tensile property and low temperature flexibility test results treatment shall be carried out according to product standard.

3.4 Evaluation method

It shall be in accordance with product standard. If no requirement is stated in the product standard, it may be judged according to the appearance and tensile property changes as well as low temperature flexibility after aging test.

4 Hot Air Aging

4.1 Principle

Place test material in a test chamber to carry out heat and oxygen accelerated aging; evaluate the heat resisting air aging property of material according to the property changes before and after aging.

4.2 Test devices

4.2.1 Hot air aging test chamber

Test chamber shall meet the following requirements:

a) Working temperature: 40~200°C or higher;

b) Temperature fluctuation: ±1°C;

c) Temperature uniformity: temperature distribution shall meet the requirements of temperature deviation in 4.3, see Appendix A (Normative);

d) Average air speed: 0.5~1.0m/s, see Appendix B (Normative);

e) Ventilation rate: 10~100 times/h, see Appendix C (Normative) and Appendix E (Informative);

f) Work room: generally 0.1~0.3m^3 in volume, otter boards and rotating frames are set in the room.

4.2.2 Indicating thermometer

The scale interval of indicating thermometer is not larger than 1°C.

4.3 Test conditions

4.3.1 Test temperature

Test temperature shall be determined according to the material service requirements and test purposes. Generally, the temperature may be 70°C for pitch-based water proofing materials and 80°C for high polymer material; the allowable deviation of humidity within 50~100°C is ±1°C, and that within 101~200°C is ±1% of the test temperature.

4.3.2 Test period

Test period shall be determined according to material characteristics; generally, the test terminal time is a specified exposure time or the exposure time when property changes to a certain specified value; generally, 168h or longer may be adopted.

4.3.3 Ventilation rate

Ventilation rate may be chosen according to the characteristics and quantity of samples; the samples mutually affecting each other shall be carried out with aging test respectively; as for those cannot be confirmed that whether they mutually affecting each other but have to be tested at the same time, larger ventilation rate is preferred.

4.4 Test procedure

4.4.1 Prior to test, specimens shall be numbered and the size shall be measured.

4.4.2 Test chamber shall be adjusted to the specified temperature and ventilation volume according to test requirements. After stabilized, specimens may be put on otter board or rotating frame using suitable metal clip or metal wire lined or wrapped with inert material. The distance between specimen and internal wall of work room shall not less than 70mm, and the distance between specimens shall not be less than

10mm; the ratio of work room volume to specimen total volume shall not less than 5: 1.

As for small specimens requiring relatively high test accuracy, double-shaft rotating frame is recommended for testing.

Samples mutually affecting each other are not allowed to be tested in the same oven.

4.4.3 The aging time is started when specimens are put into thermostatic aging test chamber; take the specimens out rapidly and immediately when the specified aging time has come to reduce the temperature change as much as possible. In order to reduce the influence of non-uniform temperature, the specimen positions on the otter board or specimen holder may be changed periodically.

4.4.4 The samples taken out shall be placed under standard conditions for 24h and then be determined the properties according to the selected items for the test.

4.5 Test results

4.5.1 Property evaluation

One or several of the following properties which are the most suitable to material application and sensitive to change shall be selected:

a) Sample's appearance changes which are visually observed, such as local pulverization, cracking, spot, bubble and deformation

b) Mass (weight) change;

c) Changes of mechanical properties such as tensile strength, elongation at maximum tension, low temperature flexibility and tear strength;

d) Changes of other properties.

4.5.2 Test results shall be processed according to the requirements of relevant product standard.

4.6 Test report

The test report shall cover the following contents:

a) The name and code of this Standard;

b) Sample name, model, specification and preparation method;

c) Test chamber model, sample holder type and work room volume;

d) Test conditions: state adjustment of the sample, test temperature, time, average air speed, ventilation rate and rotational speed of rotating frame;

distance with the sample.

6.2.6.1 Black standard thermometer

If the black standard thermometer and the sample are radiated at the same position of the sample holder, the black standard temperature is similar to that of the deep-color sample of poor thermal conductivity. Such thermometer is made of plane stainless steel which is 70mm in length, 40mm in width and 1mm in thickness. A kind of age-proof black flat light coating is used on the panel surface orienting to the light source. The coated black panel absorbs at least 95% of the total incident flux within 2500 nm. Measure the panel temperature with platinum resistance sensor. The sensor is installed on the back-surface of the light source and in good thermal contact with the panel center. The metal plate is fixed by a fluted PVDF base of 5mm in thickness to make it only form a space in the sensor range. The distance between the sensor and PVDF panel flute is about 1mm. The length and width of PVDF plate must be sufficient to ensure that when black standard thermometer is installed on sample holder, no metallic contact ever exists between the metal plate and the sample holder. The metallic support on the specimen holder shall be at least 4mm away from the edge of the metal plate.

In order to measure the temperature range of the sample surface and to better control the irradiance and test conditions of the equipment, white standard thermometer is also recommended, besides the application of black standard thermometer. White standard thermometer is of the same design as the black standard thermometer, which uses age proof white coating instead of black flat light coating. The absorption of white coating reduces at least 90% than the black flat light coating within the range of 300~1000nm, and at least 60% within the range of 1000~2500nm.

6.2.6.2 Black panel thermometer

Black panel thermometer is still popular; but the black panel thermometer used by various models of equipment has developed much in design. The black panel thermometer uses non-adiabatic black metal plate base; this is the essential difference between the black panel thermometer and the black standard thermometer. Under the prescribed operation conditions, the temperature of the black panel thermometer is lower than that of the black standard thermometer in 6.2.6.1. One kind of black panel thermometer is made of plane stainless steel of 150mm in length, 70mm in width and 1mm in thickness. A layer of black flat light coating is used on the panel surface orienting to the light source. The coated black panel absorbs at least 90% of the total incident flux within 2500 nm. The temperature of the panel is measured by a blackened rod-shaped thermo-metal disc type sensor which is at the panel center and firmly connected with the light-facing face of the black panel. The black panel thermometers of different sizes, different sensor elements and different fixing modes of sensor element shall be stated in the reports. The installation form of black panel thermometer on the sample holder shall also be stated.

6.2.7 Program control device

The equipment shall be provided with device which controls the sample moist & non-moist time program, and radiation & non-radiation time program.

6.2.8 Radiation measuring instrument

The equipment may adopt, at its option, the methods measuring the irradiance E and exposure dose H on the sample surface.

The radiometer uses a photoelectric transducer to measure the irradiance and exposure dose. The photoelectric transducer must be such installed that the radiation it received is the same as that on sample surface. If the photoelectric transducer is not at the same position as the sample surface, a large enough observation range must be provided, and the transducer must be adjusted such that, under the irradiance, the sample surface will receive at the same distance.

The radiometer must be adjusted within the applied light source radiation area according to the manufacture's recommendations. One comprehensive adjustment shall be carried out at least once a year.

If irradiance is under measurement, the wavelength range agreed by concerned parties must be reported. Generally, the irradiance within a range of 300~400nm or 300~800nm is used. Some devices may also used to measure the irradiance of specific wavelength (e.g., 340nm).

Note: The same radiation measuring instrument is preferred when directly comparing the exposure dose of artificial weather accelerated aging and natural weather aging.

6.2.9 Indicating or recording device

In order to meet the requirements of specific test methods, the test chamber needs such device that indicates or records the following operation elements.

a) Supply voltage, lamp voltage and lamp current;

b) Air temperature of the test chamber, black standard temperature or black panel temperature;

c) Relative humidity of the test chamber, water spray or condensation period, quality of water;

d) Irradiance and exposure dose;

e) Exposure duration (exposure duration or total exposure duration).

In the test report, the measuring accuracy for the temperature and humidity of the test chamber shall be stated.

6.3 Test conditions

Black standard temperature: 65°C±3°C; relative humidity: 65%±5%. Water spray duration: 18 min±0.5 min; the drying interval between two water sprays: 102min±0.5min.

If sprinkling pipe is used, the specified temperature refers to the temperature of the last stage when water is not sprayed. If the thermometer could not reach equilibrium in a short circle, then the specified temperature shall be reached when water spray has not begun yet; moreover, the temperature reached in the drying cycle shall be noted in the report. If black panel thermometer is used, such items shall be indicated in the test report, which are thermometer model, installation mode on the sample holder and operating temperature.

6.4 Test procedure

6.4.1 Sample installation

Unless otherwise stated, the sample is, generally, installed at the sample holder freely and in a way that protecting the sample from the external stress. When the sample holder is fixed on the rotating drum of the test chamber, the exposure surface of the sample shall face the light source and the sample working area shall be thoroughly exposed in the effective light source range and at a position convenient for changing the sample.

On the sample holder parallel to the xenon lamp shaft, the irradiance variance of any two points on the sample surface shall not exceed 10%; or the position of the sample shall be changed regularly to make it receive same irradiance at any position.

6.4.2 Exposure test

Open the test chamber, adjust to the specified test conditions and record the exposure starting time. The specified test conditions shall be kept constant throughout the exposure duration.

Do not touch or hit the sample surface when putting in or taking out the sample.

6.4.3 Measurement of radiation quantity

Two ways are provided for the measurement of radiation quantity:

a) Continuous measurement: continuously measure the accumulative total radiation by integrating luxmeter.

b) Discontinuous measurement: measure the radiation quantity of certain exposure duration by radiometer and then calculate the total radiation quantity.

In measurement, fix the photoreceptor at a proper position to make the radiation value

it measures equivalent to that where the sample is placed.

Radiation quantity may also be measured by other substance standards.

6.4.4 Test period

The test limit shall be determined according to the product standards; it may be a specified exposure duration or radiation quantity, or the exposure duration or radiation quantity required for the property down to a specified value. Generally, it is 720h (accumulative radiant energy: 1500 MJ / m^2) or longer.

6.4.5 Property measurement

Take the samples from the test chamber according to the pre-determined test period to carry out measurement on each property.

6.4.5.1 Appearance inspection

Check the sample surface visually or by instrument to assess the color or other appearance changes after exposure. The appearance inspection method is detailed in GB/T 3511.

6.4.5.2 Other property tests

Specified in the product standard.

6.5 Test result

The result of test on the aging sample may be expressed by the appearance change degree or property change rate after the sample is exposed for a certain duration or under certain radiation quantity, and may also be expressed by the exposure duration or radiation quantity required for the sample property changing to a specified value.

6.5.1 The sample appearance change degrees are from Grade 0 ~ Grade 4, the grade assessment is detailed in 5.5.1.

6.5.2 The sample property change may be measured according to appearance, tensile property change rate, low temperature flexibility or those specified in the product standards.

6.6 Test report

The test report shall cover the following items:

a) Test objectives and requirements;

b) The name and code of this Standard;

c) The name, specification and amount of the sample;

phase is expressed by the incident light energy of a unit area (unit: J/m^2).

7.4.4 Performance measurement

Refer to the requirements of 6.4.5.

7.5 Test results

Refer to 6.5.

7.6 Test report

Refer to 6.6.

8 Artificial Weathering Test (Ultraviolet Fluorescence-Condensing)

8.1 Principles

Expose materials to the environment with aging action such as the ultraviolet light, temperature and condensed water. Detect the performance fluctuation of samples according to the given time and in this way to evaluate the weather resistance.

8.2 Testing apparatus

8.2.1 Test chamber

The test chamber work room shall be equipped with two rows of fluorescent lamps, 4 lamps in each row: it shall also be equipped with a hot water tank, specimen holder, panel thermometer, and devices which are used for controlling and indicating the work hour and temperature.

8.2.2 Fluorescent lamps

Fluorescent lamps are classified into five types: UV-A, UV-B, UV-C, UV-D and UV-E. The wavelength of each type of fluorescent lamps is different when the maximum peak radiation occurs. Unless otherwise specified, UV-A lamps are commonly used. The luminous energy output of fluorescent lamp is gradually reduced along with the service time. In order to minimize influence towards the test caused by luminous energy decrease, a new lamp shall replace the older on in each row when the using time of lamps exceed a quarter of its service life and the position change of the rest lamps is shown in Figure 4. The fluorescent lamp shall be changed in order and regularly, thus, the ultraviolet source will always be composed by new lamps and old lamps. In this way, a constant luminous energy output can be obtained.

The mutually concerted exposure hours or the exposure hours which is required by the mutually concerted minimum variable quantity and generated in the specimen are generally being selected of 720 hours or more.

8.4 Test procedure

8.4.1 Sample installation

Install the sample on the holder in a free state and the exposed surface of the sample shall be towards the lamp. When the samples can not fully fill the holder, blank sheets shall be used to fill up the vacancy in order to maintain a stable test condition in chamber. During the exposure period, the positions of samples which are located at the center and edges of the exposure zone shall be changed regularly in order to reduce uneven exposure.

8.4.2 Exposure test

Start the test chamber, adjust the specified test condition and start recording the exposure time. Throughout the exposure period, the specified test condition shall be maintained constant.

8.4.3 Determination of the ultraviolet light radiation quantity

8.4.3.1 Instrument measurement of the radiation quantity

Put the ultraviolet light integrating illuminometer or radiometer beside specimen holder regularly to directly determine its received ultraviolet light radiation quantity.

8.4.3.2 Determine the radiation quantity according to the blue wool standard

The method of determining the radiation quantity according to the blue wool standard shall be carried out in accordance with GB 730.

8.4.4 Performance measurement

Take out samples from the test chamber according to the specified exposure time or radiation quantity and determine the sample according to the requirements of product standard.

8.5 Test results

Refer to 6.5.

8.6 Test report

The test report shall cover the following items:

a) Test objectives and requirements;

b) The name of this Standard and code;

c) The name, specification and amount of the sample;

d) The model of test chamber and fluorescent UV lamp;

e) The exposure time, condensing exposure time and temperature of the ultraviolet light;

f) Testing time;

g) Testing items and results;

h) Testers or others.

Appendix A

(Normative)

Determination of the Temperature Uniformity of Air Aging Test Chamber

A1 Test instruments

a) DC digital voltmeter whose minimum resolution ratio shall not greater than 10μV and the actual upper bound accuracy shall not less than 0.5%;

b) Transfer switch whose ten points' thermal electromotive force is not greater than 1μV;

c) The thermocouple cold-side (0°C) attemperator;

d) Nine calibrated EA-2 chromel-copel thermocouples and the wire diameter is 0.5mm, the node dimension shall not greater than 2.5mm and it shall be exposed in the open air;

e) Thermometer whose scale division is 0.1°C;

f) Iron wire holder which is used to fix the thermocouple probe. The dimension of the iron wire holder is dependent on the chamber work room dimension. It shall guarantee that the thermocouple probe is about 20mm away from the iron holder.

A2 Determination position

The location distribution of the thermocouple work room is as follows: there are nine temperature measurement points; the first to eighth point respectively located at eight corners of the chamber; the distance from each point to the inner wall in 70mm. The ninth point in located in the geometrical center of the work room.

A3 Operation

A3.1 Put the thermocouple into the work room through the test chamber thermometer inserting hole or the chamber door and fix the thermocouple on the iron wire holder according to the requirements of A2. The length of each thermocouple lead wire in the working room shall not less than 30cm. Open the vent; start the air blower. There is no sample in the chamber.

Appendix C

(Normative)

Determination of the Ventilation Rate of the Air Aging Test Chamber

C1 Test instruments

a) Grade 0.5 reference kilo-watt-hour meter whose minimum division value is 36KJ (about 0.01kW·h);

b) A stopwatch;

c) A thermometer whose scale division is 1°C.

C2 Operation

C2.1 Use pressure-sensitive adhesive tape to seal all test chamber ventilating doors, holes, thermometer patch-holes, and the gaps through where the motor shaft extends into the test chamber (it should not affect the rotating of the motor shaft). Connect the reference kilo-watt-hour meter to the test chamber power system.

C2.2 Start the air blower; raise the chamber temperature to be 80°C±2°C higher than the room temperature. Keep this temperature for one hour or longer; measure the electric energy consumption for 30min continuously. The room temperature measuring point shall be at a position 2m away from the test chamber, at the same height with the chamber air inlet and at least 1m away from any other objects.

C2.3 Remove all sealing tapes; adjust the in-and-out valve to a certain setting position. Measure the electric energy consumption according to the method given in C2.2. If necessary, reset the position of in-and-out valves until the ventilation rate up to the selected scope. During the determination process, the variation of room temperature shall not exceed 2°C.

C2.4 The ventilation rate is calculated according to Formula (C1):

$$N = \frac{9.97 \times 10^{-4} (W_2 - W_1)}{V \cdot \rho (t_2 - t_1)} \quad \text{..... (C1)}$$

Where,

N - the ventilation rate, times/h;

W_2 - the average hourly electric energy consumption when the chamber is not

Appendix E

(Informative)

Table of Air Density

Temperature °C	Density kg/m^3	Temperature °C	Density kg/m^3	Temperature °C	Density kg/m^3
1	1.288	14	1.230	27	1.177
2	1.284	15	1.226	28	1.173
3	1.297	16	1.222	29	1.169
4	1.275	17	1.217	30	1.165
5	1.270	18	1.213	31	1.161
6	1.265	19	1.209	32	1.157
7	1.261	20	1.205	33	1.154
8	1.256	21	1.201	34	1.150
9	1.252	22	1.197	35	1.116
10	1.248	23	1.193	36	1.142
11	1.243	24	1.189	37	1.139
12	1.239	25	1.185	38	1.135
13	1.236	26	1.181	39	1.132

Appendix F

(Informative)

Filter of Carbon Arc Lamp

Model 1: Corex 7058 or its equivalent (ultraviolet glass);

Model 2: Pyrex 7740 or its equivalent (borosilicate glass);

Model 3: the heat-resistant glass.

Corex 7058 and Pyrex 7740 are commercially available products. Only after the carbon arc lamp light source is filtered, the experiment can be conducted. Model 1 is a glass filter which is typically matched by the majority carbon arc boxes. If filters of model 2 or 3 are needed, a relevant negotiation shall be conducted. When filters of model pass through the relative shortwave ultraviolet radiation which is absent in part of the sunlight, a degradation reaction which is unavailable in the atmospheric exposure might be caused to emerge; filters of model 2 can absorb the shortwave radiation which will usually not emerge in the sunlight; filters of model 3 imitate the light transmittance of window glass with thickness of 1.8~2.0mm. These three models of filters can not change the difference between carbon arc lamp spectrum and sunlight ultraviolet region effectively.

This is an excerpt of the PDF (Some pages are marked off intentionally)

------ The End ------