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Antibacterial knitwear

抗菌针织品

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Antibacterial knitwear

1 Scope

This standard specifies the requirements, test methods, inspection rules, packaging and marking of antibacterial knitwear.

This standard applies to antibacterial knitwear, which is made of natural fibers, chemical fibers, blended fibers.

2 Normative references

The provisions in 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.

GB/T 4856 Package of cotton goods and knitwear

GB 5296.4 Instructions for use of products of consumer interest - Part 4: Textiles and apparel

GB 7919 Procedures and methods of safety evaluation for cosmetics

GB/T 8629-2001 Textiles - Domestic washing and drying procedures for textile testing

GB 18401-2003 National general safety technical code for textile products

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Antibacterial fiber

Chemical fiber, which has antibacterial substance and antibacterial function.

3.2

Antibacterial finish

The dyeing and finishing process of treating textiles, by the use of antibacterial substances, to make them have antibacterial functions.

3.3

Antibacterial finishing agent

Antibacterial substances, which are used as antibacterial finishing of textiles. According to its dissolution characteristics on fabric fibers, it can be divided into two categories: Dissolution type antibacterial finishing agents and non-dissolution type antibacterial finishing agents.

3.4

Antibacterial knitwear

Knitwear, which is subject to antibacterial finishing OR contains antibacterial fibers, that can inhibit the growth, reproduction of bacteria and fungi on the fabric OR inactivate them.

4 Product categories and variety specifications

4.1 According to fiber raw materials, products can be divided into knitwear of natural fiber, chemical fiber, blended fiber.

4.2 According to the product structure, the products can be divided into knitted products partially inlaid or patched with antibacterial fabrics AND knitted products composed of antibacterial fabrics as a whole.

4.3 According to the use of the products, the products can be divided into knitted underwear, underwear, sportswear, T-shirts, socks, hats, bras, abdominal belts, swimwear, other knitted products and various knitted fabrics.

4.4 The varieties and specifications of various products shall be implemented, in accordance with the current national standards or industry standards, for the corresponding knitwear.

5 Requirements

The requirements of antibacterial knitwear are divided into four aspects: intrinsic quality, appearance quality, antibacterial effect, safety.

5.3 Safety

5.3.1 The antibacterial substances, which are used in antibacterial knitwear, must be approved by relevant departments AND have a test report from a qualified organization (chemical content test method of antibacterial substances, acute oral toxicity, skin irritation, eye irritation, mutagenicity, the test report corresponding to the products). The instructions for use, which is provided by the manufacturer of antibacterial substances, according to the function promotion of the manufacturer, shall show the test report of the test content corresponding to its function promotion.

5.3.2 The skin irritation and allergy, which are caused by the leaching of antibacterial substances, which are used in antibacterial knitwear, shall be negative in the body patch test, according to GB 7919.

5.3.3 Antibacterial knitwear shall meet the requirements of GB 18401-2003.

5.3.4 Dissolution index of antibacterial substances, which are used to antibacterial knitwear: After the antibacterial fabric is washed once, the width of the antibacterial ring $D \leq 5$ mm.

6 Test methods

6.1 Inspection of intrinsic quality and appearance quality

The test methods for the intrinsic quality and appearance quality of various antibacterial knitwear shall be implemented, in accordance with the current national standards or industry standards, for the corresponding knitwear.

6.2 Inspection of antibacterial effects

6.2.1 Test according to the Quinn method, absorption method or oscillation method, in Appendix D of this standard.

6.2.2 The arbitration inspection method for grade A products shall be implemented, according to the absorption method in Appendix D of this standard.

6.2.3 The arbitration inspection method of grade AA products and grade AAA products shall be implemented, according to the oscillation method in Appendix D of this standard.

6.3 Dissolution test of antibacterial substances used in antibacterial knitwear

It is performed, according to the halo method, as shown in Appendix E of this standard.

7 Inspection rules

7.1 For the sampling quantity and rules of various types of antibacterial knitwear, in addition to following the current national or industrial standards for the corresponding knitwear, during the sampling, it shall randomly take about 200 g of antibacterial fabric samples, for the antibacterial effect testing and the testing of dissolution of antibacterial substances.

7.2 The intrinsic quality and appearance quality of all kinds of antibacterial knitwear shall be evaluated, according to the current national standards or industry standards, for the corresponding knitwear.

7.3 All kinds of antibacterial knitwear shall be evaluated whether they meet the requirements, according to the provisions in GB 18401-2003.

7.4 The relevant testing report, which is issued by the qualified organization of the state, is based to evaluate the antibacterial substances, which are used in antibacterial knitwear.

7.5 The testing report of the body patch test, which is issued by the qualified organization of the state, is based, to evaluate the skin irritation and allergenicity of the leaching substance of the antibacterial substances, which are used in the antibacterial knitwear.

7.6 For randomly selected antibacterial fabric samples, evaluate the antibacterial effect, according to the bacteriostatic rate index, which is specified in Table 1 of this standard.

7.7 For randomly selected antibacterial fabric samples, evaluate the dissolution of antibacterial substances, according to the index, which is specified in 5.3.4 of this standard.

7.8 If all the indicators of the evaluated product meet the requirements of 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, the product will be judged as a qualified product. If any one of them fails to meet the requirements, the product will be judged as a non-qualified product.

7.9 If there are any matters not covered in this inspection rule, the jurisdiction department of the industry may issue additional detailed rules.

8 Packaging and marking

8.1 All kinds of antibacterial knitwear packaging shall be implemented, in accordance with GB/T 4856.

8.2 All kinds of antibacterial knitwear markings shall be implemented, in accordance with GB 5296.4.

exceed one month.

D.3.3 Sabouraud agar medium: Accurately weigh 40 g of glucose, 10 g of peptone, 20 g of agar powder. Add 1000 mL of distilled water. Put them in a flask to mix it. Heat the flask in a boiling water bath, to fully dissolve it. Then use 0.1 mol/L sodium hydroxide solution, to adjust the pH to 5.6 ± 0.2. Cover a cotton plug. Sterilize it at 103 kPa and 121 °C, for 15 min. When using it, adjust the temperature of the medium to 45 °C ~ 46 °C. If not used immediately, store it at 5 °C ~ 10 °C. The shelf life cannot exceed one month.

D.3.4 Slant medium: Pour about 10 mL of nutrient agar medium (or Sabouraud agar medium) into a test tube. Cover a cotton plug. Sterilize it at 103 kPa and 121 °C, for 15 minutes. After sterilization, place it in a sterile chamber, at an angle of about 15° from the horizontal plane, to allow it to solidify. When not in immediate use, store it at 5 °C ~ 10 °C. When there is no condensed water, it can be heated and melted to solidify again before use. The shelf life cannot exceed one month.

D.3.5 The 0.03 mol/L PBS (phosphate) buffer solution: Take 2.84 g of disodium hydrogen phosphate, 1.36 g of potassium dihydrogen phosphate, 1000 mL of distilled water, to prepare a buffer solution of pH 7.2 ~ 7.4. After dividing in 250 mL flasks, sterilize it at 103 kPa and 121 °C, for 15 min. Prepare for use. If not used immediately, store it at 5 °C ~ 10 °C. The shelf life cannot exceed one month.

D.3.6 Physiological saline for dilution: Accurately weigh 8.5 g of sodium chloride. Add 1000 mL of distilled water. Put it into a flask, to dissolve it fully. If necessary, take a part of it and put it into a test tube. Sterilize it at 103 kPa and 121 °C, for 15 min. Prepare for use. If not used immediately, store it at 5 °C ~ 10 °C. The shelf life cannot exceed one month.

D.3.7 Physiological saline for eluting specimen live bacteria: Accurately weigh 8.5 g of sodium chloride. Add 1000 mL of distilled water. Put it into a flask, to fully dissolve it. Add 2 g of nonionic surfactant Tween-80. If necessary, take a part of it. Put it into a test tube or triangular flask. Sterilize it at 103 kPa and 121 °C, for 15 min. Prepare for use. If not used immediately, store it at 5 °C ~ 10 °C. The shelf life cannot exceed one month.

D.4 Test strains and strain preservation

D.4.1 Test standard strains: Staphylococcus aureus (ATCC 6538), Escherichia coli (8099), Candida albicans (ATCC 10231).

D.4.2 Substitution of standard strains: Escherichia coli (ATCC 29522) or pneumoniae (ATCC 4352) can be used instead of Escherichia coli (8099).

D.4.3 Strain transfer and preservation: The stored strains shall be transferred once a month. The number of transfers shall not exceed 10 generations. The transfer can be

Appendix A. The specimen size is 2.5 cm x 2.5 cm. Each specimen is wrapped with a small piece of paper; sterilized at 103 kPa and 121 °C, for 15 min; prepared for later use.

D.6.2.2 Preparation of inoculated bacterial solution: Use 0.03 mol/L PBS solution, to dilute the bacterial suspension, which is prepared in D.5.1 (or the fungal suspension in D.5.2). Control the number of viable bacteria to be 5 x 10^4 cfu/ mL ~ 1 x 10^5 cfu/mL (reference value. Take the upper limit for Staphylococcus aureus; take the lower limit for Escherichia coli and Candida albicans. If there are too many viable bacteria, it is difficult to count after culturing; if there are too little viable bacteria, it has larger counting error, after culture). For specimens, which have poor water absorption, it may add 0.05% nonionic surfactant Tween-80, to the bacterial liquid, to facilitate the bacterial liquid absorption. If a surfactant is added, it shall be indicated in the test report.

D.6.2.3 Preparation of semi-solid medium: Dissolve 1 part of nutrient agar medium (or Sabouraud agar medium), in 3 parts of distilled water, to make semi-solid medium. Divide it into flasks. Seal the cap. Sterilize it at 103 kPa and 121 °C, for 15 min. Prepare for later use. It may add 1/100000 of triphenyltetrazolium chloride (TTC) dye, to the semi-solid medium, which is prepared by nutrient agar medium, to make the bacterial colonies be red, which is very easy to observe. Note that the dye shall be added, when the semi-solid medium is cooled to about 60 °C. It shall be prepared before use. The dyeing agent will be degraded and unstable, if the temperature is too high or the placement time is too long. It is not necessary to add TTC dyeing agent, to the semi-solid medium, which is prepared by Sabouraud agar, because it cannot stain fungi, such as Candida albicans.

D.6.3 Test operation

D.6.3.1 Inoculation: Put antibacterial fabric specimens, non-antibacterial treated fabric specimens, standard blank specimens, in the sterilized empty plates, respectively. Pipette 0.1 mL of the prepared bacterial solution. Smear it evenly on each specimen, at least 5 points. Make the bacterial liquid be absorbed in the cloth, as far as possible.

D.6.3.2 Drying: Place it in a biochemical incubator, at about 37 °C under the condition of no bacterial contamination. Place it to dry for 1 h ~ 3 h. Note that the inoculated bacterial solution on the specimen shall be completely dried, before proceeding to the next step of attaching the medium. Otherwise, the strains may overflow and grow outside the specimen, resulting in counting errors.

D.6.3.3 Attaching the specimen: Pour about 15 mL of nutrient agar medium (or Sabouraud agar medium) into the plate. Cool it. Then, place the dried specimen flat on the medium. Use sterile tweezers, to gently press the specimen, to make it close to the surface of the medium. One standard blank specimen, one antibacterial fabric specimen, one non-antibacterial fabric specimen can be attached to each plate. Two parallel specimens of plates are made for each test.

number of washings. The fabric specimen without antibacterial treatment is used as a reference, for the standard blank specimen. If the customer cannot provide it, the test of this specimen can be omitted.

D.7.2 Test preparation

D.7.2.1 Specimen preparation: Accurately weigh 0.4 g ± 0.05 g of squares, which have a side length of about 18 mm. Stack them as a specimen. Prepare 2 standard blank specimens, which are prepared according to Appendix A, as well as 1 antibacterial fabric specimen. Take another 1 fabric specimen, without antibacterial treatment, as a positive control. Care shall be taken when preparing specimen, to avoid contamination.

Note 1: 2 standard blank cloth specimens, wherein one is used to test the number of inoculated bacteria, at "0" contact time, whilst the other is used to test the number of growing bacteria, after 18 hours of culture.

D.7.2.2 Specimen sterilization: Put the specimens into vials, respectively. Put the vials into a mesh metal basket. Cover the basket with a layer of aluminum foil. Use the aluminum foil, to tie up the opening of each vial. Put the basket in the autoclave, to keep at 103 kPa and 121 °C, for 15 min. Let it cool down to 100 °C naturally. Immediately take it out from the autoclave. Take away the aluminum foil on the basket. Put it on the ultra-clean workbench, to naturally dry it for 1 hour. Pay attention to tie the aluminum foil, at the opening of the vial tightly, to prevent it from loosening.

Note 2: If the specimen is prone to curling, take 0.4 g ± 0.05 g of specimen. Stack them into a square of about 18 mm. Use a piece of glass rod, to press on top of the specimen. Put it in a vial for sterilization. OR make it into a 0.4 g ± 0.05 g square of about 18 mm. Use a thin wire, to fix it well at one or both ends. Sterilize it.

Note 3: If it is cotton or wool, put 0.4 g ± 0.05 g into the vial. Press a glass rod. Sterilize it.

Note 4: If it is yarn, roll them into a bundle of 0.4 g ± 0.05 g into a bag-shape. Press a glass rod. Sterilize it.

Note 5: If it is a carpet or a carpet-like object, cut 0.4 g ± 0.05 g into a vial. Press a glass rod. Sterilize it.

D.7.2.3 Preparation of inoculum solution:

a) Use a pipette, to take 0.3 mL ~ 1 mL of the bacterial suspension, which is prepared in D.5.1 (reference value. Adjust the number of viable bacteria inoculated in this step; take the lower limit for E. coli and the upper limit for Staphylococcus aureus). Add it into the test tube, which contains 9 mL of nutrient broth. Mix well. Pipette 1 mL into the test tube, which contains 9 mL of nutrient broth. Mix well. Pipette 1 mL into the test tube, which contains 9 mL of 0.03 mol/L PBS buffer solution. After mixing well, pipette 1 mL into the test tube, which contains 9 mL of 0.03 mol/L PBS buffer solution. Mix well. The fixed four-step dilution

procedure can adjust the number of viable bacteria to 0.7 x 10^5 cfu/mL ~ 1.5 x 10^5 cfu/mL (take the lower limit for E. coli and the upper limit for Staphylococcus aureus), which are used to inoculate the specimen. This inoculation liquid contains about 1% nutrient broth, to provide the nutrition of the test bacteria. This inoculum solution shall not be stored in the refrigerator. It shall be used as soon as possible, to maintain the activity of the inoculum.

b) Using 0.03 mol/L PBS buffer solution as a diluent, to dilute the Candida albicans suspension, which is prepared in D.5.2, to a viable count of 1.0 x 10^5 cfu/mL ~ 1.3 x 10^5 cfu/mL, for inoculating the specimen. This inoculum solution shall not be stored in the refrigerator. It shall be used as soon as possible, to maintain the activity of the inoculum.

D.7.3 Test operation

D.7.3.1 For specimen inoculation, use a pipette to accurately absorb 0.2 mL of the prepared inoculum solution, to inoculate it on the prepared specimen. Evenly inoculate the bacterial solution on the specimen with several drops. Fasten the cap of the vial tightly.

Note 6: When the specimen is water repellent and it is difficult to immerse the inoculum, it may add another 0.05% non-ionic surfactant to the inoculum. If a surfactant is added, it shall be recorded in the test report.

D.7.3.2 Specimen culture: For the inoculated specimen in vials (1 standard blank specimen, 1 antibacterial fabric specimen, 1 non-antibacterial fabric specimen), it is cultured at 37 °C ± 1 °C, for 18 h ± 1 h.

D.7.3.3 Elution of viable bacteria on the specimen:

a) Elution at "0" contact time after inoculation of standard blank specimen. For the standard blank specimen, which uses the "0" contact time, to test the number of inoculated bacteria. Immediately after inoculation, add 20 mL of ice-cold physiological saline for eluted specimen's live bacteria to the vial. Tie the cap of the vial tightly. Use hands to beat (30 times, amplitude 30 cm) or vibrate (5 s, 5 times) it, to wash off the viable bacteria on the specimen.

b) Elution of viable bacteria from the specimen after 18 hours of inoculation and culture. Add 20 mL of ice-cold physiological saline for eluted specimen's viable bacteria, into the 3 specimens, which are inoculated with the test bacteria and cultured for 18 h ± 1 h, respectively. Tie the cap of the vial. Use hands to beat (30 times, amplitude 30 cm) or vibrate (5 s, 5 times) it, to wash off the viable bacteria on each specimen.

D.7.3.4 Dilution of eluent: Use a 1 mL pipette, to accurately take 1 mL ± 0.1 mL of eluent from the vial. Put it into a test tube, which contains 9 mL ± 0.1 mL of cold

g ± 0.05 g of antibacterial fabric specimens, non-antibacterial treated fabric specimens, standard blank specimens. Use a small piece of paper, to wrap the specimen. Sterilizer it at 103 kPa and 121 °C, for 15 min. Prepare for later use.

D.8.2.2 Preparation of inoculum solution

a) Use a pipette to take 2 mL ~ 3 mL of the bacterial suspension, which is prepared in D.5.1 (reference value. Adjust the number of viable bacteria inoculated in this step; take the lower limit for Escherichia coli; take the upper limit for Staphylococcus aureus). Add it to the test tube, which contains 9 mL of nutrient broth. After mixing it well, pipette 1 mL into another test tube, which contains 9 mL of nutrient broth. After mixing it well, pipette 1 mL into a test tube, which contains 9 mL of 0.03 mol/L PBS buffer solution. After mixing it well, pipette 5 mL into a conical flash, which contains 45 mL of 0.03 mol/L buffer solution. Mix it well. Dilute it to the number of viable bacteria of 3 x 10^5 cfu/mL ~ 4 x 10^5 cfu/mL (this fixed 4 dilution procedures; this inoculum contains a trace amount of nutrient broth). It is used to inoculate the specimen. This inoculum solution cannot be stored in the refrigerator. It shall be used as soon as possible, to maintain the activity of the inoculum.

Note 8: Due to the different grades of beef extract and peptone, which are used in different laboratories, the nutrition of the inoculum, which is prepared by the above 4-time dilution procedures, may be slightly more (especially obvious for E. coli). It is manifested as a small difference, between the bacteria growth of the standard blank specimen and the bacteria growth of the specimen after antibacterial finishing, after 18 h of oscillation, which is difficult to widen the gap. At this time, another fixed 4-time dilution procedure should be used: Use a pipette to take 2 mL ~ 3 mL (reference value. Adjust the number of viable bacteria in this step. Take the lower limit for Escherichia coli. Take the upper limit for Staphylococcus aureus), from the bacterial suspension, which is prepared in D.5.1. Add it to a test tube, which contains 9 mL of nutrient broth. Mix well. Pipette 1 mL into another test tube, which contains 9 mL of 0.03 mol/L PBS buffer solution. Mix well. Then pipette 1 mL into a test tube containing 9 mL of 0.03 mol/L PBS buffer. Mix well. Pipette 5 mL into a conical flask, which contains 45 mL of 0.03 mol/L PBS buffer solution. Mix well. Dilute to the number of viable bacteria of 3 x 10^5 cfu/mL ~ 4 x 10^5 cfu/mL (this inoculum solution contains a smaller amount of nutrient broth), to inoculate the specimen. (it may conduct a pre-test in advance; select a fixed 4-time dilution program, which has a good bacteriostatic rate test effect, to prepare the bacterial solution for specimen inoculation.)

b) Use a pipette, to pipette 2 mL ~ 4 mL of Candida albicans suspension, which is prepared in D.5.2. Add it to 9 mL of 0.03 mol/L PBS buffer solution. Perform 10-times series dilution. After mixing well, pipette 5 mL into 45 mL of 0.03 mol/L PBS buffer solution. Mix well. Dilute it to a number of viable bacteria of 2.5 x 10^5 cfu/mL ~ 3 x 10^5 cfu/mL, for inoculating the specimen. This inoculum solution cannot be stored in the refrigerator. It shall be used as soon as possible, to maintain the activity of the inoculum.

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