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भारतीय मानक ब्यूरो

# Bureau of Indian Standards

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**भारतीय मानक मसौदा**

## वस्त्रादि - सिंगल जर्सी, कॉटन, सिंथेटिक और मिश्रित यूनिसेक्स लेगिंग - विशिष्टताएँ

*Preliminary Draft Indian Standard*

## TEXTILES – SINGLE JERSEY, COTTON, SYNTHETIC, AND BLENDED LEGGINGS - SPECIFICATIONS

### FOREWORD

(*Formal foreword to be added later*)

Knitted leggings have become a timeless staple in modern wardrobes, celebrated for their unmatched comfort, flexibility, and stylish appeal. Made from soft, stretchable fabrics, these leggings offer a second-skin feel while ensuring freedom of movement, making them ideal for a variety of activities—from workouts to casual wear.

Their versatile design allows them to be paired effortlessly with a range of outfits, making knitted leggings perfect for both athleisure and everyday fashion. Available in a wide array of colors and patterns, they cater to personal tastes while maintaining their practicality and durability. Whether at the gym, running errands, or lounging at home, knitted leggings are the epitome of comfort without compromising on style.

# 1 SCOPE

**1.1** This standard describes constructional details, characteristics and performance related parameters of single jersey, cotton, synthetic, and blended leggings.

**1.2** This standard does not take into consideration such as appearance, lustre, handle, finish type, whiteness index or shade of the leggings.

**1.3** This standard does not apply to knitted interlinings, jeans, and dungarees.

# 2 REFERENCES

**2.1** The standard listed in **Annex A** contains provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subjected to revision and parties to agreements based on this standard are encouraged investigating the possibility of applying the most editions of these standards.

**2.2** For the purpose of this standard the definitions given in **Annex B & D**, shall apply.

# 3 TERMINOLOGY

**3.1** Leggings are tight-fitting garments that cover the legs, typically made of stretchy material such as spandex, polyester, cotton, or a blend of these fabrics. They are often worn by both men and women as casual wear, exercise attire, or as a fashion statement. Leggings are characterized by their form-fitting nature, often extending from the waist down to the ankles, though variations in length exist, such as Capri-length or mid-calf styles.

# 4 MATERIALS

## 4.1 Yarn

The yarn count for cotton shall be in the range of 30s Ne – 60s Ne (20 Tex – 10 Tex) and for multifilament synthetic yarn shall be in the range of 150D – 200D. Apart from this specification, any other yarn count in compliance with the buyer & seller agreement shall be used for knitting, splicing, and linking of the leggings.

## 4.2 Identification of Fibres

The Material used for manufacturing shall be tested as per **Annex C**.

# 5 MANUFACTURING

## 5.1 Shape

The shape of leggings shall be generally as shown in Figure. 1.

## 5.2 Knitting

**5.2.1** The leggings fabric shall be knitted on circular, flatbed and warp knitting machines. These shall be neatly tailored out of well and evenly knitted tubular fabric. The fabric shall be of uniform texture and appearance. It shall be of uniform tension throughout its length and free from spirals. It shall be scoured, bleached or dyed. The leggings shall not have any seams or joining along their two outer sides. The wales shall run along the length of the drawers. The fabric shall conform to construction particulars given in **Table 5** for plain knitted Leggings and **Table 6** for rib knitted Leggings.

**5.2.1** The mass of the leggings in grams per square meter shall be determined by the method given in B - 3.

**5.2.2** Pockets; if required may also be provided having dimensions and shape as agreed to between the buyer and the seller.

## 5.3 Elastic Strap

Leggings shall have outer woven elastic strap stitched at the waist band or inner woven elastic strap shall be formed by the folding the raw edges of the fabric to a depth of minimum 25 mm and stitching it with flat stitches. In case of latter, a cotton tape having width of 25 mm preferably confirming to IS 9686: 2022 or a suitable tape made out of same fabric that is used for fabricating the leggings shall be provided in waist fold for tying purposes. It shall be at least 30 cm longer than the corresponding waist girth.

The ankle and waistband should be either plain or rib knitted or in compliance with the agreement between the buyer and the seller. The ankle width should be atleast 5.0 - 10.0 cm’s and the waistband width up to 2.5 cm’s.

**a) Outer Elastic Strap (H)**

1) Width of strap shall be minimum 25 mm.

2) Minimum mass per 100 m of finished strap shall be 1.7 kg.

3) Minimum number of ends of covered rubber in the strap shall be 20.

4) In 250 mm of finished strap, each covered rubber thread shall have a minimum of 160 mm of rubber core of not less than 0.6 mm diameter.

5) The minimum elongation of covered rubber shall be 160 percent under a load of 225 g with respect to specimen length of 100 mm.

**b) Inner Elastic Strap (H)**

1) Width of strap shall be minimum 25mm.

2) Minimum mass per 100 m of finished strap shall be 1.1 kg.

3) Minimum number of ends of covered rubber in the strap shall be 15.

4) In 250 mm of finished strap, each covered rubber thread shall have a minimum of 160 mm of rubber core of not less than 0.6 mm diameter.

5) The minimum elongation of covered rubber shall be 160 percent under a load of 225 g with respect to specimen length of 100 mm.

## 5.4 Crutch Piece

The fabric used for crutch piece shall be of same type and construction as that of the legging (leg portion). The crutch piece shall be reinforced throughout with cotton calico (IS 1544). The crutch piece and the reinforcement fabric shall be scoured or bleached as the legging.

## 5.5 Linking

The pieces of leggings shall be securely linked using over-lock and or flat-lock stitch. The stitch type selection must be in compliance with the buyer and the seller. The linking shall be elastic, smooth and free from knots. The length of the free ends of the linking yarn and other loose ends, if any, shall be neither less than 5.0 mm nor more than 15.0 mm. The linking shall not give way when the leggings are stretched without breaking to the full extent of the stretch ability of leggings. Linking of crutch piece shall be done at right angle i.e. $90^{o}$ at the intersection to prevent tearing during extension while sitting.

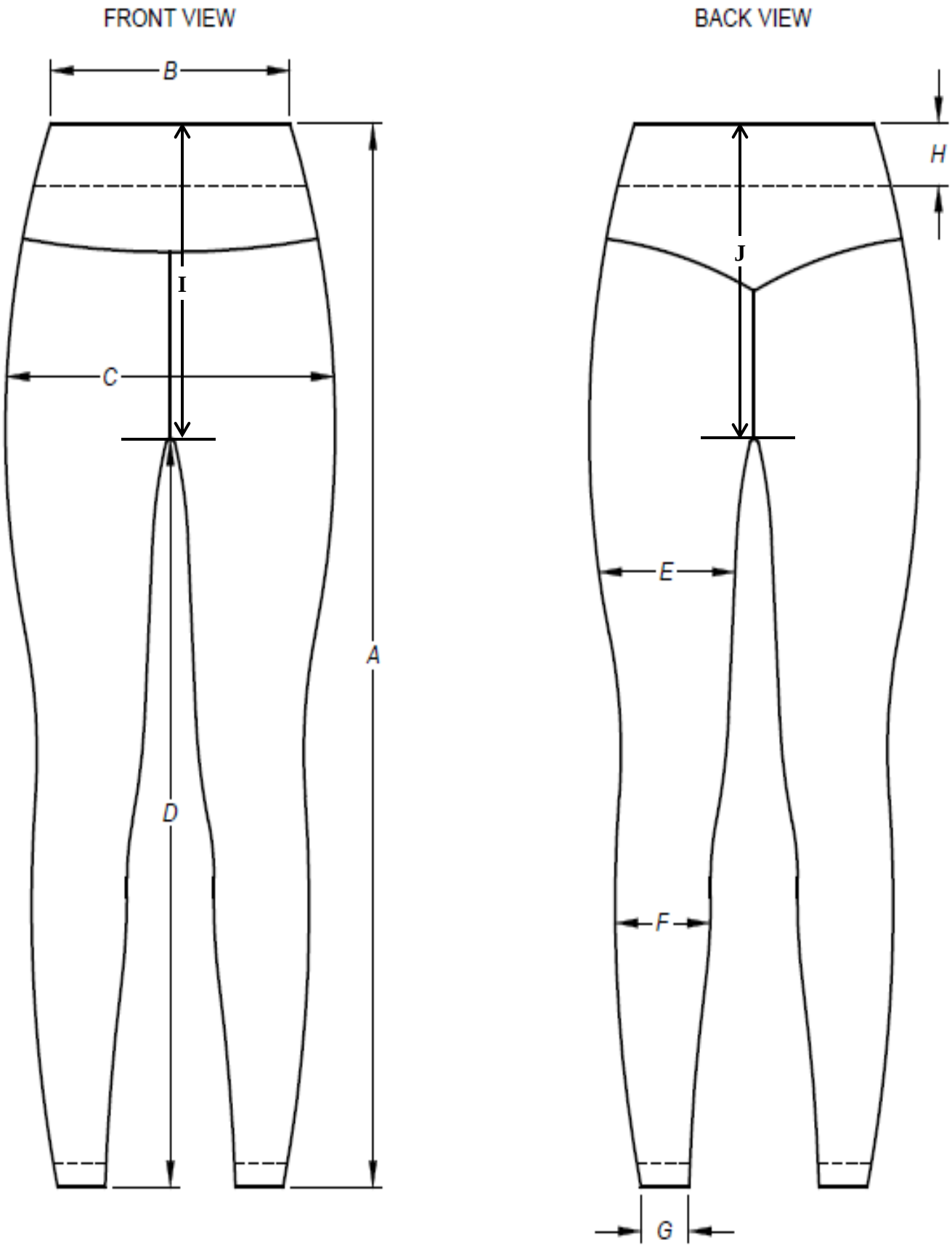


**FIGURE-1** General Shape of the Plain and Rib Knitted Leggings

**Table 5** Constructional Particulars of Plain Knitted Fabric for Leggings
(*Clause 5.1*)

| Sl. No. | Gauge of Machine (See Note) | Approximate Count of Yarn – Ne (Tex) | Mass $g/m^2$ Min (g) |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 1 | 12 - 18 | 20s (30.0) – 28s (21.0) | 220 |
| 2 | 24 - 28 | 30s (19.5) – 40s (14.5) | 210 |
| 3 | 28 - 32 | 34s (17.0) – 50s (12.0) | 200 |
| 4 | 32 - 36 | 40s (14.5) – 50s (12.0) | 180 |
| 5 | 36 - 40 | 50s (12.0) – 60s (10.0) | 150 |
| **NOTE** | *As determined by the number of needles per 2.54 CM* | | |

**Table 6** Constructional Particulars of Rib Knitted Fabric for Leggings
(*Clause 5.1*)

| Sl. No. | Gauge of Machine* (See Note) | Approximate Count of Yarn – Ne (Tex) | Mass $g/m^2$ Min (g) |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 1 | 12 – 18 | 20s (30.0) – 28s (21.0) | 250 |
| 2 | 18 – 24 | 30s (19.5) – 40s (14.5) | 230 |
| 3 | 24 – 28 | 34s (17.0) – 50s (12.0) | 220 |
| 4 | 28 – 32 | 38s (15.5) – 50s (12.0) | 200 |
| 5 | 32 – 36 | 50s (12.0) – 60s (10.0) | 180 |
| **NOTE** | *As determined by the number of needles per 2.54 CM* | | |

**TABLE 7** Body Measurements Chart for Leggings (Figure 1)
(Clause 5.1)

| Sl No. | SIZE | LENGTH [cm] | WAIST [cm] | | HIP [cm] | | INSEAM [cm] | THIGH [cm] | | CALF [cm] | | ANKLE [cm] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (B) | | € | | (D) | € | | (F) | | (G) | |
| | | | Women's | Men's | Women's | Men's | | Women's | Men's | Women' | Men's | Women's | Men's |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| 1. | XS | 90 | 61 – 66 | 71 – 76 | 81 – 86 | 86 – 91 | 64 | 46 | 52 | 30 | 33 | 18.0 | 22.0 |
| 2. | S | 94 | 68 – 72 | 76 – 81 | 86 – 91 | 91 – 97 | 66 | 48 | 54 | 30.5 | 35 | 19.0 | 22.5 |
| 3. | M | 96 | 74 – 76 | 81 – 86 | 91 – 97 | 97 – 102 | 68 | 50 | 55 | 31 | 37 | 20.0 | 23.0 |
| 4. | L | 100 | 79 – 81 | 86 – 91 | 97 – 102 | 102- 107 | 70 | 52 | 57 | 33 | 39 | 21.0 | 23.5 |
| 5. | XL | 102 | 84 – 86 | 91 – 97 | 102 – 107 | 107- 112 | 72 | 54 | 58 | 34 | 40 | 22.0 | 24.0 |
| 6. | 2XL | 104 | 89 – 91 | 97 – 102 | 107 – 112 | 112 – 117 | 74 | 56 | 60 | 35 | 41 | 23.0 | 25.0 |
| 7. | 3XL | 108 | 94 – 99 | 102 – 107 | 112 – 117 | 117 – 122 | 76 | 58 | 62 | 36 | 42 | 24.0 | 26.0 |
| 8. | 4XL | 110 | 100 – | 107 – 112 | 117 – 122 | 122 – 127 | 78 | 60 | 64 | 37 | 43 | 25.0 | 27.0 |
| 9. | 5XL | 112 | 106 – | 112 – 117 | 122 – 127 | 127 – 132 | 80 | 62 | 66 | 38 | 44 | 26.0 | 28.0 |
| 10. | 6XL | 116 | 112 – | 117 – 122 | 127 – 132 | 132 – 137 | 82 | 64 | 68 | 39 | 45 | 27.0 | 29.0 |
| 11. | 7XL | 120 | 118 – | 122 – 127 | 132 – 137 | 137 – 142 | 84 | 66 | 70 | 41 | 46 | 28.0 | 30.0 |
| 12. | 8XL | 124 | 124 – | 127 – 132 | 137 – 142 | 142 – 147 | 86 | 68 | 72 | 42 | 48 | 30.0 | 32.0 |

**NOTE** – *For sizes above 3XL, a suitable crutch piece can be added as the clause 5.4 and the agreement between the buyer and seller.*

**TABLE 8** Body Measurements Chart for Leggings (Figure 1) (Clause 5.1)

| Sl No. | Leggings Particulars | Front Rise (CM) | | Back Rise (CM) | |
|---|---|---|---|---|---|
| | | I | | J | |
| | | Women's | Men's | Women's | Men's |
| 1) | Low Rise Leggings | 18 - 20 | 20 - 23 | 25 - 28 | 25 - 28 |
| 2) | Mid Rise Leggings | 20 - 25 | 23 - 27 | 28 – 32 | 28 – 32 |
| 3) | High Rise Leggings | 25 - 30 | 27 - 30 | 32 - 36 | 32 - 36 |
| NOTE | *Measurements Shall Apply to All Sizes of Leggings* | | | | |

# 6 FREEDOMS FROM DEFECTS

The leggings shall be reasonably free from the manufacturing defects, such as large mends, ladders, dropped stitches, holes, improper splicing and chemical damages. The dyed and bleached leggings shall be free from dyeing defects, such as streakiness and uneven dyeing and the white leggings from blueing agents.

# 7 REQUIREMENTS

## 7.1 Dimension, Mass and Tolerances

The legging shall conform to the requirements of **Table 5**, and read with **Figure - 1**, along with considering the tolerances typically ±0.5 cm to ± 2.0 cm.

**NOTE----***The legging size should be denoted by the number correspond to the length and waist diameter.*

## 7.2 Seam and Stitching Tolerances

a) **Seam allowances** - Maintain consistent seam allowances (typically 0.6 cm to 1.5 cm) to ensure adequate construction and durability.

b) **Stitch quality** - Specify acceptable variations in stitch length, tension, and type such as; Lockstitch, Over-lock, or Cover-stitch; to ensure seams is secure and aesthetically pleasing.

### 7.2.1 Sewing

The sewing details of the leggings shall be as under:

| Sl No. | Portion to be Stitched | Type of Stitch | Sewing Thread |
|---|---|---|---|
| i.) | All Joining's | Flat – Lock | Three threads of 60s/3 count (100 dtex x 3) or 40s/2 count (145 dtex x 2) in the needle and one strand of the same threads in the each loopers. |
| ii.) | Flap at the front opening (For Men's Only) | Lock Stitch | One strand of cotton sewing thread of 60s/3 count (100 dtex x 3) or 40s/2 count (145 dtex x 2) in each of the needle and the looper. |
| **NOTE** - *Sewing thread of 60s/3.0 (100 dtex ) count may be used in place of 40s/2 (145 dtex x 2)* | | | |

**7.3** The leggings shall also conform to the requirements in Table 1, 2, 3, 4, 5, 6, 7

**7.4 Sealed Sample** - If in order to illustrate or specify general appearance, lustre, handle, type of finish and whiteness index or yellowness (ISO 105: J02, ISO 11475:2017), a sample has been agreed upon and sealed, the supply shall be in conformity with the sample in each respect.

# 8 MARKING

**7.1** Each pair of leggings shall be marked with the following:

a) Size (marked toward the waistband);
b) manufacturer's name, initials or trademark, if any (marked on the waistband) and;
c) fibre blend compositions must be given;
d) suitable washing instruction must be given;
e) Any other information as required by the law in force.

# 9 BIS CERTIFICATION

The Product(s) conforming to the requirements of this standard may certified as per the conformity assessment schemes under the provisions of the bureau of Indian Standards Act, 2016, and the Rules and Regulations framed thereunder, and the product (s) may be marked with the Standard Mark.

**Table 9** Other Requirements of Leggings
(*Clause 5.2*)

| Sl. No. | Characteristic | Requirements | Method of Test Ref to | Annex |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | |
| **i.** | Total number of Wales/dm, *Min* | 144 | B-4 | **Annex D** |
| **ii.** | Courses/dm, *Min* | 100 ± 4 | B-4 | |
| **iii.** | Dimensional Change (due to relaxation) Percentage, *Max* | 5.0 | B-5 | |
| **iv.** | pH value | 6 - 10 | IS 1390 | **Annex A** |
| **v.** | Water soluble, *Min* | 1.0 | IS 3456 | |
| **vi.** | Ash Content | 0.5 | IS 199 | |
| **vii.** | Colour fastness ratings to min | | | |
| | **i. Light** | 3 - 4 | IS/ISO 105 – B02 OR IS/ISO 105 – B01 | **Annex A** |
| | **ii. Washing**<br>a) Change in colour<br>b) Staining of Adjacent fabric | 4<br>4 | IS/ISO 105 – C10 | |
| | **iii. Perspiration**<br>a) Change in Colour<br>b) Staining of adjacent fabric | 3<br>3 | IS/ISO 105 – E04 | |
| | **iv. Rubbing**<br>a) Change in colour<br>**b)** Staining of adjacent fabric | 4<br>3 | ISO 766 | |
| | **v. Piling**<br>**(**Martindale Pilling Box- 14400 Rev) | 4 - 5 | BIS ISO 9943 : 2009 | |
| viii | Fibre Blend Compositions | | | **Annex** C |

# 10 PACKING

The leggings shall be packed as per the agreement between the buyer and seller.

# 11 SAMPLING

## 11.1 Lot

In any consignment, all the pairs of leggings of the same size manufactured from the same quality of yarn shall constitute a lot (IS 2500).

**11.2** The conformity of a lot to the specification shall be determined on the basis of the test carried out on the pairs of leggings selected from the lot.

**11.3** Unless otherwise agreed to between the buyer and the seller, number of pairs of leggings depending on the lot size, shall be selected at random according to the Col 1 and 2 of Table 9 & 10

**11.4** The number of pairs of leggings to be inspected and criterion for conformity for each characteristic shall be as follows:

**Table 10** Performance Assessment criteria for leggings

(Clause 12.3)

| **Sl. No.** | **Characteristic** | **Number of pairs of leggings to be Inspected** | **Criterion for Conformity** |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| I. | Visual inspection dimensions and number of wales and course | According to the col 3 of **Table 11** | Non-conforming pairs of legging shall not exceed the corresponding number given in col 4 of the **Table 11** |
| II. | Mass | Sets of 10 pairs of legging obtained from those selected according to col 3 of Table 3 | All the observations shall satisfy the relevant requirements |
| III. | Dimension change, scouring loss, pH value, ash content and colour fastness | According to col 5 of **Table 11** | All the test results shall satisfy the relevant requirement |

**Table 11:** Sample Size and Permissible Number Of Non-Conforming pairs of Leggings

(*Clause 9.3 and 9.4*)

| **Sl. No.** | **Number of pairs of Leggings In The Lot** | **For Dimensions and visual Inspection** | | **Testing** |
|---|---|---|---|---|
| | | **Number of pairs of Leggings to be Inspected** | **Number of permissible Non-Conforming Pairs** | **Number of pairs of Leggings to be tested for Chemical Characteristics** |
| (1) | (2) | (3) | (4) | (5) |
| I. | Up to 100 | 10 | 0 | 3 |
| II. | 100 – 300 | 20 | 1 | 3 |
| III. | 301 – 500 | 30 | 2 | 5 |
| IV. | 501 – 1000 | 50 | 3 | 5 |
| V. | 1001 and above | 80 | 5 | 8 |

**ANNEX A -** LIST OF REFERRED STANDARDS

**(***Clause 4.1, 4.2, 4.3***)**

| **Sl. No.** | ***IS No.*** | ***Title*** |
|---|---|---|
| 1. | IS 199 : 1989 | Textiles - Estimation of moisture, total size or finish, ash and fatty matter in grey and finished cotton textile materials (*Third Revision*) |
| 2. | IS 1390 : 2022 | Textiles Determination of pH of aqueous extract (Third Revision) |
| 3. | IS 3086 : 1965 | Code for seaworthy packaging of cotton hosiery yarn and goods |
| 4. | IS 3325 : 1965 | Code for inland packaging of cotton hosiery yarn and goods |
| 5. | IS 3456 : 2022 | Method for determination of water-soluble. matter of textile materials (*First Revision*) |
| 6. | IS 3596 : 1967 | Glossary of terms relating to hosiery |
| 7. | IS 6359 : 2023 | Method for conditioning of textiles |
| 8. | IS/ISO 105 – B01: 2014 | Textiles: Tests for colour fastness - Part B01 colour fastness to light: Daylight |
| 9. | IS/ISO 105 – B02: 2014 | Textiles: Tests for colour fastness - Part B02 colour fastness to artificial light: xenon arc fading lamp test |
| 10. | IS/ISO 105 – C10: 2006 | Textiles: Tests for colour fastness - Part C10 colour fastness to w with soap or soda and soap |
| 11. | IS/ISO 105 – E04: 2008 | Textiles: Tests for colour fastness - Part E04 colour fastness to perspiration |
| 12. | ISO 16373-3 | Textiles. Dyestuffs - Method for determination of certain carcinogenic dyestuffs (method using tri-ethylamine/methanol) |
| 13. | BS EN ISO 14362-1,2,3 | Textiles. Methods for determination of certain aromatic amines derived from Azo colorants - Textile testing; Amines (aromatic) ... |
| 14. | ISO 105 – NO2 | Textiles - Test for colour fastness Part NO2: Colour fastness to bleaching- Peroxide |
| 15. | ISO 766 | Textiles - Method for determination of colour fastness of textile materials to rubbing [TXD 5: Chemical Methods of Test] |
| 16. | IS 667: 1981 | Textiles fibres - Methods for identification of textile fibres (first revision) |
| 17. | ISO 1833-1:2020 | Textiles -- Quantitative chemical analysis -- Part 1: General principles of testing |
| 18. | IS-10971 (P-2) : 2022<br>ISO 12945-2:2020 | Textiles – Determination of Fabric Propensity to Surface Fuzzing and to Pilling, Part 2: Modified Martindale Method |
| 19. | ISO 6989:1981 | Textile fibres — Determination of length and length distribution of staple fibres (by measurement of single fibres) |
| 20. | IS 15336: 2003 | Textiles – Acrylic Yarn for Hosiery – Specification |
| 21. | IS 13719:2003 | Textiles Spun cotton regenerated cellulosic fiber blended grey yarn - Specifications |
| 22. | IS 9543:2019 | Textiles - Spun polyester sewing thread – Specifications (first revision) |
| 23. | ISO/TR 11827:2012 | Textiles — Composition testing — Identification of fibres |
| 24. | ISO 10132:1993 | Textiles - Textured filament yarn - Definitions |
| 25. | ISO 5688:2024 | Textiles - Synthetic filament yarns - Test methods for crimp |

| | | |
|---|---|---|
| | | properties of Textured yarn |
| 26. | ISO 7211-5 | Textiles- methods for the determination of linear density of yarn removed from fabric. |
| 27. | IS 13003: 1991 | Textiles - Fabric, cotton, interlock knitted - Specification |
| 28. | IS 9469 : 2003 | Textiles – Fabric, cotton, plain (Single jersey) knitted – Specification (second revision) |
| 29. | IS 834 : 2006 | Textiles – Ring Spun Grey Cotton Yarn for Textiles |
| 30. | ISO 8559 - 1 | Textiles – Size designation of clothes – Anthropometric definitions for body measurement |
| 31. | ISO 8559 - 2 | Textiles Size designation of clothes Part 2: Primary and secondary dimension indicators |
| 32. | ISO 8559 - 3 | Textiles Size designation of clothes Part 3: Methodology for the creation of body measurement tables and intervals |
| 33. | IS 1966-1 (2009) | Textiles - Bursting Properties of Fabrics - Determination of Bursting Strength and Bursting Distension, Part 1: Hydraulic Method [TXD 1: Physical Methods of Tests] |
| 34. | IS 1670 (1991) | Textiles - Yarn - Determination of breaking load and elongation at break of single strand [TXD 1: Physical Methods of Tests] |
| 35. | IS/ISO 16322 (1-3) | Determination of spirality of knitted fabrics post laundering. |
| 36. | ISO 6330 | Textiles — Domestic washing and drying procedures for textile testing |
| 37. | IS 10099 : 2020<br>ISO 3759 : 2011<br>(Active) | Textiles – Preparation marking and measuring of fabric specimens and garments in tests for determination of dimensional change (first revision) |
| 38. | IS 9686:2022 | Textiles - Specification For Elastic Tape |
| 39. | IS 2500 | Part 4,5 & 6 Sampling Procedures for inspection by attributes. |

## ANNEX B

## METHODS OF TEST

### B-1 CONDITIONING OF THE TEST SPECIMEN AND ATMOSPHERIC COMDITIONS FOR TESTING

**B - 1.1** The test specimen shall be tested in prevailing atmospheric conditions. In case of dispute**,** the specimen shall be conditioned and tested in the standard atmosphere as given in IS 6359.

### B - 2 DIMENSIONS

**B - 2.1** Take a legging from the test sample. Lay flat on a horizontal surface. Remove by hand all creases and wrinkles without distorting it. Measure dimensions correct to the nearest centimetre, as given in Table 8.

### B - 3 MASS

**B - 3.1** Take a set of 10 pairs of legging from the test sample. Condition them for moisture equilibrium for 24 hours (see B-1.1)**.**

**B - 4 WALES AND COURSES**

**B - 4.1** Take leggings from the test sample. Lay it flat on a horizontal surface. Remove by hand all creases and wrinkles without distorting it.

**B - 4.1.1** Count the number of wales including any fraction on one side of the leggings. Similarly count the number of wales including any fraction on other side of the legging and add the two values.

**B - 4.1.2** Count the number of courses in 10 cm including any fraction on both sides of the leggings and calculate the average courses per decimetre.

**B- 5 DIMENSIONAL CHANGE (Due To Relaxation)**

**B-5.1** Marking the Test Specimens. Take a legging from the test sample. Mark centrally on it, by means of indelible ink or fast dyed cotton sewing, a set of three points, namely, *X*,*Y* and, *Z* so that,

a) All the three points are on the same wale,
b) point *X* is on the top portion;
c) point *Y* is on the heel gore line; and
d) Point *Z* is on the toe portion.

**B - 5.2 Procedure**

**B - 5.2.1** Place the test specimen on a glass plate. Remove by hand all the creases and wrinkles without stretching the specimen. Place another glass plate on the specimen. Measure separately, correct to the nearest millimetre, the distance between *X* and *Y* and that between *Y* and *Z*.

**B - 5.2.2** Lay the test specimen flat in a tray of suitable size, having a depth of 10 cm. Soak the specimen under the head of 25mm of water containing 0.5 % of suitable wetting agent at room temperature for two hours. Drain out the water and remove the test specimen carefully so that it is not stretched. Lay the specimen flat on a smooth surface, remove the excess water by absorbent material and dry it at room temperature.

***Note*** *– Removal of excess water by wringing the test specimen is not permitted*

**B - 5.2.3** After drying, conditioned the test specimen to moisture equilibrium at room temperature, Place it on the glass plate, carefully remove wrinkles and creases and place another glass plate on it. Measure, correct to the nearest centimetre, the distance between *X* and *Y* and that between *Z*

**B-5.3 Calculation**

**B - 5.3.1** calculate separately, correct to one place of decimal, the percentage change between the points *X* and *Y* and that between *Y* and *Z* by following formula:

$$S = \frac{a - b}{a} \times 100$$

Where;

a) S = dimensional change (due to relaxation) percent;
b) a = distance between the two points X and Y, or Y and Z, before soaking; and
c) b = distance between the same points after soaking.

**B-5.3.2** Calculate the average dimensional change**.**

**C - 6 SPIRALITY OF THE KNITTED FABRIC**

Spirality is a major problem of knit fabrics which are produced in circular knitting machines. Relaxation of torsional stresses cause dimensional distortions and instability in the knitted loop constructions. The factors that influence the spirality include; machine gauge, no of feeders, yarn type and fabric properties, etc.

**C – 6.1 Measurement of Spirality after Laundering**

Spirality is determined by placing a protractor on the smooth fabric surface with its base-line along the course and reading the angle between the wale line and a line 90°perpendicular to the course line.

**C - 6.2 Test Specimen Preparation and Marking Procedures**

i. Prepare specimen for marking from appropriate location from the sample. Cut a specimen of size 380 mm x 380 mm single layer fabric.
ii. Place the test specimen on a glass plate with the technical face of the fabric upwards.
iii. Remove by hand all the creases and wrinkles without stretching the specimen.
iv. If necessary, place tensioning mass on either side of the fabric sample to keep the welt straight.

**C - 6.3 Procedure - Diagonal Marking**

i. Mark two pairs of 250 mm benchmark sets parallel to the length and two pairs of 250 mm benchmark sets perpendicular to the width to make a square. Draw a line through each of the four sets of adjacent benchmark to denote the square formed.

ii. Label the four corners, A, B, C and D in clockwise direction starting at the lower left corner as shown in figure -3. Using the middle third of the specimen width, place the ruler or a straightedge parallel to the direction of wales in the fabric specimen.

iii. Choose one wale, and align and the straight edge of the ruler with that wale at the intersection between the body of the specimen and the welt. Keeping that point fixed, rotate the straightedge until it crosses the same wale at a position (200 ± 1) mm from the top of the welt.

iv. Without moving the straightedge, place the protector on the straightedge with the base line parallel to the top of the welt. Measure the angle between the line of the straightedge and the bottom of the protector which is parallel to the top of the welt. (See figure 3)

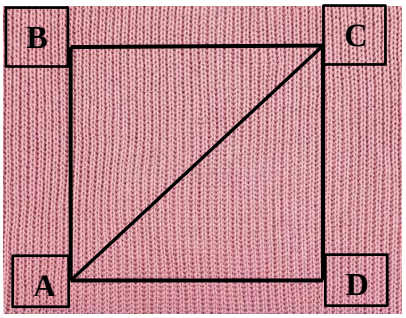


**Figure – 3** Diagonal Marking Procedures

**C – 6.2.4 Calculation of the Spirality in Percentage**

i. Calculate the percentage change in the wale angle spirality from the original measurement as follow:

$$S = \frac{\alpha - \beta}{\alpha} \times 100$$

Where;

S = is the percentage spirality change after laundering, expressed as a percentage of the original;

α = is the original wale spirality angle, expressed in degrees [See Figure 4(a)];

β = is the wale spirality after laundering, expressed in degrees [See Figure 4(b)].

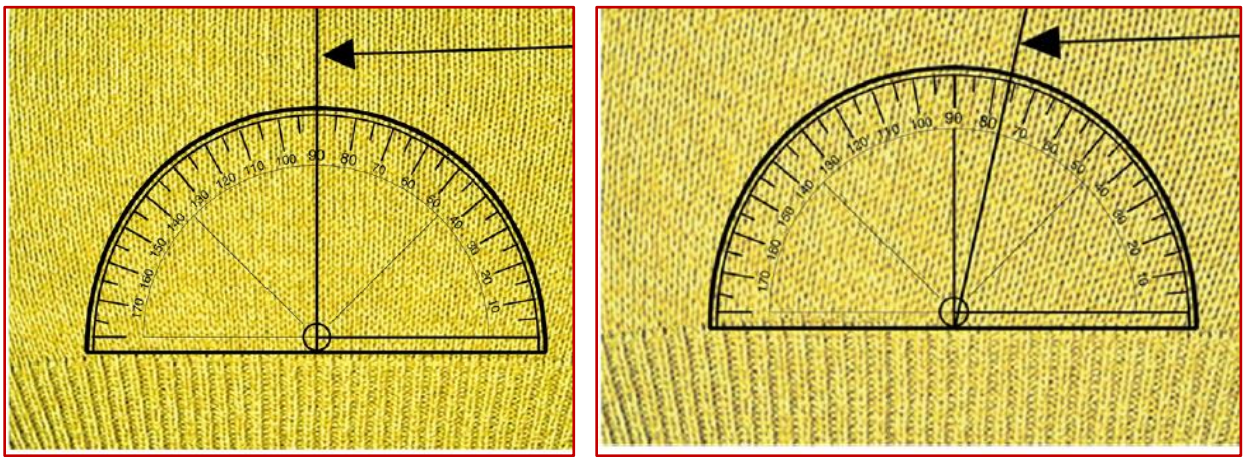

**Figure 4: (a)** Originally measured spirality angle α, (b) Measured spirality angle β after laundering.

## ANNEX C
YARN

**Table 1** 100% Cotton Carded & Combed Hosiery Yarn
(Clause 4.1)

| **Test Parameters** | **20CH** | **24CH** | **30CH** | **32CH** | **36CH** | **40CH** | **50CH** | **60CH** |
|---|---|---|---|---|---|---|---|---|
| Count(Ne) | 20s | 24s | 30s | 32s | 36s | 40s | 50s | 60s |
| | **20KH** | **24KH** | **30KH** | **32KH** | **36KH** | **40KH** | ----- | ----- |
| Count(Ne) | 20s | 24s | 30s | 32s | 36s | 40s | ---- | ---- |
| Count CV% | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| **Note:** | **KH** – Carded Yarn, **CH** – Combed Yarn | | | | | | | |
| | Data obtained from T.T Limited ***[www.ttlimited.co.in]*** | | | | | | | |

**Table 2** Blended Yarns used commercially in Hosiery
**(**Clause 4.1**)**

| **Sl. NO.** | **Blend Type** | **Blend %** | **Count Range (Ne)** | **Yarn Ply** |
|---|---|---|---|---|
| | Cotton | 100% | 20s – 60s | 1 Ply, 2 Ply |
| 1. | Cotton/Polyester | 60/40, 65/35, 50/50, 52/48, 33/67, 70/30, 80/20, | 20s – 60s | 1 Ply, 2 Ply |
| 2. | Cotton/Viscose | 55/45, 65/35 70/30, 85/15, 40/60, 50/50, | 20s – 60s | 1 Ply, 2 Ply |
| 3. | Polyester/Viscose | 50:50, 90:10, 75:25, 65:35 | 20s – 50s | 1 Ply, 2 Ply |
| 4. | Polyester/Spandex [240 – 270 GSM] | 80/20, 70/30, 88/12, 90/10, 84/16 | 20s – 60s | 1 Ply, 2 Ply [210 – 300 GSM] |
| 5. | Nylon/Spandex | 70/30, 80/20, 75/25, 90/10, 87/13 | 20s – 60s | 210 - 300 GSM |
| 6. | Cotton/Acrylic | 75/25, 60/40 | 20s – 60s | |

| | | | | |
|---|---|---|---|---|
| | | 50/50, 40/60 | | |
| 7. | Cotton/Spandex | 50/50, 90/10, 95/5 | 20s – 60s | 140 GSM Fabric |
| 8. | Viscose Jersey Fabric | _____ | 20s, 24s, 30s, 34s, 40s. | 220 GSM |
| 9. | Cotton/Nylon /Spandex Fabrics | | 20s – 60s | 200 GSM Fabric |
| 10. | Cotton/Viscose/Spandex | | 20s – 60s | 160 GSM |

**Table 3** Spandex Filament used Commercially Available
(Clause 4.1)

| Sl. No. | Filament Type | Denier |
|---|---|---|
| 1 | Spandex/Lycra | 20, 40, 55, and 70 denier (22, 44, 61, and 78 dtex) |

**Table 4** Fiber Bend compositions and Structure combinations for Leggings
(Clause 4.1)

| Sl. No. | Brands in the Market | Product Type | Fabric Structure Details | | | | | | Machine Details Gauge | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cotton | Nylon filament | Polyester Filament | Spandex (Denier) | Acrylic | | Circular | Flatbed |
| 1. | Pretty Polly | Smooth Leggings | | 93% | | 7% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 2. | CETTE | London Leggings Plus | 1.0% | 93% (60 D) | | 6.0% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 3 | Glamour Velvet 80 Leggings | Leggings | | 89% (80 D) | | 11% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 4 | FALKE | Pure Matt Leggings | | 91% (100 D) | | 9% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 5 | WOLFORD | Twenties Econyl Leggings | | 82% | | 18% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 6 | GIPSY | Thermal Legging | | 95% (200 D) | | 5% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 7 | FALKE | Cotton Touch Leggings | 43% | 50% | | 7% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 8 | GM Hosiery | Leggings | 95 % | | | 5 % | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 9 | Dinesh Exports private Ltd. | Cotton/Lycra & Custom | 50% | | | 50% | | Plain & Rib | 24 5 - 40 | 5 - 14 |
| 10 | Active Fit Apparel Co & Flexi | Acrylic /Polyester/Nylon/Spandex | | 40% | 5% | 15% | 40% | | 24 5 - 40 | 5 - 14 |

**ANNEX D**

(Clause 4.2)

## B-1 IDENTIFICATION OF POLYESTER

The material used for manufacture is dipped in the following reagents:

a) Solution of crystallized tri-chloro-acetic acid/chloroform reagent, prepared at a mass ratio 1:1.

b) Benzyl Alcohol at temperatures of 150°C.

c) M-cresol at 93 ºC, Polyester will dissolve

**B-1**.1 If the material used for manufacture is polyester; it shall dissolve in the above mentioned reagents.

## B - 2 IDENTIFICATION OF COTTON

**B – 2.1** The material used for manufacture is dipped in any one of the following reagents:

a) Cotton dissolves in Schweitzer's Reagent ($Cu(OH)_2$ in ammonia), a specific test for cellulose.
b) Cotton will dissolve in concentrated sulfuric acid, indicating the presence of cellulose.
c) Boil the fabric sample in a 5% NaOH solution. Cotton will degrade and lose its structure in strong NaOH solutions.

**B-2.2** If the material used for manufacture is cotton; it shall dissolve in the above mentioned reagents.

## B - 3 IDENTIFICATION OF SPANDEX

**B - 3.1** The material used for manufacture is dipped in any one of the following reagents:

a) Spandex will dissolve in DMF (Dimethyl formamide) or DMAc, unlike many other fibers.
b) Spandex is resistant to formic acid, while some other fibers may dissolve or degrade.
c) Spandex will degrade but not dissolve completely in sulfuric acid, often swelling and losing elasticity.

**B-3.2** Spandex shows specific thermal transitions, such as a melting point around 240-270°C.

## B – 4 IDENTIFIOCATION OF VISCOSE RAYON

**B- 4.1** The material used for manufacture is viscose rayon, it shall either dissolve or swell in the above mentioned reagents.

a) **Procedure:** Immerse a small sample in a solution of sodium hydroxide (NaOH). Viscose rayon will swell and may dissolve, while cellulose fibers like cotton will remain largely unchanged.

b) **Procedure:** Soak the fiber in concentrated acetic acid for a few minutes. Viscose rayon will dissolve in acetic acid, while most other fibers will not.