ICS 59.080.30
CCS W04

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 42694-2023

Textiles - Testing and evaluation for surface wetting resistance - Contact angle and rolling angle method

纺织品 表面抗润湿性能的检测和评价 接触角和滚动角法

Issued on: May 23, 2023 **Implemented on: December 1, 2023**

Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC

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1 Scope

GB/T 42694-2023 measures water repellency on a fabric's surface by the angles a droplet makes with it. The traditional spray test grades repellency by comparing a wetted specimen against photographic standards - a judgement by eye, which discriminates poorly at the top of the scale where modern finishes now sit. Contact angle and rolling angle measure the physics directly: the contact angle says how much the surface resists being wetted at all, and the rolling angle says how readily a droplet leaves rather than clinging, which is the property a wearer actually notices and the one that distinguishes a merely water-repellent finish from a self-cleaning one. Both are numbers rather than grades, which matters now that fluorine-free finishes are replacing the fluorocarbons being phased out and their performance has to be compared honestly. This document describes the determination of surface wetting resistance of fabrics using contact angle and rolling angle tests and provides an evaluation of the result. It applies to all types of fabrics. It is written for finishers developing repellent treatments, for outerwear and technical textile brands specifying them, and for testing laboratories.

This document describes the method for determination of surface wetting resistance of fabrics using contact angle and rolling angle tests; provides an evaluation of wetting resistance. This document applies to all types of fabrics.

2 Normative references

The contents of the following documents, through normative references in this text, constitute indispensable provisions of this document. Among them, for dated references, only the edition corresponding to that date applies to this document. For undated

references, the latest edition (including all amendments) applies to this document.

GB/T 6529 Textiles - Standard atmospheres for conditioning and testing

GB/T 6682 Water for analytical laboratory use - Specification and test methods

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Contact angle The angle containing the droplet BETWEEN the tangent (the tangent to the gas-liquid interface drawn at the intersection of the gas, liquid, and solid phases) AND the solid- liquid boundary, when the liquid forms droplets on the solid surface and reaches equilibrium.

Note: It is as shown in Figure 1.

5.1.4 Optical imaging device It shall be able to acquire clear images of the droplet and specimen. The acquired images can be viewed on the measurement system.

5.1.5 Liquid supply device The liquid supply device with injection head shall be able to quantitatively add (5±1)μL of liquid. For the injection head, it is recommended to use a flat-headed needle with a diameter of

0.21 mm~

0.52 mm. Stainless-steel needles are mostly used; other types such as Teflon-coated needles can also be used.

5.1.6 Measurement system It can control the light source, optical imaging device, liquid supply device and other components to complete the test operation. It can record and analyze the data of different droplet volume, shape and contact angle, which are obtained from the optical imaging system. The calculation is accurate to 0.1°.

Note: Contact angle calculation methods include Young-Laplace method, width-height method, circle method, ellipse method, tangent method, etc.

5.2 Rolling angle meter The rotating device of the rolling angle meter shall be able to drive the specimen stage to rotate axially continuously, to measure the rotating angle. Its rotation axis is on the surface of the specimen stage. The rotating device has a graduated line showing the rotating angle with an accuracy of 0.1°. It is equipped with a micropipette or dropper capable of dropping about 50 μL. The schematic diagram of rolling angle meter is shown in Figure 4.

7 Test procedure

7.1 General The standard atmospheres for conditioning and testing shall be carried out in accordance with the provisions of GB/T 6529. Before the test, the sample shall be

conditioned and balanced. After consultation with relevant parties, conditioning and testing can be carried out under other test conditions; but shall be noted in the test report.

Note: The test results under different environmental conditions are not comparable. The evaluation indicators may not be applicable.

7.2 Determination of contact angle

7.2.1 Adjust the liquid supply device to absorb an appropriate amount of reagent (5.3). If there are bubbles at the injection head, it is necessary to discharge the bubbles, to ensure that there are no bubbles in the liquid supply device.

7.2.2 Use a spirit level to level the specimen stage; fix the instrument debugging specimen with the testing surface facing upwards and flat on the specimen stage.

7.2.3 Set the injection liquid volume to 5 μL. The injection head is approximately 2 mm away from the surface of the specimen to be tested.

7.2.4 After dropping (5±1)μL of liquid on the surface of the instrument debugging specimen, remove the injection head. Adjust the camera and the specimen stage so that the droplet image has a clear contour and appropriate size. When the droplet is hemispherical or nearly spherical, the droplet diameter accounts for approximately 1/3 of the length of the image window.

7.2.5 Remove the instrument debugging specimen; wipe the specimen stage to keep it dry; install the test specimen. After adding (5±1)μL of droplets to the surface of the specimen, remove the injection head. When the contact time is 30 s, take photos of the specimen and the droplets above it. Use the measurement system to calculate the left and right contact angles of the droplets; take the average of the two contact angles as the contact angle of the specimen.

7.2.6 Repeat 7.2.5, to measure the contact angle of the remaining warp (longitudinal) and weft (transverse) specimens. If there are significant differences in the results of the 5 specimens, they shall be rejected and made up.

Note: The warp (longitudinal) contact angle is the contact angle formed by the droplet on the warp (longitudinal) section of the specimen. The weft (transverse) contact angle is the contact angle formed by the droplet on the weft (transverse) section of the specimen.

7.3 Determination of rolling angle Use a spirit level to adjust the rolling angle meter to the horizontal position; then rotate the specimen stage to 0 scale; fix the specimen in the center position of the specimen stage. Use a micropipette or dropper to drop about 50 μL of liquid (5.3) at a distance of 5 mm from the specimen surface; immediately rotate the rotating device slowly (at a speed of about

0.2 r/min), to drive the specimen stage to rotate. Measure the angle at which the droplet rotates just as it rolls (i.e., the rolling angle). Measure the rolling angles of 5 specimens in

the warp direction and weft direction respectively; record the measured results of the rolling angles of each specimen in turn. If there are significant differences in the results of the 5 specimens, they shall be rejected and made up.

8 Expression and evaluation of results

8.1 Expression of results For the contact angle, the average values theta1 and theta2 of 5 measurements in the warp (longitudinal) and weft (transverse) directions respectively are taken as results; round off to 0.1° according to the rounding principle. If the droplet contacts the surface of the specimen and is completely absorbed by the specimen within 30 s, the contact angle of the specimen is directly recorded as 0°. For the rolling angle, the average values alpha1 and alpha2 of 5 measurements in the warp (longitudinal) and weft (transverse) directions respectively are taken as results; round off to 0.1° according to the rounding principle. When the rolling angle is >90°, or when the droplet is completely absorbed by the specimen after addition, it can be recorded as " >90°".

8.2 Evaluation of wetting resistance If necessary, according to Table 1, evaluate the wetting resistance of the sample. The contact angle shall be evaluated based on the smaller values in the warp (longitudinal) and weft (transverse) directions. The rolling angle shall be evaluated based on the larger values in the warp (longitudinal) and weft (transverse) directions. The contact angle and rolling angle shall both comply with the corresponding wetting resistance grade.