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Man-made Fiber - Test Method for Thermal Shrinkage of Filament Yarns (after treatment)

化学纤维 长丝热收缩率 试验方法（处理后）

[ISO 18066:2015, Textiles - Man-made Filament Yarns - Determination of Shrinkage in Boiling Water, MOD;
ISO 18067:2015, Textiles - Synthetic Filament Yarns - Determination of Shrinkage in Dry-hot Air (after treatment), MOD]

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Man-made Fiber - Test Method for Thermal Shrinkage of Filament Yarns (after treatment)

1 Scope

This Standard specifies test methods for boiling water shrinkage and dry-hot air shrinkage of man-made filament yarns (after treatment) -- stranded filament method and single filament method. The stranded filament method provides two modes: manual measurement and instrument measurement; manual measurement shall be used when there is a dispute.

This Standard is applicable to man-made fiber filament yarns with a linear density of less than 3,000 dtex.

This Standard is inapplicable to pre-oriented yarns.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 4146 (all parts) *Textiles - Man-made Fibers*

GB/T 6502 *Sampling Method of Man-made Filament Yarns*

GB/T 6682 *Water for Analytical Laboratory Use - Specification and Test Methods* (GB/T 6682-2008, ISO 3696:1987, MOD)

GB/T 9994 *Conventional Moisture Regains of Textile Materials*

GB/T 14343 *Testing Method for Linear Density of Man-made Filament Yarns*

FZ/T 50005 *Testing Method for Linear Density of Spandex Filament Yarns*

3 Terms and Definitions

The terms and definitions defined in GB/T 4146 (all parts) are applicable to this document.

4 Principle

Under specified conditions, use thermal medium (boiling water or dry-hot air) to treat the test specimen. Measure the length variation of the test specimen before and after the treatment; calculate its percentage to the original length of the test specimen. Thus, the thermal shrinkage rate can be obtained.

5 Devices and Materials

5.1 Filament yarn length measuring instrument, attached with:

a) A device that can adjust tension and a reciprocating filament-guiding device;

b) A device that can adjust the speed, so as to ensure that the tension fluctuation is within the allowable range;

c) Yarn frame, with a circumference of (1.000 ± 0.002) m;

d) A reel counting device.

5.2 Filament-stranding rack: a cylindrical frame mechanism; multiple test specimens can be placed at the same time.

Each test specimen has a 2.5 cN hook weight, with a height of at least 600 mm. There is respectively a row of hooks at the upper and lower ends. During the test, the stranded filament is hung between the upper and lower hooks. The upper hook is fixed; the lower hook is the 2.5 cN hook weight, which frictionlessly lifts and lowers along the metal wires on both sides.

5.3 Manual length measuring rack, attached with:

a) Vertical measuring scale: measuring range is 1 m; minimum division value is 1 mm. The upper end is equipped with clamps and hooks. The clamping surface of the clamp is flat; it shall not damage the filament or slip during the clamping. The hooks are made of steel wire with a diameter of 2 mm ~ 3 mm; the upper end of the outer circle of the steel wire at the yarn hanging position is parallel to the zero position of the measuring scale;

b) Device for applying pre-tension: the accuracy of applying pre-tension is ± 10%; tension device is a combination weight with a hook or a combination weight with a clamp.

5.4 Automatic length measuring instrument: it can automatically measure the length of the stranded filament before and after thermal treatment; calculate the thermal shrinkage rate and automatically adjust the tension. It is also equipped with a filament-

the upper limit of the laboratory's relative humidity;

---When the temperature of the sample is 5 °C lower than the laboratory temperature.

6.2.2 Standard atmosphere for conditioning and testing

For test specimens with a conventional moisture regain less than 4.5%: temperature (20 ± 2) °C, relative humidity (65 ± 5) %.

For test specimens with a conventional moisture regain greater than or equal to 4.5%: temperature (20 ± 2) °C, relative humidity (65 ± 3) %.

The conventional moisture regain of various fibers shall refer to GB/T 9994.

6.2.3 Conditions of boiling water treatment

6.2.3.1 Add Grade-3 water that complies with GB/T 6682 to the water tank. The amount of water shall ensure that the test specimen is completely immersed and kept away from the wall of the water tank.

6.2.3.2 The boiling time is (30 ± 5) min.

6.2.3.3 After boiling, the drying temperature is (55 ± 5) °C; the drying time is around 60 min.

NOTE: since the boiling point of water depends on the atmospheric pressure at the measuring point, variation in atmospheric pressure may cause changes in the result of the boiling water shrinkage.

6.2.4 Conditions of dry-hot air treatment

In accordance with different types of fibers, different hot air temperatures and thermal treatment times shall be adopted. The recommended conditions of hot air temperature and thermal treatment time are shown in Table 1. For filaments that are not applicable, the hot air temperature and thermal treatment time may be determined through negotiation.

When manual measurement is chosen, the test specimen may also be placed in a mesh bag or be wrapped with gauze in accordance with Appendix E.

7.1.1.2 Preparation and treatment of test specimen

7.1.1.2.1 Withdraw the surface filaments from the reel. Insert the reel on a bobbin frame; draw out the filament end.

7.1.1.2.2 Introduce the filament into the tension device, so as to fix the filament end on the clamping piece of the yarn frame of the length measuring instrument. The coiling tension shall be calculated in accordance with Formula (3). Evenly and smoothly wind for the number of reels specified in 6.3.1, with knots at both ends.

7.1.1.2.3 Carefully remove the stranded filament from the yarn frame; prevent it from twisting. Loosely hang it on the filament-stranding rack without any tension.

7.1.1.2.4 In the standard atmosphere specified in 6.2.2, the test specimen shall be equilibrated before thermal treatment for the time specified in 6.2.5.

7.1.1.3 Length measurement before boiling treatment

7.1.1.3.1 Manual measurement

Successively hang the test specimens on the hooks of the vertical measuring scale as described in 5.3 a); align the inner side of the stranded filament with the zero point of the vertical measuring scale. In accordance with the stipulations of 6.4.1, calculate the tension. In addition, in accordance with this tension, on the lower end of the stranded filament, carefully hang the weight with the hook as described in 5.3 b); prevent twisting of the stranded filament. After (30 ± 3) s, the upper end of the outer circle of the hook at eye level and the scale of the vertical measuring scale at the same level is the length L_0 of the test specimen before the treatment, accurate to 1 mm.

7.1.1.3.2 Measurement with an instrument

On the filament-stranding rack, add a 2.5 cN weight to the lower end of each test specimen, so that the filament is vertically downward. Then, put it into the instrument. In accordance with the stipulations of 6.4.1, set the pre-tension. After the instrument automatically loads for (30 ± 3) s, read the length L_0 of the test specimen before the treatment, accurate to 0.1 mm.

7.1.1.4 Boiling treatment

7.1.1.4.1 Vertically place the filament-stranding rack (with specimen hanging) into the boiling water; make it completely immersed. The boiling time shall be implemented as specified in 6.2.3.2. During the entire test stage, it shall be ensured that the water is in the boiling state.

the filament, carefully apply the weight with clamp specified in 5.3 b). After (30 ± 3) s, make two marks on the test specimen at a distance of (500 ± 10) mm. The difference value between the mark at eye level and the scale of the vertical measuring scale at the same level is the length L_0 of the test specimen before the treatment, accurate to 1 mm.

7.1.2.3 Boiling treatment

7.1.2.3.1 Fold the test specimen in half, and then, in half; put it in the mesh bag in a loose state.

7.1.2.3.2 In accordance with the requirements of 6.2.3.1 and 6.2.3.2, conduct boiling treatment.

7.1.2.3.3 Carefully take out the test specimen from the mesh bag; fold it in half and hang it on the filament-stranding rack. In accordance with the drying conditions in 6.2.3.3, dry the test specimen in a tension-free and loose state.

7.1.2.3.4 Place the test specimen in the standard atmosphere specified in 6.2.2. In accordance with the time specified in 6.2.5, conduct equilibrium after thermal treatment.

7.1.2.4 Length measurement after boiling treatment

Successively clamp the test specimens in the clamp on the upper end of the vertical measuring scale as described in 5.3 a). In accordance with the stipulations of 6.4.2, on the lower end of the filament, carefully apply the weight with clamp specified in 5.3 b). After (30 ± 3) s, the difference value between the mark at eye level and the scale of the vertical measuring scale at the same level is the length L_s of the test specimen after the treatment, accurate to 1 mm.

7.2 Hot Air Shrinkage Rate (inapplicable to cellulose filament)

7.2.1 Stranded filament method (inapplicable to spandex)

7.2.1.1 Stipulations of test

For stranded filament test, the length may be measured manually or with an instrument; the rest of the steps are the same.

7.2.1.2 Preparation and treatment of test specimen

Same as 7.1.1.2.

7.2.1.3 Length measurement before thermal treatment

Same as 7.1.1.3.

7.2.1.4 Thermal treatment

S---thermal shrinkage rate (boiling water shrinkage or dry shrinkage);

L_0---length of test specimen before thermal treatment, expressed in (mm);

L_s---length of test specimen after thermal treatment, expressed in (mm).

8.2 The average value of each reel is the thermal shrinkage value of the current reel, rounded off to one decimal place. The total average value of all reels is the thermal shrinkage value of the current batch of sample, rounded off to one decimal place.

8.3 If necessary, the manufacturer shall determine the allowance of thermal shrinkage rate of a batch of products.

8.4 The coefficient of variation needs to be calculated in accordance with the stipulations of Appendix D.

9 Precision of Test Result

See Appendix F.

10 Test Report

Test report shall include:

a) Name, specification and number of reels of the sample;

b) Number identification of package being selected as batch sample;

c) The used test method and all test parameters;

d) The various performance test results of laboratory samples. If the standard deviation and coefficient of variation are calculated, they shall be written into the report;

e) Reminders on the modification of test procedures after negotiation and other parts that are inconsistent with this Standard;

f) Observed abnormalities;

g) Test personnel; date of test.

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