For BIS Use Only

BUREAU OF INDIAN STANDARDS

AGENDA

Physical Methods of Tests Sectional Committee, TXD 01 **29th Meeting**

Date/Day	Time	Venue
19 November 2024 (Tuesday)	1100 h	Through Video Conferencing

CHAIRPERSON
Dr A. S. M. Raja
Principal Scientist, ICAR-CIRCOT, Mumbai

MEMBER SECRETARY
Shri Amit Kumar Pandey
Scientist-B/Asst. Director
BIS, New Delhi

Item 0 WELCOME AND INTRODUCTORY REMARKS BY THE CHAIRMAN

Item 1 CONFIRMATION OF THE MINUTES OF THE PREVIOUS MEETING

1.1 The minutes of the 28th meeting of the committee held on 13 August 2024 were circulated vide BIS Directorate General Letter No. TXD 01/A2.28 dated 03 September 2024. The comment received from Shri Sachin P. Kulkarni based on the accuracy of recording of minutes on the circulated minutes is as follows:

"During the meeting, I clearly stated that Mr. Kishor Darda has been transferred to another department within Garware Technical Fibers. However, upon reviewing the minutes of the meeting (MoM), I noticed that it was incorrectly recorded that he is no longer an employee of the organization. This is not accurate. Mr. Darda is still with the organization and currently working in the Marketing Department.

Please correct the minutes of meeting accordingly and redistribute it.

Additionally, as discussed, kindly replace Mr. Darda's name with Mr. Sachin Kulkarni and appoint Mr. Niraj Srivastava as the alternate member"

1.1.1 The Committee may consider the comment and **CONFIRM** the minutes as circulated.

Item 2 SCOPE AND COMPOSITION OF TXD 01

2.1 The present composition and scope of TXD 01 are given in **Annex 1 (Page 07-08).**

2.1.1 The committee may **DECIDE**.

2.2 Shri Madhan R have requested for representation on TXD 01 Committee in Individual Capacity. The CV of Shri Shri Madhan R along with other information provided on BIS Standardization portal is given at **Annex 2 (attached seperately)**.

2.2.1 The Committee may **DECIDE**.

2.3 Shri Suresh Sundaramurthy have requested for representation on TXD 01 Committee in Individual Capacity. CV of Suresh Sundaramurthy along with other information provided on BIS Standardization portal is given at **Annex 3** (**attached seperately)**.

2.3.1 The Committee may **DECIDE**.

Item 3 ISSUES ARISING OUT OF THE PREVIOUS MEETING

3.1 A summary of actions on the various decisions taken in the last meeting is given in **Annex 4 (Page 09-10).**

3.1.1 The Committee may **NOTE**.

Item 4 DRAFT STANDARD FOR FINALIZATION

4.1 As decided by the Committee, the following draft Indian Standards were issued in wide circulation for eliciting technical comments:

Sl No.	Doc. No.	IS No. and Title	WC Date
1.	26245	Textiles — Linear density of yarns spun on cotton System — Methods of test (*Second revision*)	30 Oct 2024
2.	26246	Textiles — Stiffness characteristic of fabrics — Methods of Test (*first revision*)	31 Oct 2024
3.	26247	Textiles — Yarn count system for designating linear density (*first revision*)	31 Oct 2024
4.	26560	Textiles — Evaluation of the wrinkle recovery of fabrics — Appearance method (*first revision*)	11 Nov 2024
5.	26561	Amendment no. 1 to IS 6359 : 2023 Method for conditioning of textiles (*first revision*)	16 Nov 2024

4.1.1 The drafts of the standards are given in **Annex 5 (Page 11 - 64).**

4.1.2 A comment has been received on the WC document of Amendment no. 1 to IS 3442, Textiles – Method for determination of crimp and linear density of yarn removed from fabrics (*second revision*).

4.1.1 The Committee may **DECIDE**.

ITEM 5 DRAFT STANDARDS FOR WIDE CIRCULATION

5.1 The committee in the previous meetings decided to prepare wide circulation drafts for the revision of following Indian standards based on the comments received from stakeholders and review proformas. These draft standards were circulated as Preliminary draft among the

committee members for two weeks on dated 30 October 2024. No technical comments have been received yet from the committee members.

Sl. No.	IS No.	IS Title
1.	IS 1964	Textiles – Mass per unit length and mass per unit area – Methods of test (*third revision*)
2.	IS 1670	Textiles – Yarns – Determination of single-end breaking force and elongation at break (*third revision*)
3.	IS 1671	Textiles – Strength parameters of yarns spun on cotton system – Methods of test (*second revision*)
4.	IS 1963	Textiles – Woven fabrics – Determination of number of threads per unit length (*third revision*)
5.	IS 7703 (Part 1)	Textiles – Synthetic filament flat yarns – Methods of Test Part 1 Linear Density (*second revision*)

5.1.1 Accordingly, these preliminary drafts as given in **Annex 6 (Page 65 - 115)** are being put up to the committee for allowing wide circulation of the drafts, for two months, for eliciting technical comments from other stakeholders.

5.1.1.1 The committee may **DECIDE**.

ITEM 6 NEW SUBJECTS FOR STANDARDIZATION

6.1 In the 27th meeting of TXD 01, the committee had decided to take up the new subject "Smoothness test for fabrics" for formulation of Indian Standards under TXD 01 committee. The committee also constituted a working group under the convenorship of Dr M. S. Parmar, NITRA, Ghaziabad for " Preparation of Working draft for Smoothness test for fabrics".

6.1.1 Accordingly, a working group meeting was convened on 08 November 2024 through video conferencing under the convenorship of Dr M. S. Parmar, NITRA, Ghaziabad. The minutes of the said working group meeting is given in **Annex 7 (Page 116 - 118).** The working draft for Smoothness test for fabrics, as recommended by the working group, is given in **Annex 8 (Page 119 - 128).**

6.1.2 The Committee may **DECIDE**.

Item 7 COMMENCEMENT OF ISO BALLOTS RECEIVED UNDER TXD 01 THROUGH IRD PORTAL

7.1 As 'P' member of ISO/TC 38, BIS have received two ISO ballots on systematic review of following ISO standards, related to Physical Testing of Textiles, for member body voting:

i) ISO 17202:2002 (vers 4) Textiles — Determination of twist in single spun yarns

— Untwist retwist method

ii) ISO 10306:2014 (Ed 2, vers 2) Textiles — Cotton fibres — Evaluation of maturity by the air flow method

7.1.1 The inputs are sought from the National Standards Bodies of 'P' member countries on the following aspects:

i) Recommended action on ISO standards i.e. Confirm as it is, Revise or Amend or Withdraw.
ii) Proposal for nomination of experts, if the committee decides to revise the current edition of the above mentioned ISO standards

7.1.2 It is informed that comments on the above document are important for projecting India's point of view at the formulation stage of International Standards which may have to be followed by India, being signatory to WTO/TBT agreement. India should utilize this opportunity to give inputs for the International Standards while they are being formulated and it would be incumbent upon the country to implement an international standard for which it has sent a positive vote.

7.1.3 The current edition of the above mentioned ISO standards are given in **Annex 9** (**attached separately**).

7.1.4 The Committee may **DELIBERATE** and **DECIDE.**

Item 8 SECTOR-WISE WORKING GROUPS UNDER TXD 01

8.1 As per the directions of the competent Authority of BIS, it has been decided to constitute the working groups for each sectors covered in the scope of the Technical Committee. Accordingly, the Physical Methods of Test Sectional Committee has been divided into two sectors i.e. Physical Characterization of Fibres and Yarns, and Physical Characteristics of Fabrics. These working groups will work extensively for the development of New Indian Standards or review of published Indian Standard in their particular sector.

8.1.1 The Committee may **DELIBERATE** and **DECIDE**.

Item 9 WITHDRAWAL OF INDIAN STANDARDS

9.1 While reviewing the Programme of Work for TXD 01 Sectional Committee, it has been found that there are few Indian Standards which are still available in the portal, however, they are already either superseded by their revisions or amalgamated with other Indian Standards. The list of such Indian Standards under the domain of TXD 01 Sectional Committee, which shall be withdrawn, are as follows:

Sl. No.	Sectional Committee	IS No.	Tittle	Superseded by/ Amalgamated with

	TXD 01	IS 233 (Part 1-4) : 1978	Methods for determination of length parameters of cotton fibres (first revision)	Superseded by - i) IS 233 (Part 1) : 2021Textiles ─ Methods for Determination of Length Parameters of Cotton Fibres Part 1 General (Second Revision) ii) IS 233 (Part 2) : 2021 Textiles ─ Methods for Determination of Length Parameters of Cotton Fibres Part 2 Estimation of Length and Length Distribution by the Array Method (Second Revision) iii) IS 233 (Part 3) : 2021 Textiles ─ Methods for Determination of Length Parameters of Cotton Fibres Part 3 Estimation of Length and Length Distribution by the Thickness Scanning Method (Second Revision) iv) IS 233 (Part 4) : 2020 Textiles ─Methods for Determination of Length Parameters of Cotton Fibres Part 4 Estimation of Length, Uniformity Ratio and Uniformity Index by the Optical Scanning Method (Second Revision)
	TXD 01	IS 10014 (Part 2) : 1981	Methods of Tests for Man-Made Staple Fibres Part 2 Determination of Linear Density	Amalgamated in IS 234 : 2013 Textiles - Method for determination of linear density of textile fibres (Gravimetric and vibroscope method) - Specification (second revision)

9.1.1 The Committee may **DELIBERATE** and **DECIDE.**

Item 10 REVIEW OF INDIAN STANDARDS

10.1 As per the direction of DG, BIS, the Indian Standards which are due for review in the current shall be reviewed either through Action Research Project allocated to an individual committee member or through working group. Accordingly, the Indian Standards which are due for review under Physical Methods of Test Sectional Committee, TXD 01 in the financial year 2024 – 2025, along with the proposed expert for review, are tabled below:

Sl No.	IS No.	IS Title	Allocated experts (Proposed)
1.	IS 232: 2020	Glossary of textile terms - Natural fibres (*third revision)*	Dr Nagesh Kumar
2.	IS 3674: 2020	Textiles - Cotton Fibres - Determination of micronaire value (*first revision*)	Dr T. Senthilkumar

3.	IS 3675: 2020	Textiles - Cotton Fibres - Determination of breaking tenacity of flat bundles (*first revision*)	Dr A. Arputharaj
4.	IS 6919: 2020 ISO 1136:2015	Wool – Determination of mean diameter of fibres – Air-permeability method (*first revision*)	Dr Mayur Basuk

10.1.1 The Committee may **DELIBERATE** and **DECIDE.**

Item 10 DATE AND PLACE OF NEXT MEETING

Item 11 ANY OTHER BUSINESS

ANNEX 1
(*Item* 2.1)

SCOPE AND COMPOSITION OF TXD 01

SCOPE: To formulate Indian Standards for terminology and methods of physical test for all types of textiles; for example, fibres yarns and fabrics (woven, non-woven, knitted or felted) made from natural or Man-made fibres:

Meetings held	**Date and Place**
26th Meeting	23 Nov 2023, CISCO Webex
27th Meeting	10 April 2024, CISCO Webex
28th Meeting	13 August 2024, CISCO Webex

Sl No.	Organization	Representative(s)	Attendance	Attendance
1.	ICAR - Central Institute for Research on Cotton Technology (CIRCOT) Mumbai	DR A. S. M. RAJA **(*Chairperson*)**	**3/3**	111
2.	Ahmedabad Textile Industry's Research Association (ATIRA), Gujarat	MS. DEEPALI PLAWAT SHRI JIGAR DAVE (*Alternate*)	**1/2**	01
3.	Central Silk Technological Research Institute (CSTRI), Bangalore	DR S. PERIYASAMY DR PRAKASH BHAT (*Alternate*)	**2/3**	101
4.	Delta Ropes Mfg. Co., Kolkata	SHRI ANAND MAJARIA SHRI AAYUSH MAJARIA (*Alternate*)	**3/3**	111
5.	DGQA (HQ), New Delhi	SHRI R. K. BORUAH SHRI P. H. TEMBHEKAR (*Alternate*)	**2/3**	101
6.	Garware Technical Fibres Limited, Pune	SHRI SACHIN KULKARNI SHRI NEERAJ SRIVASTAVA(*Alternate*)	**2/3**	101
7.	ICAR - Central Institute for Research on Cotton Technology (CIRCOT), Mumbai	DR T. SENTHILKUMAR DR ARPUTHARAJ A. (*Alternate*)	**1/3**	001
8.	ICAR - National Institute of Natural Fibre Engineering and Technology (NINFET), Kolkata	DR SANTANU BASAK DR NAGESH KUMAR (*Alternate*)	**3/3**	111
9.	Imposub Solutions, Vadodara	SHRI GIRISH T. MASAND SHRI T. D. MASAND (*Alternate*)	**2/3**	011
10.	Indian Institute of Technology (IIT), Delhi	PROF. R. S. RENGASAMY PROF. APURBA DAS (*Alternate*)	**1/3**	100
11.	Indian Jute Industries Research Association, Kolkata	MS. SOUMITA CHOWDHURY SHRI D. P. GON (*Alternate*)	**2/3**	011
12.	Indian Jute Mills Association, Kolkata	SHRI S. K. CHANDRA SHRI BHUDIPTA SAHA (*Alternate*)	**3/3**	111
13.	Kusumgar Corporates, Mumbai	SHRI YOGESH KUSUMGAR DR MUNENDRA SINGH (*Alternate*)	**3/3**	111
14.	National Jute Board, Kolkata	SHRI MAHADEB DUTTA	**0/0**	

15.	National Test House, Kolkata	SHRI S.P. KALIA SHRI VIPIN V. (*Alternate*)	**1/1**	1
16.	North India Textile Research Association, Ghaziabad	SHRI SANJEEV SHUKLA DR NEHA KAPIL (*Alternate*)	**2/3**	110
17.	Office of the Jute Commissioner, Kolkata	SHRI SOMYADIPTA DATTA SHRI ANUSUA MUKHERJEE (*Alternate*)	**3/3**	111
18.	Office of the Textile Commissioner, Mumbai	SHRI SIVAKUMAR S. SHRI GAURAV GUPTA (*Alternate*)	**1/3**	001
19.	SGS India Pvt. Ltd, Chennai	DR KARTHIKEYAN K. SMT. ANITHA JEYARAJ (*Alternate*)	**1/3**	111
20.	Testex India Laboratories Pvt. Ltd, Mumbai	DR MEETA SHINGALA SHRI CHANDRAKANT PALEKAR (*Alternate*)	**1/1**	1
21.	Testing Centre & Testing Station Division, Ministry MSME, New Delhi	SHRI PHOOL SINGH SHRI VED P. SHARMA (*Alternate*)	**1/3**	010
22.	Texanlab Laboratories Pvt. Ltd., Mumbai	SHRI HARIT SARDANA SHRI VIVEK PATIL (*Alternate*)	**1/3**	010
23.	Textiles Committee, Mumbai	SHRI KARTIKAY DHANDA DR P. RAVICHANDRAN (*Alternate*)	**3/3**	111
24.	Thanawala & Co., Mumbai	SHRI HEMAL THANAWALA SHRI VIVAAN THANAWALA (*Alternate*)	**2/3**	011
25.	The Bombay Textile Research Association, Mumbai	SHRI R. A. SHAIKH SMT. PRAGTI KULKARNI (*Alternate*)	**2/3**	011
26.	The Synthetic and Art Silk Mills Research Association, Mumbai	DR MANISHA MATHUR SMT A. A. SUDAM (*Alternate*)	**1/3**	100
27.	Tirupati Technik, Mumbai	SHRI VISHAL MASAND	**3/3**	111
28.	TUV Rheinland (India) Pvt. Ltd., Gurgaon	DR P. S. SUNDARAM SHRI SHIVENDRA PARMAR (*Alternate*)	**2/3**	101
29.	VJTI, Mumbai	DR SURANJANA GANGOPADHYAY DR S. P. BORKAR (*Alternate*)	**2/3**	011
30.	Welspun India Ltd, Mumbai	MR. RAJEEV CHAUHAN MR. SRIDHAR DEVARAKONDA (*Alternate*)	**1/2**	01
31.	Wool Research Association, Thane	MS. SEEMA PATEL SHRI MAYUR BASUK (*Alternate*)	**2/3**	110
32.	World Traders Manufacturing Co., Mumbai	SHRI VARUN GUPTA SHRI ADITYA GUPTA (*Alternate*)	**3/3**	111

ANNEX 4

(*Item* 3.1)

SUMMARY OF ACTIONS TAKEN ON THE DECISIONS TAKEN IN THE PREVIOUS MEETINGS

Item No.	Brief Description	Action Taken
2	**COMPOSITION AND SCOPE OF TXD 01**	Updated.
4	**DRAFTS STANDARDS FOR FINALIZATION** i) **[Doc.: TXD 01 (24993)],** Textiles - Biaxial tensile properties of woven fabric – determination of maximum force and elongation at maximum force using the grab method ii) **[[Doc. : TXD 01 (25026)],** *Second revision* of IS 7032 (Part 1-9), Textiles – Physical methods of test for uncut Indian Jute, Mesta and Bimli iii) **[Doc.: TXD 01 (25027)],** *First revision* of IS 9030, Textiles – Methods for determination of Seam Strength of Jute Fabrics including their laminates iv) **[Doc.: TXD 01(255573)],** Textiles - Synthetic Filament Yarns - Electrostatic propensity evaluation by measuring electrical resistance v) **[Doc.: TXD 01(25579)],** Textiles - Synthetic Filament Yarns - Test methods for crimp properties of textured yarns vi) **[Doc.: TXD 01(24909)]**, *Amendment no. 1 to* IS 3442, Textiles – Method for determination of crimp and linear density of yarn removed from fabrics (*second revision*) vii) **[Doc.: TXD 01(25561)]**, *Amendment no. 2 to* IS 1969 (Part -1), Textiles – Tensile properties of fabrics – Part 1 - Determination of maximum force and elongation at maximum force using the strip method (*fourth revision*)	The Current Status of the finalized standards are: i) Under Printing ii) Under Publication iii) Under Printing iv) Under Publication v) Under Publication vi) Already Published vii) Already Published
5	**DRAFT STANDARDS FOR WIDE CIRCULATION** i) **[Doc.: TXD 01(26247)],** *First revision* of IS 3689, Textiles – Yarn count systems for designating linear density **ii)** **[Doc.: TXD 01(26246)],** *First revision* of IS 6940, Textiles – Test methods for determination of stiffness of fabrics **iii)** **[Doc.: TXD 01 (26245)]**, *Second revision* of IS 1315, Textiles – Method for determination of linear density of yarn spun on cotton system	The draft standards are wide circulated for two months for receiving comments from other stakeholders. The wide circulation time has been completed. Coming under **Agenda item 4** for finalization.

6	**COMMENTS ON PUBLISHED INDIAN STANDARDS** **6.1 Issue of Tolerance for relative humidity as ± 4% instead of ± 2% for atmospheric conditioning of Textiles** In the last meeting of TXD01, the committee has prepared an amendment to IS 6359 : 2023 and decided to wide circulate for 60 days to elicit comments from other stakeholders. **6.2 Comment received on IS 3675 : 2020** In the last meeting of TXD 01, the committee has finalized an amendment to IS 3675 : 2020 for updated the ICAR-CIRCOT calibration cotton requirements. **6.3 Comment received on IS 4871 : 1968** In the last meeting of TXD 01, the committee has finalized an amendment to prescribe the test specimen size for measuring trash content in cotton fibres be means of Mechanic-Pneumatic Machine.	**6.1** Amendment no. 1 to IS 6359 was wide circulated for 60 days to receive comments from other stakeholders. The wide circulation period is to be completed on 16 November 2024. Coming under **Agenda Item 4.** **6.2** Amendment has already been published **6.3** Amendment has already been published.
7	**NEW SUBJECTS FOR STANDARDIZATION** **7.1 Formulation of Indian Standard on "Smoothness Test for Fabrics"** A working group meeting was convened on 08 November 2024 for preparation of Working draft for Smoothness test for fabrics. The working group finalizes the working draft for the mentioned subject. **7.2 Formulation of Indian Standard on "Test method for Identification of Handloom Fabrics"** **7.3 Formulation of Indian Standard on "Test method for evaluation of Bursting strength of fabric using Ball burst method"** In the last meeting of TXD 01, the committee decided to consider the above subject for formulation of Indian Standard.	**7.1** Coming under **Agenda item 6.** **7.2** A working group meeting is to be conveyed shortly. **7.3** The working draft for the mentioned subject is under preparation.
8	**INTERNATIONAL ACTIVITY** i) **ISO 9867 : 2022,** Textiles — Synthetic filament yarns — Test method for crimp properties of textured yarns. The committee decided to adopted this above ISO standard under TXD 01 committee for revision of IS 16575 : 2016.	The draft for adoption of ISO 9867 : 2022 is under wide circulation.

Annex 5
(Item 4.1)

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26245) WC
August 2024

भारतीय मानक मसौदा

वस्त्रादि — कपास प्रणाली पर काते गए धागों के रैखिक घनत्व — परीक्षण पद्धतियाँ

(आई एस 1315 *का दूसरा पुनरीक्षण*)

Draft *Indian Standard*

TEXTILES — LINEAR DENSITY OF YARNS SPUN ON COTTON SYSTEM — METHODS OF TEST

(*Second Revision of* IS 1315)

ICS 59.080.20

Physical Methods of Test Sectional Committee, TXD 01	Last date for receipt of comments **30 October 2024**

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1959 and subsequently revised in 1977. This standard was originally published to introduce the metric system in the country for measurement of linear density of yarn i.e., tex system and also their conversion to cotton count system. The first revision of this standard was published to supersede IS 237 : 1951 which is for determination of cotton yarn count. The first revision gives the method for determination of linear density of yarn in both cotton count and tex system.

This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

a) The Scope of the standard has been modified;
b) The terminology for ‘Linear density’, ‘Commercial moisture regain’, ‘Moisture equilibrium’, and ‘Oven-dry mass’ has been incorporated;

c) A new clause ‘Principle’ has been incorporated;
d) A new test method for determination of linear density using oven-dry mass plus commercial moisture regain has been incorporated;
e) The clause ‘Test report’ has been modified;
f) The clause ‘Calculation’ has been modified; and
g) References to Indian standards have been updated.

This standard introduced a new method for determining the linear density of yarn in both cotton count and tex system using the oven-dry mass plus the commercial moisture regain which is applicable for all type of yarns.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft Indian Standard

TEXTILES — LINEAR DENSITY OF YARNS SPUN ON COTTON SYSTEM — METHODS OF TEST

(*Second Revision*)

1 SCOPE

1.1 This standard prescribes two methods for determination of linear density of yarn spun on cotton system in cotton count and tex:

a) Method A — Evaluation of linear density by determining the mass of the conditioned yarn at equilibrium with the standard atmosphere for testing; and,
b) Method B — Evaluation of linear density by determining the mass of the oven-dry yarn plus the commercial moisture regain.

1.2 This method is applicable to single, plied, and cabled yarns. In case of plied and cabled yarns, linear density is expressed in term of its resultant count.

2 REFERENCES

The standard listed in Annex A contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 232 and the following shall apply.

3.1 Cotton Count — The yarn numbering system of cotton yarn expressed as number of 768.1 m hanks per 453.6 g (840 yd hanks/lb).

3.2 Commercial Moisture Regain — Arbitrary value formally adopted as the moisture regain to be used with oven-dry mass when calculating the linear density and/or the commercial mass of any specific textile material (*see* IS 13157).

3.3 Linear Density — Mass per unit length of a yarn. It is expressed generally in tex or its multiples or submultiples (*see* **3.7**).

3.4 Moisture equilibrium — Condition reached by a sample at a closely defined temperature and relative humidity when the net difference between the amount of moisture absorbed and the amount desorbed, as indicated by a change in mass, shows no trend and becomes insignificant.

NOTE — A textile material is in moisture equilibrium with the ambient atmosphere when it does not exchange water with this atmosphere; its mass then remains constant as long as the experiment is carried out in an unchanged atmosphere. For test purposes, moisture equilibrium is reached by absorption starting from a relatively low moisture content. Moisture equilibrium for testing is considered as having been reached when the rate of increase in mass of a Sample or specimen due to moisture uptake does not exceed that prescribed for the material being tested (see IS 6359).

3.5 Oven-dry mass — Constant mass of a specimen obtained by drying in an oven under prescribed conditions for temperature and humidity.

NOTE — Conditions most frequently used are a temperature of (105 ± 3) °C and an air supply having a relative humidity of (65 ± 2) percent at a temperature of (27 ± 2) °C, under which conditions the specimens will not be moisture-free.

3.6 Skein — A continuous length of yarn in the form of a coil made on a reel of known girth. Usually 109.73 m (120 yd) skeins made on 1.372 m (1.5 yd) girth reel is in use in cotton count system and is called 'lea'; while skein of 200 m, 100 m and 10 m made on 1 m girth reel are in use in tex system.

NOTES

1 Test skeins for measurement of linear density in tex shall be of the following lengths whether the yarn is single folded, multiplied or cabled:

a) 200 m for yarns having a linear density below 12.5 tex;
b) 100 m for yarns having a linear density from 12.5 to 100 tex; and
c) 10 m for yarns having a linear density of more than 100 tex.

2 Tolerance for skein lengths are given in Annex C.

3 In case of folded and cabled yarns, the limit stated applies to the linear density of the resultant yarn.

3.7 Tex — The primary unit in a system of units for expressing the universal count of yarn (*see* Note). It is equivalent to the mass in grams per kilometre of yarn.

NOTE — This system is also intended to be used for expressing the mass per unit length of fibres, yarns and other textile products like ropes and rovings. The following multiple and sub-multiple units may be used to avoid large numbers and small fractions, respectively:

1 ktex (kilotex) = 1 000 tex
1 mtex (millitex) = 0.001 tex
1 dtex (decitex) = 0.1 tex

4 PRINCIPLE

The linear density is calculated from the length and mass of suitable specimens. Specimens of suitable length are prepared by reeling test skeins for yarn numbering under specified conditions from samples that have been adequately conditioned after suitable preconditioning in skein form. And, the mass of the skeins is determined either by conditioning the yarn at equilibrium with the standard atmosphere for testing or by oven-drying the yarn at a specified conditions as mention in **3.5** and adding the commercial moisture regain.

5 SAMPLING

5.1 The samples shall be drawn in accordance with the procedure laid down in IS 3920.

Unless otherwise agreed to between the buyer and the seller, 25 tests shall be made for evaluating average count. However, 200 tests are required for determination of coefficient of variation of count with an accuracy (limit of error of CV) of 10 percent.

6 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

6.1 The samples shall be conditioned to moisture equilibrium in standard atmosphere of (65 ± 2) percent relative humidity and (27 ± 2) °C temperature for 24 h or until there is no progressive change in mass greater than 0.1 % in successive exposures of at least 30 min duration (*see* also IS 6359).

6.2 The test shall be carried out in the standard atmosphere as mentioned in **6.1** (*see also* IS 196).

7 APPARATUS

For the purpose of this test, the following apparatus may be used depending upon the availability.

7.1 Pan Balance — It shall be capable of weighing the skeins of known length to a sensitivity of 1 mg.

7.2 Wrap Reel — It shall have a girth such that the required length of yarn (i.e. 120 yds in cotton count and 100 m or 50 m in tex system) is given by a whole number of revolutions, and with a traversing device that will avoid bunching of the yarn during reeling. A girth of 1.372 m (1.5 yd) or 1 m girth is recommended.

7.3 Yarn Tensioning Device — An adjustable tensioning device capable of giving a reeling tension that will result in skeins of the specified length when measured on a skein gauge. The adjustment in reeling tension may be made, for example, by making more than one wrap around thread guides or by passing the yarn around tensioning bars. The reeling tension shall be the same at all reeling positions and may be checked as follows:

The yarn is wound from the same package at different reeling positions. The length of the skeins when measured on a skein gauge shall not differ by more than 0.1 percent.

7.4 Skein Gauge — A gauge for checking the length of the skein under a load of 0.5 cN/tex and expressing the length as a plus or minus deviation from the nominal length. The sensitivity of the skein gauge shall be sufficient to permit rejection of skeins falling outside ± 0.25 percent

tolerances. The skein-gauge length may be adjustable or non-adjustable. A non-adjustable skein gauge may be used when its nominal length differs by not more than 0.4 percent from the measured perimeter of the reel.

NOTE — For details of skein gauge, see Annex C.

7.5 Ventilated Drying Oven — A oven in which the skeins are exposed at a temperature maintained at (105 ± 3) °C. The specimens shall not be subjected to direct radiation from the heating units. The oven shall be supplied with a current of pre-dried air at such a rate that the volume of air in the oven will be renewed at least every 4 min. The oven shall be designed to facilitate the free passage of air through the specimens. The oven may be provided with the facilities for cutting-off the air current and weighing the specimens, with a sensitivity of 1 mg, without their removal from the oven.

8 PROCEDURE

8.1 Method A

8.1.1 Prepare a test skein of specified length of yarn as given in **3.6** on the wrap reel (*see* Annex B).

8.1.2 Place the skein on a balance and measure the mass in grams accurate to 1 mg, after conditioning the test skeins till moisture equilibrium with the standard atmosphere as given in **6.1.**

8.1.3 Calculate the linear density of yarn in cotton count and in tex system as given in **9.1.1** and **9.1.2** respectively.

8.1.4 Test at least 25 test specimens by repeating the steps as given in **8.1.1** to **8.1.3**.

8.2 Method B

8.2.1 Prepare a test skein of specified length of yarn as given in **3.6** on the wrap reel (*see* Annex B).

8.2.2 Place the test skein in the drying-oven and dry it to a constant mass which shall be considered as attained when no progressive change in mass greater than 0.1 percent occurs in successive weighing spaced by a drying period of

a) at least 20 min if the specimen has not been removed from the oven for weighing,
b) at least 40 min if the specimen has been removed and cooled for weighing outside the oven.

8.2.3 Obtain the oven-dry mass of the test skein, in grams, to the accuracy of 1 mg.

8.2.4 Calculate the linear density of the yarn in cotton count and in tex system as given in **9.2.1** and **9.2.2** respectively.

8.2.5 Test at least 25 test specimens by repeating the steps as given in **8.2.1** to **8.2.3**.

9 CALCULATIONS

9.1 Method A

9.1.1 *Cotton count system*

Calculate linear density of yarn in the cotton count system up to one decimal place by the following formula:

$$Ne = \frac{453.6}{(7 \times m)} = \frac{64.8}{m}$$

Where

N_e = linear density of yarn in the cotton count system; and
m = mass of conditioned skein of 109.73 m (or 120 yd), in grams.

9.1.2 *Tex System*

Calculate the linear density of yarn in tex system up to one decimal place by the following formula:

$$t = \frac{m}{l} \times 1000$$

where

t = linear density of yarn in tex system;
m = mass of conditioned skein, in grams; and
l = length of yarn in test skein, in metres.

9.2 Method B

9.2.1 *Cotton count system*

Calculate linear density of yarn in the cotton count system, using commercial moisture regain, up to one decimal place by the following formula:

$$Ne = \frac{453.6 \times 100}{(7 \times m_{od}) \times (100 + R)} = \frac{6480}{m \times (100 + R)}$$

Where

N_e = linear density of yarn in the cotton count system; and
m_{od} = oven-dry mass of skein of 109.73 m (or 120 yd), in grams; and
R = Commercial moisture regain of any specific textile fibre.

9.2.2 *Tex system*
Calculate the linear density of yarn in tex system, using commercial moisture regain, up to one decimal place by the following formula:

$$t = \frac{m_{od} \times (100 + R)}{l \times 100} \times 1000 = \frac{10 m_{od} \times (100 + R)}{l}$$

Where

t = linear density of yarn in tex system;
m_{od} = oven-dry mass of skein, in grams;
l = length of yarn in test skein, in metres; and
R = Commercial moisture regain of any specific textile fibre.

9.3 Calculate the average of all the values up to one decimal place and report it as the average linear density of yarn.

9.4 Calculate the coefficient of variation (CV) of all the linear density observations made.

9.5 For conversion of cotton count to tex system the following formula shall be used:

$$t = \frac{590.5}{Ne}$$

9.5.1 For interconversion of values from one system to the other, reference to IS 3689 may be made.

10 REPORT

10.1 The report shall include the following information:

a) Type of yarn;
b) Type of method used;
c) Average linear density in cotton count system and tex system;
d) CV of linear density;
e) Number of test specimens tested;
f) Any deviation, by agreement or otherwise, from the procedure specified; and
g) The temperature and relative humidity of the air supplied to the drying oven.

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 196 : 1966	Atmospheric conditions for testing (revised)
IS 232 : 2020	Glossary of textile terms - Natural fibres (t*hird revision*)
IS 3689 : 1966	Conversion factors and conversion tables for yarn counts
IS 3920 : 1985	Methods for sampling of cotton yarn for determination of physical characteristics *(first revision)*
IS 6359 : 2023	Method for conditioning of textiles *(first revision)*
IS 13157 : 1991	Textile fibres - Commercial moisture regains - Specification

ANNEX B
(*Clause* 8.1.1 and 8.2.1)

PREPARATION OF SKEINS

B-1 APPARATUS

B-1.1 To reel off the skeins, a wrap reel having a girth of 1.372 m (1.5 yd) or of a specified length as mentioned in **3.6** shall be used. The wrap reel shall be fitted with thread guides fixed on a horizontal bar which has a traverse of about 25 mm. The wrap reel shall also be provided with a counting device to indicate the length of yarn reeled out and a bell to ring just before the last revolution or a reel that automatically stops after the required number of revolutions.

B-2 PROCEDURE

B-2.1 Mount a test package on the wrap reel. Pass the end through the thread guides taking care that the yarn shall be kept under sufficient tension to avoid kinks, curls and slack in the yarn on the one hand and stretch on the other (see Note) and lead it to the reel.

NOTE — If necessary, the yarn may be wound one full turn around the thread guide.

B-2.2 Start the wrap reel. Running it at uniform speed, reel out a skein of required length. Cut and tie the trailing end of the skein to its leading end.

ANNEX C
(*Clause* 7.4)

SKEIN GAUGE

C-1 APPARATUS

C-1.1 The skein gauge, which measures the length of a test skein under specified loading conditions, is made up of two circular metal pegs in the same vertical plain that are roughly 1.25 cm in diameter and 5 to 6 cm long. A low-friction bearing, which is likewise supported by the instrument's rigid frame, serves as the fulcrum of a basic loading system lever that holds the second peg. One peg is fixed to the rigid frame of the instrument. It is required that at least one peg be able to freely rotate on its axis.

C-2 PROCEDURE

C-2.1 Place the skein without bunching, around the two pegs, and apply the appropriate load, for example, by hanging a weight on the end of the lever arm or by moving a sliding weight along the lever arm. The girth of the skein is indicated, on a scale attached to the frame of the instrument, by a pointer attached to the lever arm or by an index line on the end of the lever arm.

If L is the actual girth of the wrap reel, d the diameter of the pegs, then, the distance (D) between the axes of the pegs when the indicator registers on the scale the actual girth of the wrap reel, is given by the equation

$$D = \frac{L}{2} - \frac{\pi d}{2}$$

Measure the skein length under a load per end equal to (0.5 ± 0.1) cN/tex per unit of nominal yarn linear density, expressed in tex.

C-3 Requirement

Skeins whose length fall outside the limits of ± 2 percent of the length of yarn expected from one turn of the reel shall be rejected.

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26247) WC
September 2024

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भारतीय मानक मसौदा

वस्त्रादि – रैखिक घनत्व निर्दिष्ट करने के लिए सूत गणना प्रणाली

(*प्रथम* पुनरीक्षण)

Draft *Indian Standard*

TEXTILES — YARN COUNT SYSTEMS FOR DESIGNATING LINEAR DENSITY

(First Revision)

ICS 59.080.01

Physical Methods of Test Sectional Committee TXD 01	Last date for receipt of comments **31 October 2024**

FOREWORD

(*Formal clauses will be added later***)**

This standard is first published in 1966. In this standard, the conversion factors for a variety of count systems to the Tex system along with the conversion tables were described.

This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

i) Title of the standard has been modified;
ii) Scope of the standard has been modified;
iii) The new clauses 'Terminolgy', 'Units', and 'Notations' have been incorporated;
iv) The clause 'Definition' has been deleted; and
v) References of Indian Standards have been updated.

A variety of count systems is being used in the different sectors of the textile industry. With the increasing complexity to be found in industrial and commercial fields, there is an ever-growing need for standardization of count systems. Further, with the growing use of yarns containing more

than one kind of fibre and of fabrics containing yarns made from different fibres, it has become increasingly evident that the adoption of a single yarn count system would avoid confusion and save time.

The Technical Committee, TC 38, of the International Organization for Standardization recommended the Tex System as a universal count for international adoption in place of the various traditional count systems. Tex System is a direct system based on metric units and suitable for application to structures like fibre, yarn, cord and rope, and made of any textile material like cotton, silk, wool, man-made fibres, jute or their blends. The universal count in tex is obtained by dividing the mass in grams of a given length of yarn by its length in kilometres.

To avoid small fractions and large numbers, sub-multiple and multiple units recommended in preference to other possible combinations, are milligrams per kilometre named 'millitex' and kilograms per kilometre or grams per metre named 'kilotex'.

With the introduction of metric system in India, certain sectors of the textile industry are planning to adopt the Tex System. It has, therefore, become necessary to formulate this standard which defines the various count systems and provides factors and tables for conversion of values in traditional count system and Tex System.

In the preparation of this standard, considerable assistance has been derived from ISO 1144 : 2016 'Textiles -Universal system for designating linear density (Tex System)', issued by the International Organization for Standardization.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

Draft Indian Standard

TEXTILES —YARN COUNT SYSTEMS FOR DESIGNATING LINEAR DENSITY

(First Revision)

1 SCOPE

1.1 This standard defines the various yarn count systems and provides factors and formulae for conversion of yarn count systems into Tex system and vice versa.

1.2 Tables for inter-conversion of values in traditional count systems and Tex System has been given in Appendix A.

1.3 The procedure for obtaining rounded values of tex based on ISO 1144:2016 'Textiles — Universal system for designating linear density (Tex system)' has been given in Appendices B.

2 REFERENCES

The standards listed below contain 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 subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

IS No.	*Title*
IS 232 : 2020	Glossary of textile terms - Natural fibres (*third revision*)
IS 6359 : 2023	Method for conditioning of textiles (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Direct System — A system to express the coarseness or the fineness of the yarn is expressed in the terms of mass per unit length (linear density, often called yarn number).

NOTE — Some examples of direct system of yarn count are Tex, Denier, Grist etc.

3.1.1 *Denier* — It expresses the linear density ,that is to say, the mass, in grams, of 9 000 m length of yarn.

3.1.2 *Grist* — It expresses the linear density ,that is to say, the mass, in pounds, of 14 400 yd length of yarn.

NOTE – Grist is specifically used as yarn count system for Jute, Hemp and Linen (dry spun) yarns.

3.1.3 *Tex* — It expresses the linear density ,that is to say, the mass, in grams, of 1 000 m length of yarn.

3.2 Indirect System — A system to express the coarseness or the fineness of the yarn is expressed in the terms of length per unit mass.

NOTE — Some examples of Indirect system of yarn count are Cotton Count (N_{eC}), Metric Count (N_m) etc.

3.2.1 *Cotton Count (Ne_C)* — It expresses the yarn count in indirect system i.e. no. of hanks of 840 yds of yarn in 1 pound (lb) mass of yarn. It is also often known as English Count.

3.2.2 *Metric Count (Nm)* **—** It expresses the yarn count in indirect system i.e. no. of hanks of 1 000 m of yarn in 1 kilogram (kg) mass of yarn.

3.2.3 *Worsted Count (Ne_W)* **—** It expresses the yarn count in indirect system i.e. no. of hanks of 560 yds of yarn in 1 pound (lb) mass of yarn.

4 UNITS

Units are the representation of yarn count systems. Every yarn count systems are indicated by a specific unit as mentioned below:

Yarn Count Systems	*Corresponding Unit*
Tex	tex
Denier	denier
Grist	lb
Cotton	Ne_C
Linen	Ne_L
Metric	Nm
Woollen (Dewsbury)	Nd
Woollen (Yorkshire)	Nv
Worsted	Ne_W

The multiple and submultiple units of the tex unit recommended for use in preference to other possible combinations are

— kilogram per kilometre, designated kilotex (ktex);

— decigram per kilometre, designated decitex (dtex); and

— milligram per kilometre, designated militex (mtex).

5 NOTATIONS

The yarn count in direct or indirect systems is indicated by the numerical value followed by the name of the unit used.
Example – 50 tex; 1.8 denier; 50 Ne_C

6 CONVERSION OF YARN COUNT SYSTEMS INTO TEX SYSTEM

6.1 Conversion from direct systems

In the direct system, the coarseness or fineness of the yarn is expressed in terms of mass per unit length. Table 1 gives the conversion factors for conversion of counts in direct systems to Tex system and vice versa.

For Example – The equivalent of 24 grist into tex is

$$T_t = 34.45 \times T_j = 34.45 \times 24 = 826.8 \text{ tex} \approx 830 \text{ tex}.$$

Table 1 Conversion Factors for Direct Systems and Tex

Sl. No.	Yarn Count System	Symbolic Abbreviation	Unit of Mass used	Unit of Length used	Unit of Yarn Count	Conversion Factor	
						To Other Yarn Counts From Tex	To Tex From Other Yarn Counts
i)	Tex	T_t	1 g	1 000 m	g/1 000m	—	—
ii)	Denier	T_d	1 g	9 000 m	g/9 000m	$T_d = 9\ T_t$	$T_t = 0.1111\ T_d$
iii)	Grist [Jute, Hemp, Linen (dry spun)]	T_j	1 lb	14 400 yd (Spindle unit)	lb/14 400 yd	$T_j = 0.02903\ T_t$	$T_t = 34.45\ T_j$

6.2 Conversion from indirect systems

In the indirect systems, the coarseness or fineness of the yarn is expressed in terms of length per unit mass. Table 2 gives the conversion factors for conversion of counts in indirect systems to Tex system and vice versa.

For Example – The equivalent of 20 Ne_C into tex is

$$T_t = 590.5/Ne_C = 590.5/20 = 29.525 \text{ tex} \approx 30 \text{ tex}.$$

Table 2 Conversion Factors for Indirect Systems and Tex

Sl. No.	Yarn Count System	Symbolic Abbreviation	Unit of Length Used	Unit of Mass Used	Unit of Yarn Count	Conversion Factor	
						To other Yarn Counts from Tex	To Tex from other Yarn Counts

i)	Cotton count (spun rayon staple, spun silk)	Ne_C	840 yd (hank)	1 lb	840 yd/lb	$Ne_C = \frac{590.5}{T_t}$	$T_t = \frac{590.5}{Ne_C}$
ii)	Linen (wet spun)	Ne_L	300 yd (lea)	1 lb	300 yd/lb	$Ne_L = \frac{1654}{T_t}$	$T_t = \frac{1654}{Ne_L}$
iii)	Metric (cotton and wool)	Nm	1000 m (hank)	1 kg	1000 m/kg	$Nm = \frac{1000}{T_t}$	$T_t = \frac{1000}{N_m}$
iv)	Woollen (Dewsbury)	Nd	1 yd	1 oz	yd/oz	$Nd = \frac{31000}{T_t}$	$T_t = \frac{31000}{N_d}$
v)	Woollen (Yorkshire)	Nv	256 yd (skein)	1 lb	256 yd/lb	$Nv = \frac{1938}{T_t}$	$T_t = \frac{1938}{N_v}$
vi)	Worsted	Ne_W	560 yd (hank)	1 lb	560 yd/lb	$Ne_W = \frac{885.8}{T_t}$	$T_t = \frac{885.8}{Ne_W}$

APPENDIX A
(*Clause 1*)

Table 4 Denier (T_d) to Tex (T_t)
Tex= 0.1111 × Denier

Denier	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	0.111	0.222	0.333	0.444	0.556	0.667	0.778	0.889	1.0
10	1.11	1.22	1.33	1.44	1.56	1.67	1.78	1.89	2.00	2.11
20	2.22	2.33	2.44	2.56	2.67	2.78	2.89	3.00	3.11	3.22
30	3.33	3.44	3.56	3.67	3.78	3.89	4.00	4.11	4.22	4.33
40	4.44	4.56	4.67	4.78	4.89	5.00	5.11	5.22	5.33	5.44
50	5.56	5.67	5.78	5.89	6.00	6.11	6.22	6.33	6.44	6.56
60	6.67	6.78	6.89	7.00	7.11	7.22	7.33	7.44	7.56	7.67
70	7.78	7.89	8.00	8.11	8.22	8.33	8.44	8.56	8.67	8.78
80	8.89	9.00	9.11	9.22	9.33	9.44	9.56	9.67	9.78	9.89
90	10.0	10.1	10.2	10.3	10.4	10.6	10.7	10.8	10.9	11.0
100	11.1	-	-	-	-	-	-	-	-	-

Table 5 Grist(T_j) to Tex (T_t)
Tex = 34.45 × Grist

Grist	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	17.2	34.4	51.7	68.9	86.1	103.3	120.6	137.8	155.0
5	172.2	189.4	206.7	223.9	241.1	258.4	275.6	292.8	310.0	327.3
10	344.5	361.7	378.9	396.1	413.3	430.6	447.8	465.0	482.3	500.0
15	516.7	534.0	551.2	568.4	585.6	602.8	620.1	637.3	654.5	671.7
20	689.0	706.2	723.4	740.6	757.9	775.1	792.3	809.5	826.8	844.0
25	861.2	878.4	895.6	912.8	930.1	947.3	964.6	981.8	999.0	1016.2
30	1033	-	-	-	-	-	-	-	-	-

Table 6 Cotton Count (Spun-Rayon Staple, Spun Silk) (Ne_C) to Tex(T_t)
$$\text{Tex} = \frac{590.5}{\text{Cotton Count}}$$

Cotton count	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	590.5	295.3	196.8	147.6	118.1	98.4	84.4	73.8	65.6
10	59.0	53.7	49.2	45.4	42.2	39.4	36.9	34.7	32.8	31.1
20	29.5	28.1	26.8	25.7	24.6	23.6	22.7	21.9	21.1	20.4
30	19.7	19.0	18.4	17.9	17.4	16.9	16.4	16.0	15.5	15.1

40	14.8	14.4	14.1	13.7	13.4	13.1	12.8	12.6	12.3	12.1
50	11.8	11.6	11.4	11.1	10.9	10.7	10.5	10.4	10.2	10.0
60	9.84	9.68	9.52	9.37	9.23	9.09	8.95	8.81	8.68	8.56
70	8.44	8.32	8.20	8.09	7.98	7.87	7.77	7.67	7.57	7.48
80	7.38	7.29	7.20	7.11	7.03	6.95	6.87	6.79	6.71	6.64
90	6.56	6.49	6.42	6.35	6.28	6.22	6.15	6.09	6.03	5.96
100	5.91	5.85	5.79	5.73	5.68	5.62	5.57	5.52	5.47	5.42
110	5.37	5.32	5.27	5.23	5.18	5.14	5.09	5.05	5.00	4.96
120	4.92	-	-	-	-	-	-	-	-	-

Table 7 Linen Count (Ne_L) to Tex (T_t)

$$\textbf{Tex} = \frac{\mathbf{1654}}{\boldsymbol{Linen\ count}}$$

Linen count	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	1654	826.8	551.2	413.4	33o.7	275.6	236.2	206.7	183.7
10	165.4	150.3	137.8	127.2	118.1	110.2	103.3	97.3	91.9	87.0
20	82.7	78.7	75.2	71.9	68.9	66.1	63.6	61.2	59.1	57.0
30	55.1	53.3	51.7	50.1	48.6	47.2	45.9	44.7	43.5	42.4
40	41.3	40.3	39.4	38.5	37.6	36.7	35.9	35.2	34.4	33.7
50	33.1	32.4	31.8	31.2	30.6	30.1	29.5	29.0	28.5	28.0
60	27.6	27.1	26.7	26.2	25.8	25.4	25.1	24.7	24.3	24.0
70	23.6	23.3	23.0	22.7	22.3	22.0	21.8	21.5	21.2	20.9
80	20.7	20.4	20.2	19.9	19.7	19.5	19.2	19.0	18.8	18.6
90	18.4	18.2	18.0	17.8	17.6	17.4	17.2	17.0	16.9	16.7
100	16.5	16.4	16.2	16.1	15.9	15.7	15.6	15.5	15.3	15.2
110	15.0	14.9	14.8	14.6	14.5	14.4	14.3	14.1	14.0	13.9
120	13.8	-	-	-	-	-	-	-	-	-

Table 8 Metric Count (N_m) to Tex (T_t)

$$\textbf{Tex} = \frac{\mathbf{1000}}{\boldsymbol{Metric\ count}}$$

Metric count	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	1000	500.0	333.3	250.0	200.0	166.7	142.8	125.0	111.1
10	100.0	90.9	83.3	76.9	71.4	66.7	62.5	58.8	55.6	52.6
20	50.0	47.6	45.4	43.5	41.7	40.0	38.5	37.0	35.7	34.5
30	33.3	32.3	31.2	30.3	29.4	28.6	27.8	27.0	26.3	25.6
40	25.0	24.4	23.8	23.3	22.7	22.2	21.7	21.3	20.8	20.4

50	20.0	19.6	19.2	18.9	18.5	18.2	17.9	17.5	17.2	17.0
60	16.7	16.4	16.1	15.9	15.6	15.4	15.2	14.9	14.7	14.5
70	14.3	14.1	13.9	13.7	13.5	13.3	13.2	13.0	12.8	12.7
80	12.5	12.3	12.2	12.0	11.9	11.8	11.6	11.5	11.4	11.2
90	11.1	11.0	10.9	10.8	10.6	10.5	10.4	10.3	10.2	10.1
100	10.0	-	-	-	-	-	-	-	-	-

Table 9 Woollen (Dewsbury) (N_d) to Tex (T_t)

$$\textbf{Tex} = \frac{\mathbf{31000}}{\boldsymbol{Woollen\ count(Dewsbury)}}$$

Woollen count	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	31000	15500	10333	7750	6200	5167	4428	3875	3444
10	3100	2828	2583	2385	2214	2067	1938	1824	1722	1632
20	1550	1476	1409	1348	1292	1240	1192	1148	1107	1069
30	1033	1000	968.8	939.4	911.8	885.7	861.1	837.8	815.8	794.9
40	775.0	756.1	738.1	720.9	704.5	688.9	673.9	659.6	645.8	632.6
50	620.0	607.8	596.2	584.9	574.1	563.6	553.6	543.8	534.5	525.4
60	516.7	508.2	500.0	492.1	484.4	476.9	469.7	462.7	455.9	449.3
70	442.8	436.6	430.6	424.6	418.9	413.3	407.9	402.6	397.4	392.4
80	387.5	382.7	378.0	373.5	369.0	364.7	360.5	365.3	352.3	348.3
90	344.4	340.6	337.0	333.3	329.8	326.3	322.9	319.6	316.3	313.1
100	310.0	-	-	-	-	-	-	-	-	-

Table 10 Woollen (Yorkshire) (N_v) to Tex (T_t)

$$\textbf{Tex} = \frac{\mathbf{1938}}{\boldsymbol{Woollen\ count(Yorkshire)}}$$

Woollen count	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	1938	968.9	645.9	484.4	387.5	323.0	276.8	242.2	215.3
10	193.8	176.2	161.5	149.1	138.4	129.2	121.1	114.0	107.6	102.0
20	96.9	92.3	88.1	84.2	80.7	77.5	74.5	71.8	69.2	66.8
30	64.6	62.5	60.6	58.7	56.9	55.4	53.8	52.4	50.9	49.7
40	48.4	47.3	46.1	45.1	44.0	49.1	42.1	41.2	40.4	39.5
50	38.8	37.9	37.3	36.6	35.9	35.2	34.6	34.6	33.4	32.8
60	32.3	-	-	-	-	-	-	-	-	-

Table 11 Worsted (Ne_W) to Tex (T_t)

$$\textbf{Tex} = \frac{\textbf{885.8}}{\boldsymbol{Worsted\ count}}$$

Worsted count	0	1	2	3	4	5	6	7	8	9
	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex	Tex
0	0	885.8	442.9	295.3	221.5	177.2	147.6	126.5	110.7	98.4
10	88.6	80.5	73.8	68.1	63.3	59.1	55.4	52.1	49.2	46.6
20	44.3	42.2	40.3	38.5	36.9	35.4	34.1	32.8	31.6	30.6
30	29.5	28.6	27.7	26.8	26.0	25.3	24.6	23.9	23.3	22.7
40	22.1	21.6	21.1	20.6	20.1	19.7	19.3	18.8	18.5	18.1
50	17.7	17.4	17.0	16.7	16.4	16.1	15.8	15.5	15.3	15.0
60	14.8	14.5	14.3	14.1	13.8	13.6	13.4	13.2	13.0	12.8
70	12.6	12.5	12.3	12.1	12.0	11.8	11.7	11.5	11.4	11.2
80	11.1	-	-	-	-	-	-	-	-	-

Table 12 Tex to other Count Systems

tex	cotton count	denier	grist	linen	metric	woollen (dewsbury)	woollon (yorkshire)	worsted
T_t	Ne_C	T_d	T_j	Ne_L	N_m	N_d	N_y	Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	590.5	9.0	0.029	1654	1000	31000	1938	885.8
2	295.2	18.0	0.058	826.8	500.0	15500	968.9	442.9
3	196.8	27.0	0.087	551.2	333.3	10333	645.9	295.3
4	147.6	36.0	0.116	413.4	250.0	7750	484.4	221.5
5	118.1	45.0	0.145	330.7	200.0	6200	387.5	177.2
6	98.4	54.0	0.174	275.6	166.7	5167	323.0	147.6
7	84.4	63.0	0.203	236.2	142.9	4428	276.8	126.5
8	73.8	72.0	0.232	206.7	125.0	3875	242.2	110.7
9	65.6	81.0	0.261	183.7	111.1	3444	215.3	98.5
10	59.0	90.0	0.290	165.4	100.0	3100	193.8	88.6
11	53.7	99.0	0.319	150.3	90.9	2818	176.2	80.5
12	49.2	108.0	0.348	137.8	83.3	2583	161.5	73.8
13	45.4	117.0	0.377	127.2	76.0	2385	149.1	68.1
14	42.2	126.0	0.406	118.1	71.4	2214	138.4	63.3
15	39.4	135.0	0.435	110.2	66.6	2067	129.2	59.0
16	36.9	144.0	0.464	103.3	62.5	1938	121.1	55.4
17	34.7	153.0	0.494	97.3	58.8	1824	114.0	52.1
18	32.8	162.0	0.523	91.9	55.5	1722	107.7	49.2
19	31.1	171.0	0.552	87.0	52.6	1632	102.0	46.6
20	29.5	180.0	0.581	82.7	50.0	1550	96.9	44.3
21	28.1	189.0	0.610	78.7	47.6	1476	92.3	42.2
22	26.8	198.0	0.639	75.2	45.4	1409	88.1	40.3
23	25.7	207.0	0.668	71.9	43.5	1348	84.2	38.5
24	24.6	216.0	0.697	68.9	41.7	1292	80.7	36.9
25	23.6	225.0	0.726	66.1	40.0	1240	77.5	35.4
26	22.7	234.0	0.755	63.6	38.5	1192	74.5	34.1
27	21.9	243.0	0.784	61.2	37.0	1148	71.8	32.8
28	21.1	252.0	0.813	59.1	35.7	1107	69.2	31.6
29	20.4	261.0	0.842	57.0	34.5	1069	66.8	30.6
30	19.7	270.0	0.871	55.1	33.3	1033	64.6	29.5
31	19.0	279.0	0.900	53.3	32.3	1000	62.5	28.6
32	18.4	288.0	0.929	51.7	31.2	968.8	60.6	27.7
33	17.9	297.0	0.958	50.1	30.3	939.4	58.7	26.8
34	17.4	306.0	0.987	48.6	29.4	921.8	56.9	26.0
35	16.9	315.0	1.02	47.2	28.6	885.7	55.4	25.3

(*continued*)

Table 12 Tex to other Count Systems — Contd

tex T_t	cotton count Ne_C	denier T_d	grist T_j	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
36	16.4	324.0	1.04	45.9	27.8	861.1	53.8	24.6
37	16.0	333.0	1.07	44.7	27.0	837.8	52.4	23.9
38	15.5	342.0	1.10	43.5	26.3	815.8	50.9	23.3
39	15.1	351.0	1.13	42.4	25.6	794.9	49.7	22.7
40	14.8	360.0	1.16	41.3	25.0	775.0	48.4	22.2
41	14.4	369.0	1.19	40.3	24.4	756.1	47.3	21.6
42	14.1	378.0	1.22	39.4	23.8	738.1	46.1	21.1
43	13.7	387.0	1.25	38.5	23.2	720.9	45.1	20.6
44	13.4	396.0	1.28	37.6	22.7	704.5	44.0	20.1
45	13.1	405.0	1.31	36.7	22.2	688.9	43.1	19.7
46	12.8	414.0	1.34	35.9	21.7	673.9	42.1	19.3
47	12.6	423.0	1.36	35.2	21.3	659.6	41.2	18.8
48	12.3	432.0	1.39	34.4	20.8	645.8	40.4	18.4
49	12.0	441.0	1.42	33.7	20.4	632.6	39.5	18.1
50	11.8	450.0	1.45	33.1	20.0	620.0	38.8	17.7
51	11.6	459.0	1.48	32.4	19.6	607.8	37.9	17.4
52	11.4	468.0	1.51	31.8	19.2	596.2	37.3	17.0
53	11.1	477.0	1.54	31.2	18.9	584.9	36.6	16.7
54	10.9	486.0	1.57	30.6	18.5	574.1	35.9	16.4
55	10.7	495.0	1.60	30.1	18.2	563.6	35.2	16.1
56	10.5	504.0	1.63	29.5	17.8	553.6	34.6	15.8
57	10.4	513.0	1.65	29.0	17.5	543.8	33.9	15.5
58	10.2	522.0	1.68	28.5	17.2	534.5	33.4	15.3
59	10.0	531.0	1.71	28.0	16.9	525.4	32.8	15.0
60	9.84	540.0	1.74	27.6	16.6	516.7	32.3	14.8
61	9.68	549.0	1.77	27.1	16.4	508.2	31.8	14.5
62	9.52	558.0	1.80	26.7	16.1	500.0	31.3	14.3
63	9.37	567.0	1.83	26.2	15.9	492.1	30.8	14.1
64	9.23	576.0	1.86	25.8	15.6	484.4	30.3	13.8
65	9.09	585.0	1.89	25.4	15.4	476.9	29.8	13.6
66	8.95	594.0	1.92	25.1	15.2	469.7	29.4	13.4
67	8.81	603.0	1.94	24.7	14.9	462.7	28.9	13.2
68	8.68	612.0	1.97	24.3	14.7	455.9	28.5	13.0
69	8.56	621.0	2.00	24.0	14.5	449.3	28.1	12.8

70	8.44	630.0	2.03	23.6	14.3	442.8	27.7	12.6

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex T_t	cotton count Ne_C	denier T_d	grist T_j	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
71	8.32	639.0	2.06	23.3	14.1	436.6	27.3	12.5
72	8.20	648.0	2.09	23.0	13.9	430.6	26.9	12.3
73	8.09	657.0	2.12	22.7	13.7	424.6	26.5	12.1
74	7.98	666.0	2.15	22.3	13.5	418.9	26.2	11.9
75	7.87	675.0	2.18	22.0	13.3	413.3	25.8	11.8
76	7.77	684.0	2.21	21.8	13.2	407.9	25.5	11.7
77	7.67	693.0	2.24	21.5	13.0	402.6	25.2	11.5
78	7.57	702.0	2.26	21.2	12.8	392.4	24.8	11.4
79	7.48	711.0	2.29	20.9	12.6	393.4	24.5	11.2
80	7.38	720.0	2.32	20.7	12.5	387.5	24.2	11.1
81	7.29	729.0	2.35	20.4	12.3	382.7	23.9	10.9
82	7.20	738.0	2.38	20.2	12.2	378.0	23.6	10.8
83	7.11	747.0	2.41	19.9	12.0	373.5	23.3	10.7
84	7.03	756.0	2.44	19.7	11.9	369.0	23.1	10.5
85	6.95	765.0	2.47	19.5	11.8	364.7	22.8	10.4
86	6.87	774.0	2.50	19.2	11.6	360.5	22.5	10.3
87	6.79	783.0	2.53	19.0	11.5	356.3	22.3	10.2
88	6.71	792.0	2.55	18.8	11.4	352.3	22.0	10.1
89	6.64	801.0	2.58	18.6	11.2	348.3	21.8	10.0
90	6.56	810.0	2.61	18.4	11.1	344.4	21.5	9.84
91	6.49	819.0	2.64	18.2	11.0	340.6	21.3	9.73
92	6.42	828.0	2.67	18.0	10.9	337.0	21.1	9.63
93	6.35	837.0	2.70	17.8	10.8	333.3	20.8	9.52
94	6.28	846.0	2.73	17.6	10.6	329.8	20.6	9.42
95	6.22	855.0	2.76	17.4	10.5	326.3	20.4	9.32
96	6.15	864.0	2.79	17.2	10.4	322.9	20.2	9.23
97	6.09	873.0	2.82	17.0	10.3	319.6	20.0	9.13
98	6.03	882.0	2.84	16.9	10.2	316.3	19.8	9.04
99	5.97	891.0	2.87	16.7	10.1	313.1	19.6	8.95
100	5.91	900.0	2.90	16.5	10.0	310.0	19.4	8.86
105	5.62	945.0	3.05	15.7	9.52	295.2	18.5	8.44
110	5.37	990.0	3.19	15.0	9.09	281.8	17.6	8.05
115	5.14	1035	3.34	14.4	8.70	269.6	16.9	7.70

120	4.92	1080	3.48	13.8	8.33	258.3	16.1	7.38
125	4.72	1125	3.63	13.2	8.00	248.0	15.5	7.09

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex T_t	cotton count Ne_C	denier T_d	grist T_j	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
130	4.54	1170	3.77	12.7	7.69	238.5	14.9	6.81
135	4.37	1215	3.92	12.2	7.41	229.6	14.4	6.56
140	4.22	1260	4.06	11.8	7.14	221.4	13.8	6.33
145	4.07	1305	4.21	11.4	6.90	213.8	13.4	6.11
150	3.94	1350	4.35	11.0	6.66	206.7	12.9	5.90
155	3,81	1395	4.50	10.7	6.45	200.0	12.5	5.71
160	3.69	1440	4.64	10.3	6.25	193.8	12.1	5.54
165	3.58	1485	4.79	10.0	6.06	187.9	11.7	5.37
170	3.47	1530	4.93	9.73	5.88	182.4	11.4	5.21
175	3.37	1575	5.08	9.45	5.71	177.1	11.1	5.06
180	3.28	1620	5.23	9.19	5.55	172.2	10.8	4.92
185	3.19	1665	5.37	8.94	5.41	167.6	10.5	4.79
190	3.11	1710	5.52	8.70	5.26	163.2	10.2	4.66
195	3.03	1755	5.66	8.48	5.13	159.0	9.94	4.54
200	2.95	1800	5.81	8.27	5.00	155.0	9.69	4.43
205	2.88	1845	5.95	8.07	4.88	151.2	9.45	4.32
210	2.81	1890	6.10	7.87	4.76	147.6	9.23	4.22
215	2.75	1935	6.24	7.69	4.65	144.2	9.01	4.12
220	2.68	1980	6.39	7.52	4.54	140.9	8.81	4.03
225	2.62	2025	6.53	7.35	4.44	137.8	8.61	3.94
230	2.57	2070	6.68	7.19	4.35	134.8	8.42	3.85
235	2.51	2115	6.82	7.04	4.26	131.9	8.25	3.77
240	2.46	2160	6.97	6.89	4.17	129.2	8.07	3.69
245	2.41	2205	7.11	6.75	4.08	126.5	7.91	3.62
250	2.36	2250	7.26	6.61	4.00	124.0	7.75	3.54
255	2.32	2295	7.40	6.49	3.92	121.6	7.60	3.47
260	2.27	2340	7.55	6.36	3.85	119.2	7.45	3.41
265	2.23	2385	7.69	6.25	3.77	117.0	7.31	3.34
270	2.19	2430	7.84	6.12	3.70	114.8	7.18	3.28
275	2.15	2475	7.98	6.01	3.64	112.7	7.05	3.22
280	2.11	2520	8.13	5.91	3.57	110.7	6.92	3.16
285	2.07	2565	8.27	5.80	3.51	108.8	6.80	3.11

290	2.04	2610	8.42	5.70	3.45	106.9	6.68	3.06
295	2.00	2655	8.56	5.61	3.39	105.0	6.57	3.00
300	1.97	2700	8.71	5.51	3.33	103.3	6.46	2.95

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex $\boldsymbol{T_t}$	cotton count Ne_C	denier $\boldsymbol{T_d}$	grist $\boldsymbol{T_j}$	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
305	1.94	2745	8.85	5.42	3.28	101.6	6.35	2.90
310	1.90	2790	9.00	5.33	3.23	100.0	6.25	2.86
315	1.87	2835	9.14	5.25	3.17	98.4	6.15	2.81
320	1.84	2880	9.29	5.17	3.12	96.9	6.06	2.77
325	1.82	2925	9.43	5.09	3.08	95.4	5.96	2.73
330	1.79	2970	9.58	5.01	3.03	93.9	5.87	2.68
335	1.76	3015	9.72	4.94	2.99	92.5	5.79	2.64
340	1.74	3060	9.87	4.86	2.94	92.2	5.69	2.60
345	1.71	3105	10.0	4.79	2.90	89.9	5.62	2.57
350	1.69	3150	10.2	4.72	2.86	88.6	5.54	2.53
355	1.66	3195	10.3	4.66	2.82	87.3	5.46	2.50
360	1.64	3240	10.5	4.59	2.78	86.1	5.38	2.46
365	1.62	3285	10.6	4.53	2.74	84.9	5.31	2.43
370	1.60	3330	10.7	4.47	2.70	83.8	5.24	2.39
375	1.57	3375	10.9	4.41	2.67	82.7	5.17	2.36
380	1.55	3420	11.0	4.35	2.63	81.6	5.09	2.33
385	1.53	3465	11.2	4.30	2.60	80.5	5.03	2.30
390	1.51	3510	11.3	4.24	2.56	79.5	4.97	2.27
395	1.49	3555	11.4	4.19	2.53	78.5	4.91	2.24
400	1.48	3600	11.6	4.13	2.50	77.5	4.84	2.22
405	1.46	3645	11.8	4.08	2.47	76.5	4.79	2.19
410	1.44	3690	11.9	4.03	2.44	75.6	4.73	2.16
415	1.42	3735	12.0	3.99	2.41	74.7	4.67	2.13
420	1.41	3780	12.2	3.94	2.38	73.8	4.61	2.11
425	1.39	3825	12.3	3.89	2.35	72.9	4.56	2.08
430	1.37	3870	12.5	3.85	2.32	72.1	4.51	2.06
435	1.36	3915	12.6	3.80	2.30	71.3	4.46	2.04
440	1.34	3960	12.8	3.76	2.27	70.4	4.40	2.01
445	1.33	4005	12.9	3.72	2.25	69.7	4.36	1.99
450	1.31	4050	13.1	3.67	2.22	68.9	4.31	1.97
455	1.30	4095	13.2	3.64	2.20	68.1	4.26	1.95

460	1.28	4140	13.4	3.59	2.17	67.4	4.21	1.93
465	1.27	4185	13.5	3.56	2.15	66.7	4.17	1.90
470	1.26	4230	13.6	3.52	2.13	66.0	4.12	1.88
475	1.24	4275	13.8	3.48	2.11	65.3	4.08	1.86

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex T_t	cotton count Ne_C	denier T_d	grist T_j	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
480	1.23	4320	13.9	3.44	2.08	64.6	4.04	1.84
485	1.22	4365	14.1	3.41	2.06	63.9	4.00	1.83
490	1.20	4410	14.2	3.37	2.04	63.3	3.95	1.81
495	1.19	4455	14.4	3.34	2.02	62.6	3.92	1.79
500	1.18	4500	14.5	3.31	2.00	62.0	3.88	1.77
505	1.17	4545	14.7	3.28	1.98	61.4	3.84	1.75
510	1.16	4590	14.8	3.24	1.96	60.8	3.79	1.74
515	1.15	4635	15.0	3.21	1.94	60.2	3.76	1.72
520	1.14	4680	15.1	3.18	1.92	59.6	3.73	1.70
525	1.12	4725	15.2	3.15	1.90	59.0	3.69	1.69
530	1.11	4770	15.4	3.12	1.89	58.5	3.66	1.67
535	1.10	4815	15.5	3.09	1.87	57.9	3.62	1.66
540	1.09	4860	15.7	3.06	1.85	57.4	3.59	1.64
545	1.08	4905	15.8	3.03	1.83	56.9	3.56	1.63
550	1.07	4950	16.0	3.01	1.82	56.4	3.52	1.61
555	1.06	4995	16.1	2.98	1.80	55.9	3.49	1.60
560	1.05	5040	16.3	2.95	1.78	55.4	3.46	1.58
565	1.05	5085	16.4	2.93	1.77	54.9	3.43	1.57
570	1.04	5130	16.5	2.90	1.75	54.4	3.39	1.55
575	1.03	5175	16.7	2.88	1.74	53.9	3.37	1.54
580	1.02	5220	16.8	2.85	1.72	53.4	3.34	1.53
585	1.01	5265	17.0	2.83	1.71	53.0	3.31	1.51
590	1.00	5310	17.1	2.80	1.69	52.5	3.28	1.50
595	0.992	5355	17.3	2.78	1.68	52.1	3.26	1.49
600	0.984	5400	17.4	2.76	1.66	51.7	3.23	1.48
605	0.976	5445	17.6	2.73	1.65	51.2	3.20	1.46
610	0.968	5490	17.7	2.71	1.64	50.9	3.18	1.45
615	0.960	5535	17.9	2.69	1.63	50.4	3.15	1.44
620	0.952	5580	18.0	2.67	1.61	50.0	3.13	1.43
625	0.945	5625	18.1	2.65	1.60	49.6	3.10	1.42

630	0.937	5670	18.3	2.62	1.59	49.2	3.08	1.41
635	0.930	5715	18.4	2.60	1.57	48.8	3.05	1.39
640	0.923	5760	18.6	2.58	1.56	48.4	3.03	1.38
645	0.916	5805	18.7	2.56	1.55	48.1	3.00	1.37
650	0.909	5850	18.9	2.54	1.54	47.7	2.98	1.36

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex T_t	cotton count Ne_C	denier T_d	grist T_j	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
655	0.902	5895	19.0	2.53	1.53	47.3	2.96	1.35
660	0.895	5940	19.2	2.51	1.52	47.0	2.94	1.34
665	0.888	5985	19.3	2.49	1.50	46.6	2.91	1.33
670	0.881	6030	19.4	2.47	1.49	46.3	2.89	1.32
675	0.875	6075	19.6	2.45	1.48	45.9	2.87	1.31
680	0.868	6120	19.7	2.43	1.47	45.6	2.85	1.30
685	0.862	6165	19.9	2.41	1.46	45.3	2.83	1.29
690	0.856	6210	20.0	2.40	1.45	44.9	2.81	1.28
695	0.850	6255	20.2	2.38	1.44	44.6	2.79	1.27
700	0.844	6300	20.3	2.36	1.43	44.3	2.77	1.26
705	0.838	6345	20.5	2.35	1.42	44.0	2.75	1.26
710	0.832	6390	20.6	2.33	1.41	43.7	2.73	1.25
715	0.826	6435	20.8	2.31	1.40	43.4	2.71	1.24
720	0.820	6480	20.9	2.30	1.39	43.1	2.69	1.23
725	0.814	6525	21.0	2.28	1.38	42.8	2.67	1.22
730	0.809	6570	21.2	2.27	1.37	42.5	2.65	1.21
735	0.803	6615	21.3	2.25	1.36	42.2	2.64	1.21
740	0.798	6660	21.5	2.23	1.35	41.9	2.62	1.19
745	0.793	6705	21.6	2.22	1.34	41.6	2.60	1.19
750	0.787	6750	21.8	2.20	1.33	41.3	2.58	1.18
755	0.782	6795	21.9	2.19	1.32	41.1	2.57	1.17
760	0.777	6840	22.1	2.18	1.32	40.8	2.55	1.17
765	0.772	6885	22.2	2.16	1.31	40.5	2.53	1.16
770	0.767	6930	22.4	2.15	1.30	40.3	2.52	1.15
775	0.762	6975	22.5	2.13	1.29	40.0	2.50	1.14
780	0.757	7020	22.6	2.12	1.28	39.8	2.48	1.14
785	0.752	7065	22.8	2.11	1.27	39.5	2.47	1.13
790	0.748	7110	22.9	2.09	1.26	39.3	2.45	1.12
795	0.743	7155	23.1	2.08	1.26	39.0	2.44	1.11

800	0.738	7200	23.2	2.07	1.25	38.8	2.42	1.11
805	0.734	7245	23.4	2.05	1.24	38.5	2.41	1.10
810	0.729	7290	23.5	2.04	1.23	38.3	2.39	1.09
815	0.725	7335	23.7	2.03	1.23	38.0	2.38	1.09
820	0.720	7380	23.8	2.02	1.22	37.8	2.36	1.08
825	0.716	7425	23.9	2.00	1.21	37.6	2.35	1.07

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex T_t	cotton count Ne_C	denier T_d	grist T_j	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
830	0.711	7470	24.1	1.99	1.20	37.4	2.33	1.07
835	0.707	7515	24.2	1.98	1.20	37.1	2.32	1.06
840	0.703	7560	24.4	1.97	1.19	36.9	2.31	1.05
845	0.699	7605	24.5	1.96	1.18	36.7	2.29	1.05
850	0.695	7650	24.7	1.95	1.18	36.5	2.28	1.04
855	0.691	7695	24.8	1.93	1.17	36.3	2.27	1.04
860	0.687	7740	25.0	1.92	1.16	36.0	2.25	1.03
865	0.683	7785	25.1	1.91	1.16	35.8	2.24	1.02
870	0.679	7830	25.3	1.90	1.15	35.6	2.23	1.02
875	0.675	7875	25.4	1.89	1.14	35.4	2.21	1.01
880	0.671	7920	25.5	1.88	1.14	35.2	2.20	1.01
885	0.667	7965	25.7	1.87	1.13	35.0	2.19	1.00
890	0.664	8010	25.8	1.86	1.12	34.8	2.18	1.00
895	0.660	8055	26.0	1.85	1.12	34.6	2.17	0.989
900	0.656	8100	26.1	1.84	1.11	34.4	2.15	0.984
905	0.652	8145	26.3	1.83	1.10	34.3	2.14	0.979
910	0.649	8190	26.4	1.82	1.10	34.1	2.13	0.973
915	0.645	8235	26.6	1.81	1.09	33.9	2.12	0.968
920	0.642	8280	26.7	1.80	1.09	33.7	2.11	0.963
925	0.638	8325	26.9	1.79	1.08	33.5	2.09	0.958
930	0.635	8370	27.0	1.78	1.08	33.3	2.08	0.952
935	0.632	8415	27.1	1.77	1.07	33.2	2.07	0.947
940	0.628	8460	27.3	1.76	1.06	33.0	2.06	0.942
945	0.625	8505	27.4	1.75	1.06	32.8	2.05	0.937
950	0.622	8550	27.6	1.74	1.05	32.6	2.04	0.932
955	0.618	8595	27.7	1.73	1.05	32.5	2.03	0.928
960	0.615	8640	27.9	1.72	1.04	32.3	2.02	0.923
965	0.612	8685	28.0	1.71	1.04	32.1	2.01	0.918

970	0.609	8730	28.2	1.70	1.03	32.0	2.00	0.913
975	0.606	8775	28.3	1.70	1.03	31.8	1.99	0.909
980	0.603	8820	28.4	1.69	1.02	31.6	1.98	0.904
985	0.599	8865	28.6	1.68	1.02	31.5	1.97	0.899
990	0.597	8910	28.7	1.67	1.01	31.3	1.96	0.895
995	0.594	8955	28.9	1.66	1.01	31.2	1.95	0.890
1000	0.591	9000	29.0	1.65	1.00	31.0	1.94	0.886

(*continued*)

Table 12 Tex to other Count Systems — Contd

tex $\boldsymbol{T_t}$	cotton count Ne_C	denier $\boldsymbol{T_d}$	grist $\boldsymbol{T_j}$	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1010	0.585	9090	29.3	1.64	0.990	30.7	1.92	0.877
1020	0.579	9180	29.6	1.62	0.980	30.4	1.90	0.868
1030	0.573	9270	29.9	1.61	0.971	30.1	1.88	0.860
1040	0.568	9360	30.2	1.60	0.962	29.8	1.86	0.852
1050	0.562	9450	30.5	1.58	0.952	29.5	1.85	0.844
1060	0.557	9540	30.8	1.56	0.943	29.2	1.83	0.836
1070	0.552	9630	31.1	1.55	0.935	29.0	1.81	0.828
1080	0.547	9720	31.4	1.53	0.926	28.7	1.79	0.820
1090	0.542	9810	31.6	1.52	0.917	28.4	1.78	0.813
1100	0.537	9900	31.9	1.50	0.909	28.2	1.76	0.805
1110	0.532	9990	32.2	1.49	0.901	27.9	1.75	0.798
1120	0.527	10080	32.5	1.48	0.893	27.7	1.73	0.791
1130	0.522	10170	32.8	1.46	0.885	27.4	1.72	0.784
1140	0.518	10260	33.1	1.45	0.877	27.2	1.70	0.777
1150	0.514	10350	33.4	1.44	0.870	27.0	1.69	0.770
1160	0.509	10440	33.7	1.43	0.862	26.7	1.67	0.764
1170	0.505	10530	34.0	1.41	0.855	26.5	1.66	0.758
1180	0.500	10620	34.3	1.40	0.847	26.3	1.64	0.751
1190	0.496	10710	34.5	1.39	0.840	26.0	1.63	0.744
1200	0.492	10800	34.8	1.38	0.833	25.8	1.62	0.738
1210	0.488	10890	35.1	1.37	0.826	25.6	1.60	0.732
1220	0.484	10980	35.4	1.36	0.820	25.4	1.59	0.727
1230	0.480	11070	35.7	1.34	0.813	25.2	1.58	0.720
1240	0.476	11160	36.0	1.33	0.806	25.0	1.56	0.714
1250	0.472	11250	36.3	1.32	0.800	24.8	1.55	0.709
1260	0.469	11340	36.6	1.31	0.794	24.6	1.54	0.703
1270	0.465	11430	36.9	1.30	0.787	24.4	1.53	0.697

1280	0.462	11520	37.2	1.29	0.781	24.2	1.51	0.692
1290	0.458	11610	37.4	1.28	0.775	24.0	1.50	0.687
1300	0.454	11700	37.7	1.27	0.769	23.8	1.49	0.681
1310	0.451	11790	38.0	1.26	0.763	23.7	1.48	0.676
1320	0.447	11880	38.3	1.25	0.758	23.5	1.47	0.671
1330	0.444	11970	38.6	1.24	0.752	23.3	1.46	0.666
1340	0.441	12060	38.9	1.23	0.746	23.1	1.45	0.661
1350	0.437	12150	39.2	1.22	0.741	23.0	1.44	0.656

(*continued*)

Table 12 Tex to other Count Systems — Contd

tex $\boldsymbol{T_t}$	cotton count Ne_C	denier $\boldsymbol{T_d}$	grist $\boldsymbol{T_j}$	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1360	0.434	12240	39.5	1.22	0.735	22.8	1.43	0.651
1370	0.431	12330	39.8	1.21	0.730	22.6	1.41	0.647
1380	0.428	12420	40.1	1.20	0.725	22.5	1.40	0.642
1390	0.425	12510	40.4	1.19	0.719	22.3	1.39	0.637
1400	0.422	12600	40.6	1.18	0.714	22.1	1.38	0.633
1410	0.419	12690	40.9	1.17	0.709	22.0	1.37	0.628
1420	0.416	12780	41.2	1.16	0.704	21.8	1.36	0.624
1430	0.413	12870	41.5	1.16	0.699	21.7	1.36	0.619
1440	0.410	12960	41.8	1.15	0.694	21.5	1.35	0.615
1450	0.407	13050	42.1	1.14	0.690	21.4	1.34	0.611
1460	0.404	13140	42.4	1.13	0.685	21.2	1.33	0.607
1470	0.402	13230	42.7	1.13	0.680	21.1	1.32	0.603
1480	0.399	13320	43.0	1.12	0.676	20.9	1.31	0.598
1490	0.396	13410	43.3	1.11	0.671	20.8	1.30	0.594
1500	0.394	13500	43.5	1.10	0.667	20.7	1.29	0.591
1510	0.391	13590	43.8	1.10	0.662	20.5	1.28	0.587
1520	0.388	13680	44.1	1.09	0.658	20.4	1.28	0.583
1530	0.386	13770	44.4	1.08	0.654	20.3	1.26	0.579
1540	0.383	13860	44.7	1.07	0.649	20.1	1.26	0.575
1550	0.381	13950	45.0	1.07	0.645	20.0	1.25	0.571
1560	0.378	14040	45.3	1.06	0.641	19.9	1.24	0.568
1570	0.376	14130	45.6	1.05	0.637	19.7	1.23	0.564
1580	0.374	14220	45.9	1.05	0.633	19.6	1.23	0.561
1590	0.371	14310	46.2	1.04	0.629	19.5	1.22	0.557
1600	0.369	14400	46.4	1.03	0.625	19.4	1.21	0.554
1610	0.367	14490	46.7	1.03	0.621	19.3	1.20	0.550

1620	0.364	14580	47.0	1.02	0.617	19.1	1.20	0.547
1630	0.362	14670	47.3	1.01	0.613	19.0	1.19	0.543
1640	0.360	14760	47.6	1.01	0.610	18.9	1.18	0.540
1650	0.358	14850	47.9	1.00	0.606	18.8	1.17	0.537
1660	0.356	14940	48.2	0.996	0.602	18.7	1.17	0.534
1670	0.354	15030	48.5	0.990	0.599	18.6	1.16	0.530
1680	0.351	15120	48.8	0.985	0.595	18.5	1.15	0.527
1690	0.349	15210	49.1	0.979	0.592	18.3	1.15	0.524
1700	0.347	15300	49.4	0.973	0.588	18.2	1.14	0.521

(*continued*)

Table 12 Tex to other Count Systems — Contd.

tex $\boldsymbol{T_t}$	cotton count Ne_C	denier $\boldsymbol{T_d}$	grist $\boldsymbol{T_j}$	linen Ne_L	metric N_m	woollen (dewsbury) N_d	woollon (yorkshire) N_y	worsted Ne_W
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1710	0.345	15390	49.6	0.967	0.585	18.1	1.13	0.518
1720	0.343	15480	49.9	0.962	0.581	18.0	1.13	0.515
1730	0.341	15570	50.2	0.956	0.578	17.9	1.12	0.512
1740	0.339	15660	50.5	0.951	0.575	17.8	1.11	0.509
1750	0.337	15750	50.8	0.945	0.571	17.7	1.11	0.506
1760	0.336	15840	51.1	0.940	0.568	17.6	1.10	0.503
1770	0.334	15930	51.4	0.934	0.565	17.5	1.09	0.500
1780	0.332	16020	51.7	0.929	0.562	17.4	1.09	0.498
1790	0.330	16110	52.0	0.924	0.559	17.3	1.08	0.495
1800	0.328	16200	52.3	0.919	0.556	17.2	1.08	0.492
1810	0.326	16290	52.5	0.914	0.552	17.1	1.07	0.489
1820	0.324	16380	52.8	0.909	0.549	17.0	1.06	0.487
1830	0.323	16470	53.1	0.904	0.546	16.9	1.06	0.484
1840	0.321	16560	53.4	0.899	0.543	16.8	1.05	0.481
1850	0.319	16650	53.7	0.894	0.541	16.8	1.05	0.479
1860	0.317	16740	54.0	0.889	0.538	16.7	1.04	0.476
1870	0.316	16830	54.3	0.884	0.535	16.6	1.04	0.474
1880	0.314	16920	54.6	0.880	0.532	16.5	1.03	0.471
1890	0.312	17010	54.9	0.875	0.529	16.4	1.03	0.469
1900	0.311	17100	55.2	0.870	0.526	16.3	1.02	0.466
1910	0.309	17190	55.4	0.866	0.524	16.2	1.01	0.464
1920	0.308	17280	55.7	0.861	0.521	16.1	1.01	0.461
1930	0.306	17370	56.0	0.857	0.518	16.1	1.00	0.459
1940	0.304	17460	56.3	0.853	0.515	16.0	0.999	0.457
1950	0.303	17550	56.6	0.848	0.513	15.9	0.994	0.454

1960	0.301	17640	56.9	0.844	0.510	15.8	0.989	0.452
1970	0.300	17730	57.2	0.840	0.508	15.7	0.984	0.450
1980	0.298	17820	57.5	0.835	0.505	15.7	0.979	0.447
1990	0.297	17910	57.8	0.831	0.503	15.6	0.974	0.445
2000	0.295	18000	58.1	0.827	0.500	15.5	0.969	0.443

APPENDIX B

(*Clause* 1.2)

PROCEDURE FOR ROUNDING OFF ACCORDING TO ISO 1144:2016

A-l ROUNDED VALUES OF TEX

A-1.1 When nominal counts or linear densities are converted into tex, decimal values are usually obtained, which may have to be rounded for practical purposes. To provide consistency in rounding, and for convenience during the initial stage of implementation of the Tex System, convenient rounded values have been evolved from those commonly used in the textile industry. These are listed in co1 3 of Table 13. The range of exact values represented by each rounded value is also given in Table 13. The list of rounded values includes a minimum of decimals and uses even numbers as far as possible.

A-2 PROCEDURE TO DETERMINE ROUNDED TEX VALUES

A-2.1 Use the following procedure to determine the rounded tex value corresponding with a yarn count or linear density expressed in any other counting system:

a) Determine the exact tex equivalent of the nominal count or linear density by means of the appropriate conversion factor given in Table 1 or Table 2.

Example:

T_d 150 corresponds to 16.66 tex.

b) Find the range of values in co1 1 and 2 of Table 13, which contains the tex number determined in accordance with (a) above.

Example:

16.66 tex is contained in the range 16.5 to 17.5.

c) Read off the rounded tex value given in co1 3 of Table 13 for the range of values selected in accordance with (b) above.

Example:

For the range 16.5 to 17.5, the rounded tex number is 17.

The values in Table 13 are valid for the unit tex and for its multiples and sub-multiples, including kilotex and millitex units. The scope of the table may be extended for coarser and finer linear densities by multiplying or dividing the values given by 10 or 100.

A-3 SPECIAL CASES

A-3.1 Where special circumstances necessitate the use of a finer grading of tex numbers than is provided by Table 13 (for example, for fine-spun cotton in the range < 10 tex), the rounded value may be obtained by taking the arithmetical mean of two adjacent rounded values. The value range to which this rounded value corresponds is half the relevant value range given in co1 1 and 2 of Table 13.

Example:

Value Range		Corresponding Rounded Value*
From Over	Up to and Including	
5.9	6.1	6.0
6.1	6.3	6.2
6.3	6.5	6.4
6.5	6.7	6.6
*Rounded values given in this table have been underlined in this example.		

Table 13 Ranges Of Values In Tex, With Their Corresponding Rounded Value

(Clause A-1.1)

Value Range		Corresponding Rounded Value*
From Over	Up to and Including	
(1)	(2)	(3)
>9.4	<9.8	9.6
9.8	10.25	10
10.25	10.75	10.5
10.75	11.25	11
11.25	11.75	11.5
11.75	12.25	12
12.25	12.75	12.5
12.75	13.5	13
13.5	14.5	14
14.5	15.5	15
15.5	16.5	16
16.5	17.5	17
17.5	18.5	18
18.5	19.5	19
19.5	20.5	20
20.5	21.5	21
21.5	22.5	22

22.5	23.5	23
23.5	24.5	24
24.5	25.5	25
25.5	27	26
27	29	28
29	31	30
31	33	32
33	35	34
35	37	36
37	39	38
39	41	40
41	43	42
43	45	44
45	47	46
47	49	48
49	51	50
51	54	52
54	58	56
58	62	60
62	66	64
66	70	68
70	74	72
74	78	76
78	82	80
82	86	84
86	90	88
90	94	92
94	98	96
98	102.5	100
102.5	107.5	105
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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

Draft For Comments Only

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WC
September 2024

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भारतीय मानक मसौदा

वस्त्रादि — कपड़ो की अकड़न — परीक्षण पद्धतियाँ

(पहला पुनरीक्षण)

Draft *Indian Standard*

TEXTILES — STIFFNESS CHARACTERISTIC OF FABRICS — METHODS OF TEST

(*First Revision*)

ICS 59.080.30

Physical Methods of Test Sectional Committee TXD 01	Last date for receipt of comments **31 October 2024**

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1971. This standard was prepared with the view to specify a test method for determination of stiffness of fabrics by the measurement of bending length using cantilever test.

This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

h) The title of the standard has been modified;
i) The Scope of the standard has been modified;
j) A new test method “Heart Loop Test” has been incorporated;
k) A new clause for “Principle” has been incorporated;
l) The clause ‘Calculations’ has been modified;
m) The clause “Test report” has been modified; and

n) References to Indian standards have been updated.

In the original standard, the test method, i.e. Cantilever test, given for determination of stiffness of fabric is not applicable for very limp fabric or those that show a marked tendency to curl or twist at a cut edge. Therefore, a new test method, i.e. Heart Loop test, has been introduced in this revision which can also be applicable for determination of stiffness for very limp fabric or those that show a marked tendency to curl or twist at a cut edge.

In the preparation of this standard, considerable assistance has been derived from the following:

ASTM Designation: D 1388-64 Methods of test for stiffness of fabrics, American Society for Testing Materials.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft Indian Standard

TEXTILES — STIFFNESS CHARACTERISTIC OF FABRICS — METHODS OF TEST

(*First Revision*)

1 SCOPE

1.1 This standard prescribes two methods for determination of stiffness of fabrics made from any textile fibre or a blend of two or more textile fibres by the measurement of bending length.

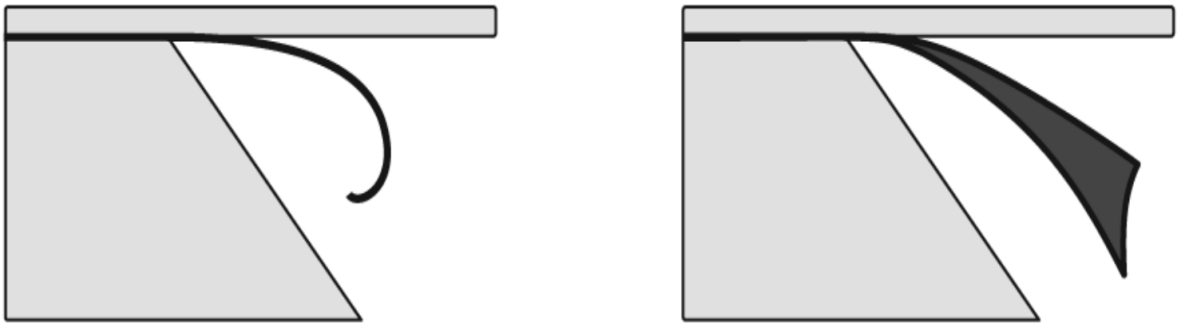
— Method A – Cantilever Test; and

— Method B – Heart Loop Test.

1.2 This test method applies to most fabrics including woven fabrics, air bag fabrics, blankets, napped fabrics, knitted fabrics, layered fabrics, pile fabrics. The fabrics may be untreated, heavily sized, coated, resin-treated, or otherwise treated.

1.3 The 'Method A' is not suitable for very limp fabric or those that show a marked tendency to curl or twist at a cut edge (*see* Fig. 1). Whereas the 'Method B' is suitable for very limp fabrics or the fabrics which shows a tendency to curl or twist.

NOTE — These methods are more suitable for testing woven fabrics than knitted fabrics.



Curl **Twist at a cut edge**

FIG.1: EXAMPLES OF FABRIC NOT SUITABLE FOR CANTILEVER TEST

2 NORMATIVE REFERENCES

The standards listed below contain 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 subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

IS No.	*Title*
IS 196 : 1967	Atmospheric conditions for testing (revised)
IS 1964 : 2001	Textiles – Methods for determination of mass per unit length and mass per unit area of fabrics (second revision)
IS 3919 : 1966	Methods for sampling cotton fabrics for determination of physical characteristics
IS 6359 : 2023	Method for conditioning of textiles (*first revision*)
IS 6668 : 1972	Method for preparing test specimens from fabric samples for physical tests

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall be used.

3.1 Stiffness — Resistance of fabric to bending.

3.2 Flexural Rigidity — Ratio of the small change in bending moment per unit width of the material to the corresponding small change in the curvature, expressed in milligram centimetres (mg-cm).

NOTE — This quantity is a measure of the resistance of cloth to bending by external forces. It is related to the quality of stiffness that is appreciated when a fabric is handled; that is, the cloth having a high flexural rigidity tends to feel stiff.

3.3 Bending Length — Cube root of the ratio of flexural rigidity (milligram-centimeters) to the weight per unit area (milligram per square centimetre) of the fabric. Bending length equals to the half of the length of rectangular strip of fabric that will bend under its own weight to an angle of 41.5°. It is also equal to the length of a rectangular strip of materials that will bend under its own weight to an angle of 7.l °. It is expressed in centimetres.

NOTE — This quantity is one of the factors that determines the manner in which fabric drapes. It is related to the quality of the stiffness that is appreciated by visual examination of the draped material, that is, the cloth having high bending length tends to drape stiffly.

4 PRINCIPLE

4.1 Method A works on the cantilever principal where a specimen slides at a specified rate in a direction parallel to its long dimension, until its leading edge projects from the edge of a horizontal surface. The length of the overhang is measured when the tip of the specimen is depressed under its own mass to the point where the line joining the tip to the edge of the platform makes a 0.724 rad (41.5°) angle with the horizontal. From this measured length and the specimen’s fabric mass per unit area, the bending length and flexural rigidity are calculated.

4.2 In Method B, a strip of fabric is formed into a heart-shaped loop. The length of the loop is measured when it is hanging vertically under its own mass. From this measured length and the specimen's fabric mass per unit area, the bending length and flexural rigidity are calculated.

5 SAMPLING

Follow the method of drawing the test sample from the gross sample with respect to the lot as given in the relevant specification for the material or as agreed to between the buyer and the seller.

NOTE — For cotton fabrics, IS 3919 may be followed.

6 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

Prior to test, the fabrics shall be conditioned to moisture equilibrium and tested in standard atmospheric conditions of (65 ± 2) percent RH and (27 ± 2) °C temperature as laid down in IS 6359 (*see also* IS 196).

7 METHOD A — CANTILEVER TEST

7.1 Apparatus

7.1.1 *Bend Angle Indicator* — A platform inclined at an angle of 41.5° ± 0.5° (0.724 rad ± 0.01 rad) below the plane of the horizontal platform surface.

7.1.2 *Horizontal Platform* — A platform with a minimum area of 38 mm by 200 mm (1.5 in. by 8 in.) and having a smooth, low-friction, flat surface such as polished metal or plastic.

7.1.3 *Movable Specimen Slide* — It shall consist of a metal bar not less than 25 mm by 200 mm (1 in. by 8 in.) by approximately 3 mm (1/8 in.) thick and having a mass of 270 ± 5 g. A motorized specimen feed unit set to 120 mm/min ± 5 percent may be used.

7.1.4 *Scale* — It shall be of 25 × 200 mm weighing (10 ± 2) g/cm with rough bottom surface to grip the specimen and graduated in centimeters and millimeters.

NOTE — A typical sketch of stiffness tester based on cantilever test is given in Fig. 2.

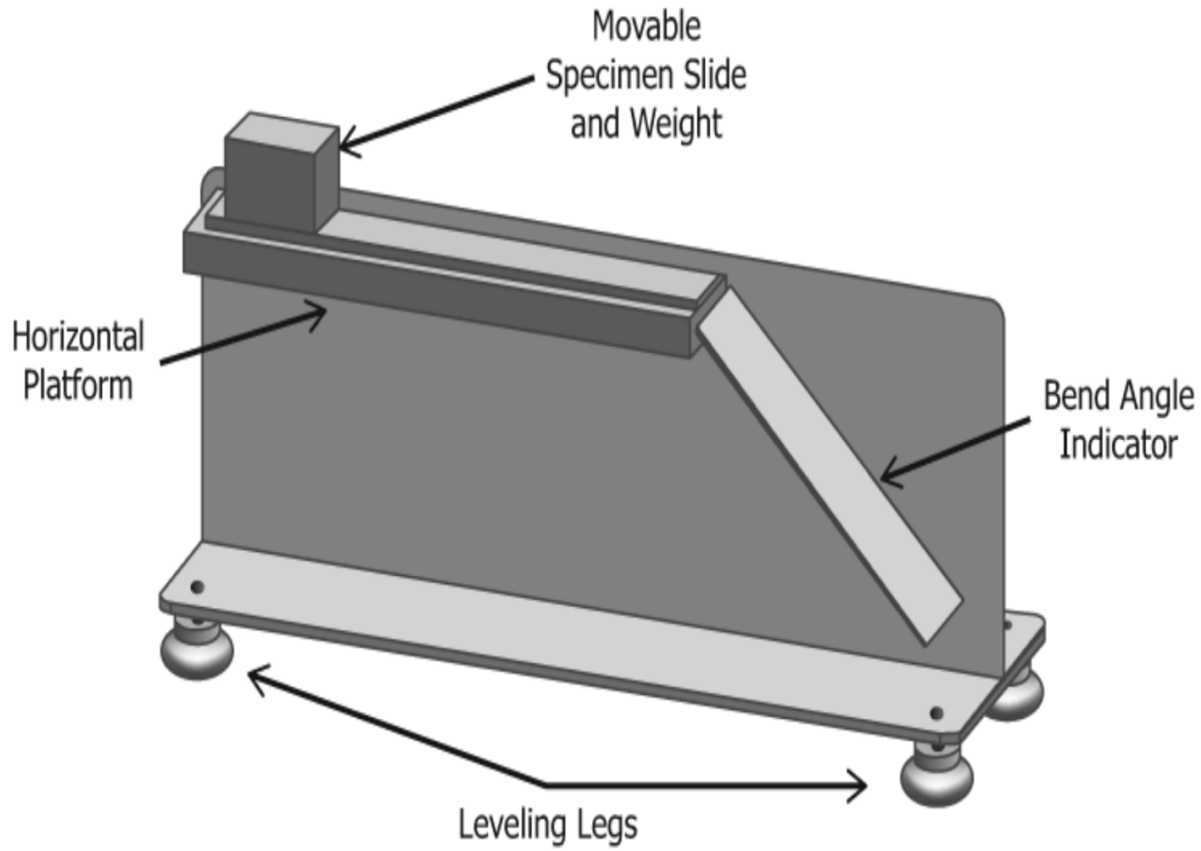


FIG. 2 A SUITABLE APPARATUS FOR DETERMINING STIFFNESS USING CANTILEVER TEST

7.2 Preparation of Test Specimens

7.2.1 From the samples, as selected in **5**, cut rectangular warp way and weft way test specimens of 25 mm × 200 mm size preferably with the help of a template from different portions of the sample under test. The lengthwise (longer) direction of specimens shall be parallel to the warp or weft direction for which the stiffness is to be determined. Specimens cut in each direction shall be scattered as far as possible so that no two warpway specimens contain the same set of warp yarns and no two weftway specimens contain the same set of weft yarns. Avoid selvedges (within 10 cm), end portions, creased or folded places (*see* IS 6668). The specimens shall be handled as little as possible.

7.3 Procedure

7.3.1 Place the tester on a table or bench so that horizontal platform and inclined reference line are at eye level of the operator. Adjust the platform with the help of a spirit level so that it is horizontal.

7.3.2 Remove the movable specimen slide. Place the specimen on the horizontal platform with the length of the specimen parallel to the platform edge. For instruments equipped with a reference point, align the leading edge of the specimen with the line scribed on the right-hand

edge of the horizontal platform. For all other instruments, align the leading edge of the specimen with the edge of the horizontal platform edge (closest to the bend angle indicator).

7.3.3 Place the movable slide on the specimen, being careful not to change its initial position.

7.3.3.1 For automatic testers, turn the tester switch on and watch the leading edge of the specimen closely. Turn the switch off the instant the edge of the specimen touches the bend angle indicator.

7.3.3.2 For manual testers, advance the moveable specimen slide by hand in a smooth manner at approximately 120 mm/min ± 5 % until the edge of the specimen touches the bend angle indicator.

7.3.4 Using the scale, read and record the overhang length from the fulcrum (edge of the horizontal platform) to the nearest 1 mm.

NOTE - If the specimen has a tendency to twist, take the reading from at the center of the leading edge. Do not measure specimens that twist more than 45°.

7.3.5 Repeat **7.3.2 – 7.3.4** to test the face and back of both ends of each specimen for a total of four readings per specimen. Test the face and back of one specimen end before proceeding to test the face and back of the other end of the specimen.

NOTE — A typical sketch of fabric in bent position in cantilever test is given in Fig. 3.

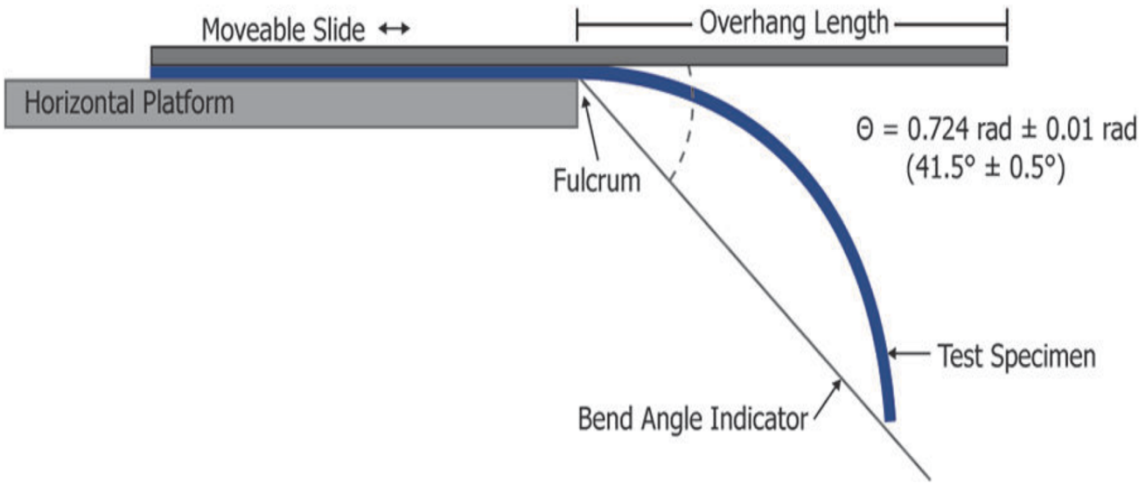


FIG. 3 FABRIC IN BENT POSITION UNDER CANTILEVER TEST

7.3.4 Similarly, test at least 4 test specimens for each warpway and weftway.

7.3.5 Determine the weight per unit area of the fabric according to IS 1964 and express in terms of milligrams per square centimetre. Alternatively, the weight per unit area can be determined

by weighing all the warpway and weftway test specimens together after completion of stiffness test.

7.4 Calibration

7.4.1 Set the tester on a table or bench and adjust the platform so that it is level to horizontal.

7.4.2 Verify that the bend angle indicator is at the 41.5° (0.724 rad) angle marked on the scale.

8 METHOD B — HEART LOOP TEST

8.1 Apparatus

8.1.1 *Clamp and Stand* — It shall be suitable for hanging the specimen.

NOTE — A convenient method for mounting and measuring the specimen involves the use of two bars 25 mm by 75 mm by 3 mm (1 in. by 3 in. by 0.125 in.), to which the strip is fastened and a clip for holding these bars and the attached strip in a suitable position in front of scale.

8.1.2 *Scale* — It shall be suitably mounted on the stand for measuring the length of the specimen loop and calibrated either in cm or directly in bending length.

NOTE — If a constant strip length is adopted, the scale may be calibrated to read directly in units.

8.1.3 *Pressure Sensitive Tape.*

8.1.4 *Jig (optional)* — It shall be constructed in such a way to allow positioning of the two bars with there inner edges parallel and at a distance from each other equal to the selected strip length.

8.1.5 *Balance* — It shall have a capacity and sensitivity to weigh within ± 0.1 percent of the specimen weigh being tested.

NOTE — A typical sketch of stiffness tester based on Heart loop test is given in Fig. 4.

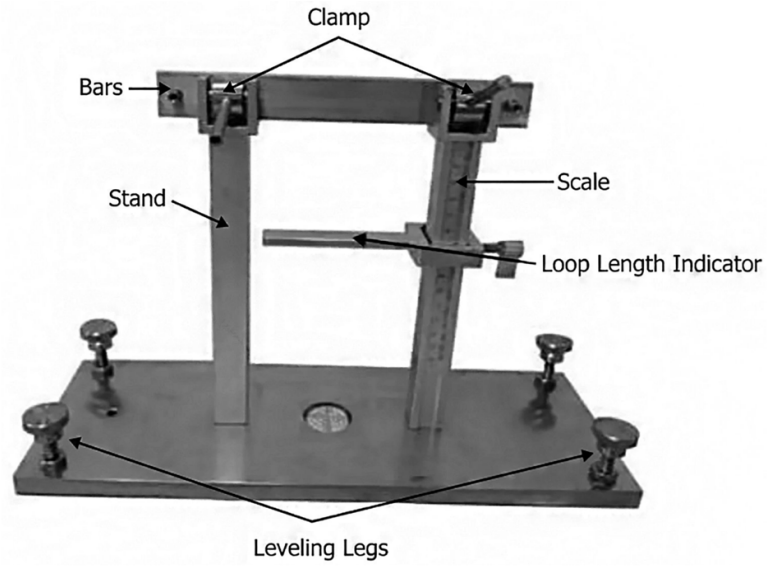


FIG. 4 A SUITABLE APPARATUS FOR DETERMINING STIFFNESS USING HEART LOOP TEST

8.2 Preparation of Test Specimens

8.2.1 This method does not require a standard size of the test specimen. When using two bars as described in **8.1.1,** cut test specimen of 5 cm longer than the selected strip length to allow for clamping at the ends. For other size bars, adjust the length to allow for clamping at the ends. As a starting point, use Table 2 to determine a suitable strip length for any given fabric.

NOTE — Strip length, L, is the circumferential length of the unclamped portion of the specimen.

8.2.2 Make several trial tests using various strip lengths selected from Table 2 to obtain an estimate of the loop length. Select a suitable strip length for a corresponding loop length from Table 3, such that the bending length is relatively independent of strip length.

NOTE — The bending length using the heart loop option is not entirely independent of the strip length. In general, the bending length rises with the strip length up to a value that remains relatively constant as the strip length is further increased. An additional rise may further be encountered for much longer strip lengths. Whenever possible, compare fabrics in the range where bending length is independent of strip length.

8.2.3 Select a specimen width at least 25 mm and no more than 75 mm with respect to the tendency of the fabric to curl. For fabrics having a slight tendency to curl, a 25 mm ± 1 mm wide specimen has been found to be satisfactory. As the tendency to curl becomes greater, increase the width up to a maximum of 75 mm.

8.2.4 From the sample, as selected in **5,** take at least four test specimens from the warp way and four test specimens from the weft way. Consider the long dimension of the specimen as the direction of test and also label the specimen to maintain identity.

TABLE 2 Strip Lengths for Various Fabric Types

Sl. No.	Bending length, cm	Strip length, cm
(1)	(2)	(3)
i)	Less than 2	15
ii)	2 to 3	20
iii)	Over 3	At least 25

TABLE 3 Table of Bending Lengths for Heart Loop Test

Sl. No	Loop Length, cm	Bending length, cm		
		15-cm Strip Length	20-cm Strip Length	25-cm Strip Length
(1)	(2)	(3)	(4)	(5)
i)	4.0	2.19	-	-
ii)	4.2	2.07	-	-
iii)	4.4	1.99	-	-
iv)	4.6	1.86	344	5.43
v)	4.8	1.76	3.30	5.16
vi)	5.0	1.65	3.17	4.91
vii)	5.2	1.56	3.03	4.71
viii)	5.4	1.45	2.90	4.53
ix)	5.6	1.35	2.80	4.36
x)	5.8	1.25	2.67	4.20
xi)	6.0	1.14	2.57	4.06
xii)	6.2	1.04	2.47	3.92
xiii)	6.4	0.93	2.37	3.80
xiv)	6.6	0.81	2.26	3.67
xv)	6.8	0.69	2.16	3.56
xvi)	7.0	0.53	2.06	3.45
xvii)	7.2	-	1.96	3.34
xxviii)	7.4	-	1.86	3.21
xix)	7.6	-	1.76	3.12
xx)	7.8	-	1.66	3.02
xxi)	8.0	-	-	2.91
xxii)	8.2	-	-	2.82
xxiii)	8.4	-	-	2.72

8.3 Procedure

8.3.1 Remove the two bars from the clamp and stand, and place them parallel to one another on a horizontal surface such that the inner edges are separated by a distance equal to the selected strip length. This can be done easily with a jig (*see* **8.1.4**).

8.3.2 Lay the test specimen across the two bars (*see* **8.2.1**).

8.3.3 Attach one end of the specimen strip to one bar using pressure-sensitive tape, being careful to align to one edge of the bar. Apply just enough tension to the specimen to hold it taut, but without stretching, and attach the other specimen end to the second bar in a similar manner.

8.3.4 Turn the bars and mounted specimen over, such that the fabric is on the underside of each bar. Grasp one bar in each hand, lift and rotate each bar three-quarter turn or 270° (4.71 rad). Rotate the left-hand bar in a clockwise direction and the right-hand bar in a counterclockwise direction. Bring the bars together such that the fabric ends are touching one another. Insert the assembly on a suitable holder with the loop formed free to hang vertically.

8.3.5 Allow the looped specimen to hang freely for (60 ± 5) seconds. Measure the loop length as the distance from the top of the bars to the bottom of the loop to the nearest 2 mm (*see* Fig. 5).

8.3.6 Remove the bars from the holder and free the adhering tape from each end of the strips carefully to prevent distortion of the fabric. Turn the specimen strip and test the other side of the fabric by re-attaching to the bars and testing as described in **8.3.1 – 8.3.5**.

8.3.7 Determine the weight per unit area of the fabric according to IS 1964 and express in terms of milligrams per square centimeter. Alternatively, the weight per unit area can be determined by weighing all the warp way and weft way test specimens together after completion of stiffness test.

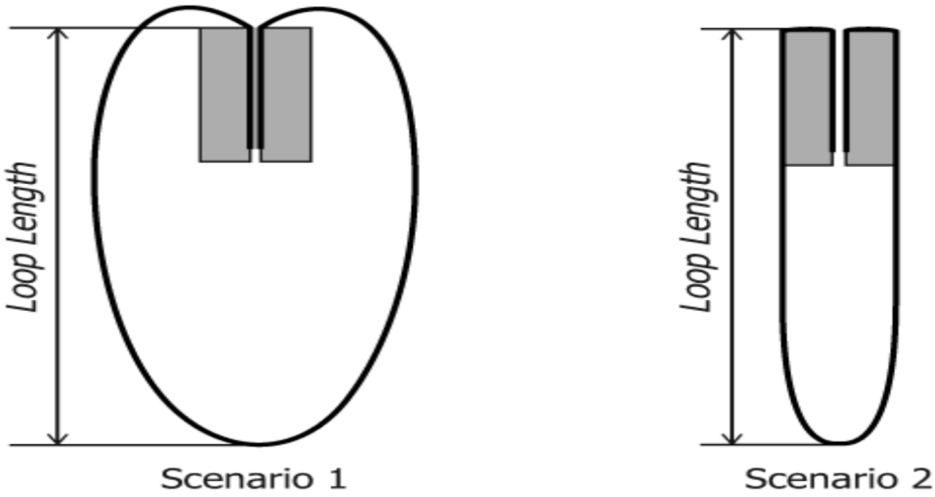


FIG. 5 MEASURING LOOP LENGTH FOR HEART LOOP TEST

8.4 Calibration

8.4.1 A suitable procedure for mounting and measuring the specimen is the use of two brass bars to which the specimen strip is fastened. The bars and the attached specimen strip are

clamped to the stand in a suitable vertical position in front of a scale calibrated either in cm or directly in bending length.

9 CALCULATIONS

9.1 Calculate the average of the four readings of overhang length (in case of Method A) and of the two readings of loop length (in case of Method B) for each test specimen. Determine the average of the values for the warpway and weftway test specimens separately.

9.2 Determine the bending length for warp way and weft way specimens by using the following formula:

a) For Method A — Cantilever Test, bending length (C), in centimeters, can be calculated as -

$$C = \frac{L}{2}$$

Where

L = the mean length of over-hanging portion in centimetres.

b) For Method B — Heart Loop Test, bending length (C), in centimeters, can be calculated as –

$$C = l_o f(\theta)$$

$$\text{and } f(\theta) = \left(\frac{cos\theta}{tan\theta}\right)^{\frac{1}{3}}$$

Where,

l = Loop length in centimeters
$l_o = 0.1337L$
L = Strip length in centimeters
$\theta = 32.85° \, d/l_o$
$d = (l - l_o)$

NOTE – The values of $f(\theta)$ for different values of θ is given in Annex A.

9.3 Determine the flexural rigidity, in milligram-centimeters, for warp way and weft way specimens by using the following formula:

$$G = W \times (C)^3$$

Where

W = weight per unit area of the fabric in milligrams per square centimetre.

c) Overall flexural rigidity

$$G_o = \sqrt{G_W \times G_f}$$

Where

G_w = warp way flexural rigidity, and
G_f = weftway flexural rigidity.

10 TEST REPORT

10.1 The report shall include the following information:

a) Type of fabric.
b) Type of Method used.
b) Number of test specimens tested:
    1) Warp way, and
    2) Weft way.
c) Bending length:
    1) Warp way and
    2) Weft way.
e) Flexural rigidity:
    1) Warp way, and
    2) Weft way.
f) Overall flexural rigidity, if required.

Annex A
(Clause 9.2)

TABLE 4 Values of $f(\theta)$ For Different Values of θ

Θ, deg	0	1	2	3	4	5	6	7	8	9
0	--	3.855	3.059	2.671	2.425	2.250	2.115	2.007	1.917	1.841
10	1.774	1.716	1.663	1.616	1.573	1.533	1.496	1.462	1.430	1.400
20	1.372	1.345	1.319	1.294	1.271	1.248	1.226	1.205	1.186	1.164
30	1.144	1.126	1.107	1.089	1.071	1.054	1.037	1.022	1.003	0.986
40	0.970	0.954	0.933	0.922	0.906	0.891	0.875	0.860	0.845	0.829
50	0.813	0.799	0.784	0.768	0.753	0.738	0.722	0.707	0.692	0.676
60	0.661	0.645	0.630	0.614	0.596	0.582	0.566	0.549	0.533	0.516
70	0.499	0.482	0.465	0.447	0.429	0.411	0.392	0.373	0.354	0.333
80	0.313	0.291	0.269	0.246	0.222	0.197	0.170	0.140	0.107	0.067

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BUREAU OF INDIAN STANDRADS

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September 2024

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भारतीय मानक मसौदा

वस्त्रादि – कपड़ो में वलि रिकवरी का मूल्यांकन — अपीयरेंस विधि

(आई एस 16575 : 2016 *का पहला पुनरीक्षण*)

(Draft Indian Standard)

TEXTILES — EVALUATION OF THE WRINKLE RECOVERY OF FABRICS — APPEARANCE METHOD

(*First Revision of* IS 16575 : 2016)

ICS 59.080.30

Physical Methods of Test Sectional Committee, TXD 01	Last date for receipt of comments 11 November 2024

NATIONAL FOREWORD

(Formal clauses will be added later)

This Indian Standard intended to be adopted is identical with ISO 9867 : 2022 'Textiles — Evaluation of the Wrinkle Recovery of Fabrics — Appearance Method' issued by the International Organization for Standardization (ISO).
This standard was originally published in 2016. The second revision of the standard has been undertaken to align it with the latest version of ISO 9087 : 2022. The major changes in this revision are as follows:

- Clause 3, Terms and definitions, has been added and subsequent clauses have been renumbered;
- Requirements for "Wrinkle tester" has been added in 5.1 (former 4.1);
- Figure 1 has been improved;
- A "timer" has been added in the list of apparatus in Clause 5 (former Clause 4);
- The requirements of atmospheres for preconditioning, conditioning and testing have been revised;
- Addition of "If the rating appears between two ratings, intermediate rating can be used in increments of a half for a rating (for example, No. 3,5)." in 9.4 (Former 8.4);
- The description of wrinkle rating has been added in Table 1;

- The annex on the "Summary of an international interlaboratory study on wrinkle recovery of fabrics" has been deleted and the former Annex B has been relabelled as Annex A.

Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the standard intended to be adopted, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 105-A03, Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining	IS/ISO 105-A03 : 2019, Textiles Tests for colour fastness Part A03: Grey scale for assessing staining (*first revision*)	Identical under single numbering
ISO 139, Textiles — Standard atmospheres for conditioning and testing	IS 6359 : 2023, Method for conditioning of textiles (*first revision*)	Technically Equivalent with ISO 139

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (second revision)'.

Extract of ISO 9087 : 2022 'Textiles — Evaluation of the Wrinkle Recovery of Fabrics — Appearance Method'

1 SCOPE

This document specifies a method for evaluating the appearance of textile fabrics after induced wrinkling.

This document is applicable to all kinds of textile fabrics.

NOTE — A digital description of the ISO wrinkle replicas is given in Annex A.

2 TERMS AND DEFINITIONS

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

a) ISO Online browsing platform: available at **https://www.iso.org/obp**
b) IEC Electropedia: available at **https://www.electropedia.org/**

2.1 Wrinkle Recovery

Property of a fabric which enables it to recover from wrinkling deformations.

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BUREAU OF INDIAN STANDARDS

Draft for Comments Only *Doc:* TXD 01 (26561)WC
September 2024

भारतीय मानक में संशोधन का मसौदा

IS 6359 : 2023 वस्त्रादि के अनुकूलन की विधि

(*पहला पुनरीक्षण* **)**

संशोधन - १

Draft Amendment to Indian Standard

AMENDMENT NO. 1

TO

IS 6359 : 2023 METHOD FOR CONDITIONING OF TEXTILES

(*First Revision*)

Physical Methods of Test Sectional Committee	Last date of receipt of comments TXD 01 16 November 2024

(*Foreword*, *para* 5) — Insert the following new para after para 3:

"This standard also includes the allowance for uncertainty of measurement in the overall tolerances for relative humidity. However, although the tolerances for relative humidity appear more lenient, in practice, it is advisable that the laboratory shall essentially control the relative humidity to (65 ± 2) percent."

(*Page* 1, *Clause* 5.2.3) — Substitute the following for the existing:

"Tolerance limits for temperature and relative humidity shall be ± 2 °C and ± 4 percent respectively, for conditioning of all the textile materials except the fibres whose moisture regain value is more than 8 % such as cotton, wool, silk, jute, linen and viscose fibres etc. for which the tolerance limit for relative humidity shall be ± 2 percent.

NOTE — The textile materials referred in the above clause consist of fibres, yarns, fabrics, and made-up textiles including technical textile products.

Annex 6

(Item 5.1)

Preliminary Draft

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26867) P
October 2024

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भारतीय मानक मसौदा

वस्त्रादि — कपड़ों के प्रति इकाई क्षेत्रफल द्रव्यमान तथा प्रति इकाई लम्बाई द्रव्यमान — परीक्षण पद्धतियाँ

(आई एस 1964 *का पहला पुनरीक्षण)*

Draft *Indian Standard*

TEXTILES — MASS PER UNIT LENGTH AND MASS PER UNIT AREA OF FABRICS — METHODS OF TEST

(Third Revision of IS 1964 *)*

ICS 59.080.30

Physical Methods of Test Sectional Committee TXD 01	Last date for receipt of comments 13 Nov 2024

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1961 and subsequently revised in 1970 and 2001. This standard was revised earlier for removal of selvedge in case the fabric mass is different than that of selvedge.

This revision has been made to incorporate the following major changes:

a) The Scope of the standard has been modified;
b) The clause "Terminology" of the standard has been modified;
c) A new clause "Sampling" has been incorporated;
d) The clause "Apparatus" for both method A and B has been modified;
e) The tolerance of relative humidity for atmospheric conditioning of samples has been modified;
f) The clause "Calculation" for both method A and B has been modified;

g) The tolerance for temperature in oven-drying has been modified; and
h) References to standards have been updated.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft *Indian Standard*

TEXTILES — MASS PER UNIT LENGTH AND MASS PER UNIT AREA OF FABRICS — METHODS OF TEST

(First Revision of IS 1964 *)*

1 SCOPE

1.1 This standard prescribes two methods for determination of mass per unit length and the mass per unit area of fabrics.

1.2 The methods prescribed in this standard are applicable to all other textile fabrics irrespective of their composition (that is, whether they are made of cotton, wool, silk or man-made fibres or blends of two or more such fibres), manufacturing processes and finishing treatments. The methods are also applicable to narrow fabrics.

1.3 The methods prescribed in this standard are not applicable to tyre cord fabrics.

2 REFERENCES

The Indian Standards given below contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
196 : 2024	Atmospheric conditions for testing (*first revision*)
232 : 1985	Glossary of textile terms — Natural fibres (*second revision*)
1954:2024	Textiles — Fabrics — Determination of Width and Length (*third revision*)
3919 : 1966	Methods for sampling cotton fabrics for determination of physical characteristics
6359 : 2023	Method for conditioning of textiles (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 232 and the following shall apply.

3.1 Commercial Moisture Regain

An arbitrary value formally adopted as a regain to be used with the oven-dry mass for calculating the commercial or legal mass of a shipment or a delivery of any specific textile material.

3.2 Conditioned Mass

The mass of a textile material conditioned in the standard atmosphere for testing.

3.3 Moisture Regain

The amount of moisture present in a textile material expressed as a percentage of its oven-dry mass.

3.4 Oven-Dry Mass

The constant mass of textile material obtained by drying it at a temperature of (110 ± 2) °C.

3.5 Moisture equilibrium — Condition reached by a sample at a closely defined temperature and relative humidity when the net difference between the amount of moisture absorbed and the amount desorbed, as indicated by a change in mass, shows no trend and becomes insignificant.

> NOTE — A textile material is in moisture equilibrium with the ambient atmosphere when it does not exchange water with this atmosphere; its mass then remains constant as long as the experiment is carried out in an unchanged atmosphere. For test purposes, moisture equilibrium is reached by absorption starting from a relatively low moisture content. Moisture equilibrium for testing is considered as having been reached when the rate of increase in mass of a Sample or specimen due to moisture uptake does not exceed that prescribed for the material being tested (see IS 6359).

4 PRINCIPLES

In Method A, the mass is determined by conditioning of material to the moisture equilibrium in standard atmospheric conditions. In Method B, the mass is determined by adding the commercial moisture regain of material with the oven dry mass of the material.

> NOTE — Any method may be used for the determination of mass per unit length and mass per unit area of fabric depending upon the type of the instruments and facilities available subject to agreement between the buyer and the seller. In case of dispute, Oven-dry method is recommended to be used as a reference method.

5. SAMPLING

Follow the method of drawing the test sample from the gross sample with respect to the lot as given in the relevant specification for the material or as agreed to between the buyer and the seller.

> NOTE — For cotton fabrics, IS 3919 may be followed.

5.1 Preparation of Test Specimens

5.1.1 From the samples, as selected in **5**, draw or cut the test specimen in the form of full piece, roll, bolt, or cut, or in the form of full width sample or in the form of small swatches of fabrics or from narrow fabrics of the below specified dimensions.

5.1.1.1 *Full Piece, Roll, Bolt or Cut* — The full piece, roll, bolt or cut of fabric drawn from the lot sample shall be considered as the test specimen.

5.1.1.2 *Full Width Sample* — From each sample drawn from the lot, cut (don't tear) the test specimen having width equal to the full width of sample including selvedges and length of 250

mm ± 2 mm. The cut edge must be a straight line, free of indentations or bulges, unless both edges have been made to trace parallel filling yarns.

NOTE — If the mass per unit length (or area) of the selvedge differs appreciably from the mass per unit length (or area) of the fabric, the mass per unit area shall be determined on a sample from which the selvedges have been removed along the outermost warp threads of the body and calculation(s) shall be based on the mass of the trimmed sample and its length and width.

5.1.1.3 *Small Swatch of Fabrics* — From each sample drawn from the lot, prepare a test specimen having an area of at least 100 cm^2 either in square (10 cm × 10 cm) or circular shape.

5.1.1.4 *Narrow Fabrics* — From each sample drawn from the lot, cut the test specimens having a length of 1 m ± 3 mm perpendicular to the selvedges, distributed as evenly as practicable along the length of the sample.

6 METHOD A — CONDITIONED MASS METHOD

6.1 Apparatus

6.1.1 *Horizontal, Flat Smooth Table*

6.1.2 *Graduated Steel Scale*

6.1.3 *Balance* — Capable of weighing to a sensitivity of 0.005 g.

6.1.4 *Cutting die*, either square or round and capable to cut the test specimen to an area of at least 100 cm^2.

6.2 Atmospheric Conditions for Conditioning and Testing

6.2.1 Prior to test, the test samples shall be conditioned to moisture equilibrium from dry side in the standard atmosphere of (65 ± 4) percent relative humidity and (27 ± 2) °C temperature (*see* also IS 6359).

NOTE — The time required for a fabric to reach moisture equilibrium depends mainly on:
a) the thickness of the fabric or mass per unit area,
b) the closeness of the weave,
c) the hygroscopicity of the textile material comprising the fabric, and
d) type of finish given to the fabric.

The test samples shall be deemed to have been conditioned satisfactorily for the purpose of this test after these have been exposed to standard atmosphere for at least as much time as given below in such a way as to expose, as far as possible, all portions of the specimens to the atmosphere:

Textile Fabrics having Equilibrium Moisture Regain Values at Standard Atmosphere, Percent	*Time* h
Less than 4	6
From 4 to 10	12
Above 10	24 to 48

6.2.2 The test shall be carried out in a standard atmosphere as specified in **6.2.1** (*see* also IS 196).

6.3 Procedure

6.3.1 Take the conditioned test specimens (*see* **6.2.1**) and determine its mass to an accuracy of 0.005 g.

6.3.2 Determine the length and width of samples according to IS 1954.

6.4 Calculations

Calculate the mass per unit length and mass per unit area of the test specimens by the following formula:

a) In case of full pieces, roll, bolt or cut:

$$\text{Mass per unit length, g/m} = \frac{M}{L} \times 10^3$$

$$\text{Mass per unit area, g/m}^2 = \frac{M}{L \times W} \times 10^3$$

Where
M = mass of fabric in kg,
L = length of fabric in m, and
W = width of fabric in m.

b) In case of swatches of 250 mm × full width:

$$\text{Mass per unit length, g/m} = \frac{G}{L_s} \times 10^3 = G \times 4$$

$$\text{Mass per unit area, g/m}^2 = \frac{G}{L_s \times W} \times 10^6 = \frac{G \times 4 \times 10^3}{W}$$

Where
G = mass of specimen in g,
L_s = length of specimen in mm, and
W = width of fabric in mm.

c) In case of small swatches of fabric i.e. 100 cm^2 area:

$$\text{Mass per unit length, g/m} = \frac{G \times W}{A} \times 10 = \frac{G \times W}{10}$$

$$\text{Mass per unit area, g/m}^2 = \frac{G}{A} \times 10^4 = G \times 10^2$$

Where
G = mass of specimen in g,
A = Area of specimen in cm^2, and
W = width of fabric in mm.

d) In case of narrow fabric of 1 m × full width:

Mass per unit length, g/m = $\frac{G}{L_s} \times 10^3 = G$

Mass per unit area, g/m^2 = $\frac{G}{L_s \times W} \times 10^6 = \frac{G \times 10^3}{W}$

Where
G = mass of specimen in g,
L_s = length of specimen in mm, and
W = width of fabric in mm.

6.5 Similarly, determine the mass per unit length and mass per unit area of at least four more test specimens and determine the average of all the values.

7 METHOD B — OVEN-DRY METHOD

7.1 Apparatus

7.1.1 *Horizontal, Smooth Flat Table*

7.1.2 *Graduated Steel Scale*

7.1.3 *Dying Oven* — Suitable for drying sample to constant mass at (110 ± 2) °C.

7.1.4 *Balance* — Capable of weighing to an accuracy of 0.005 g.

7.1.5 *T- Square*

7.1.6 *Cutting die*, either square or round and capable to cut the test specimen to an area of at least 100 cm^2.

7.2 Procedure

7.2.1 Lay the test specimens smoothly on a flat table. Mark at least five test specimens with the help of the scale and T-square of the dimensions given in **5.1**.

7.2.2 Determine the Length and width of the fabric according to IS 1954.

7.2.3 Dry the test specimen to constant mass in an oven maintained at (110 ± 2) °C temperature and weigh to an accuracy of 0.5 g without removing the specimen from the oven, the draught being stopped during weighing.

7.3 Calculations

Calculate the mass per unit length or mass per unit area of specimen, at the applicable commercial moisture regain value (*see* Note) by the following formula:

a) In case of full pieces, roll, bolt or cut:

Mass per unit length, g/m = $\frac{M_o \times (100 + R)}{L} \times 10$

Mass per unit area, g/m^2 = $\frac{M_o \times (100 + R)}{L \times W} \times 10$

Where
M_o = oven-dry mass of fabric in kg,
L = length of fabric in m,
W = width of fabric in m,
R = applicable commercial moisture regain in percentage.

b) In case of swatches of 250 mm × full width:

Mass per unit length, g/m = $\frac{G_o \times (100 + R)}{L_s} \times 10 = \frac{G_o \times (100 + R)}{25}$

Mass per unit area, g/m^2 = $\frac{G_o \times (100 + R)}{L_s \times W} \times 10^4 = \frac{G_o \times (100 + R) \times 40}{W}$

Where
G_o = oven-dry mass of specimen in g,
L_s = length of specimen in mm,
W = width of fabric in mm,
R = applicable commercial moisture regain in percentage.

c) In case of small swatches of fabric i.e. 100 cm^2 area:

Mass per unit length, g/m = $\frac{G_o \times (100 + R) \times W}{A \times 10} = \frac{G_o \times (100 + R) \times W}{1000}$

Mass per unit area, g/m^2 = $\frac{G_o \times (100 + R)}{A} \times 10^2 = G_o \times (100 + R)$

where
G_o = oven-dry mass of specimen in g,
A = area of specimen in cm^2,
W = width of fabric in mm,
R = applicable commercial moisture regain in percentage.

d) In case of narrow fabric of 1 m × full width:

Mass per unit length, g/m = $\frac{G_o \times (100 + R)}{L_s} \times 10 = \frac{G_o \times (100 + R)}{100}$

Mass per unit area, g/m^2 = $\frac{G_o \times (100 + R)}{L_s \times W} \times 10^4 = \frac{G_o \times (100 + R) \times 10}{W}$

where
G_o = oven-dry mass of specimen in g,
L_s = length of specimen in cm^2,
W = width of fabric in mm,
R = applicable commercial moisture regain in percentage.

NOTES — Commercial moisture regain value of fabrics shall be as stipulated in the relevant Indian Standard specifications for the material or in the absence of such specifications, it shall be as agreed to between the buyer and the seller.

7.4 Similarly, determine the mass per unit length and mass per unit area of at least four more test specimens and calculate the average of all the values obtained.

8 REPORT

Report shall include the following:
a) Type of fabric tested;
b) Method followed;
c) Number of specimens tested;
d) Mass per unit length;
e) Mass per unit area; and
f) Commercial moisture regain value used (in case of Method B).

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26871) P
October 2024

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भारतीय मानक मसौदा

वस्त्रादि — धागा — एकल अंत टूटन बल और टूटन पर दीर्घीकरण का निर्धारण

(IS 1670 *का तीसरा पुनरीक्षण*)

Draft *Indian Standard*

TEXTILES — YARN — DETERMINATION OF SINGLE-END BREAKING FORCE AND ELONGATION AT BREAK

(Third Revision of IS 1670 *)*

ICS 59.080.20

Physical Methods of Test Sectional Committee TXD 01	Last date for receipt of comments 13 Nov 2024

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1960 and subsequently revised in 1970 and 1991. This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

a) Title of the standard has been modified;
b) The Scope of the standard has been modified;
c) The tensile testing machines based on CRT and CRL principles have been deleted;
d) The clause ‘Terminologies’ have been updated;
e) The clause ‘Principle’ has been modified;
f) The clause ‘Procedure’ has been updated;

g) Test report has been modified; and
h) References to Standard have been updated.

In the 1960s and 1970s when this Indian Standard was first prepared, three types of tensile testers were in wide use: constant rate of specimen extension (CRE), constant rate of travel (CRT) and constant rate of loading (CRL). It was therefore advisable to state the rate of operation in a way which would be common to all three types of tester. In addition, the best possible agreement was sought between the test results of the three types of tester. Consequently, the principle of constant time to break was adopted, and 20 s to break was chosen for this International Standard and also for a number of national standards.

In the early 1990s, CRE testers were recognized as the best type. As CRT and CRL testers were still in use nationally, the procedure for using them was continued in the standard. There is no assurance that the results from the three types of tester will agree. This revision of the Standard considers CRE testers only, so the time-to-break principle is no longer needed and a simpler statement of rate of extension is used. The rate of extension of 100 % per minute has been adopted as standard, but higher rates were permitted by agreement for automatic testers.

CRT and CRL testers are now considered to be obsolete. The methods of using them are deprecated and their inclusion in informative Annex B does not have an influence on the status of this Indian Standard.

In the formulation of this standard, considerable assistance has been derived from ISO 2062:2009, Textiles — Yarns from packages — Determination of single-end breaking force and elongation at break using constant rate of extension (CRE) tester.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft *Indian Standard*

TEXTILES — YARN — DETERMINATION OF SINGLE-END BREAKING FORCE AND ELONGATION AT BREAK

(Third Revision of IS 1670 *)*

1 SCOPE

1.1 This standard prescribes method for determination of breaking load and elongation at break of yarn using constant rate of elongation only. Since for any fibre type breaking load is approximately proportional to the linear density, strands of different sizes are compared by converting the observed breaking load to breaking tenacity (centinewtons or millinewtons per tex).

1.2 The method prescribed in this standard is applicable to monofilaments and multi-filaments (other than tyre cords and industrial yarns), and spun yarns (single, plied or cabled) and textured yarns made from all kinds of textile fibres or their blends with the exception of yarns that stretch more than 5.0 percent when tension is increased from 0.5 to 1.0 g (5 to 10 mN) per unit linear density of the yarn in tex. The method prescribed in this standard is not applicable to fancy yarns.

1.3 This standard is designed primarily for yarn in package form but can be used for single strands removed/extracted from a woven/ knitted fabric.

1.4 This test method offers two options with respect to moisture content of the specimens at the time of testing.

1.4.1 *Option 1* — Conditioning to moisture equilibrium in the standard atmosphere for testing textiles (*see* IS 6359).

1.4.2 *Option 2* — Testing in wet condition. Tests on wet specimens are usually made only on yarns which show a less strength when wet or when exposed to high humidity, for example, yarns made from animal fibres and man-made fibres based on regenerated and modified cellulose. Wet tests are made on flax yarns to detect adulteration by failure to gain strength.

1.5 This method also offers three options for the physical confirmation of the specimen.

1.5.1 *Option A* — Straight (*see* Note 4).

1.5.2 *Option B* — Knotted (*see* Notes 1, 2 and 3).

1.5.3 *Option C* — Looped (*see* Notes 1 and 3).

NOTES

1 The reduction in strength due to the presence of a knot or loop is considered a measure of brittleness of yarn. If a textile yarn is looped or knotted, its tensile strength may reduce. This can arise when a yarn is bent to a small radius of curvature (as in sewing or knitting) or knotted (as in the manufacture of nets). In order to assess the importance of these effects, loop strength and knot strength are described.
2 The knot strength test as described in this standard is not intended to assess the efficiency of any given type of knot for joining together two separate lengths of yarn.
3 Elongation in knot or loop test is not known to have any significance and is not usually recorded.
4 Unless otherwise indicated, 'single-end breaking strength' is assumed to refer to a straight, conditioned specimen (Option 1A).

2 REFERENCES

The standards listed in Annex A contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Breaking Force - The maximum force applied to a specimen in a tensile test carried to rupture.

3.1 Breaking Tenacity — The ratio of a yarn's breaking force to its linear density.

NOTE — For yarns, breaking tenacity is expressed in centinewtons per tex.

3.2 Clamp — The part of a tensile testing machine used to grip the specimen by means of suitable jaws.

3.3 Elongation at Break — In a tensile test, the difference between the length of a stretched specimen at breaking load and its initial length usually expressed as percentage of the latter.

Elongation is an indication of the ability of yarn to absorb energy. If it is too low, weaving becomes difficult or even impossible but low elongation yarns or cords have greater dimensional stability and are desirable as reinforcement for plastic products, hoses, tyres, etc.

3.4 Elongation at Rupture — The elongation occurring at the final rupture of the specimen. The elongation at rupture is usually but not always, identical with the elongation at the breaking load.

3.5 Gauge Length — The distance between the two effective clamping points of a testing device.

NOTE — With bollard or capstan clamps, it is the distance between their gripping points, measured along the path of the yarn.

3.6 Initial Length — The length of a test specimen (between the clamping points) under specified pretension at the beginning of the test.

3.7 Jaws — The elements of a clamp which grip the specimen.

3.8 Package — The length of yarn in a form suitable for use, handling, storing, etc.

NOTE — Packages can be supported (e.g. cones, bobbins) or unsupported (e.g. skeins, balls).

3.9 Single End Breaking Load — The breaking load of a single end, monofilament or cord, not knotted or looped but running strength between the clamps of the testing machine.

3.10 Knot Breaking Load — The breaking load of a single end with a knot tied in the portion of the specimen between the clamps.

3.11 Loop Breaking Load — The breaking load of a specimen consisting two lengths of yarn, monofilament from the same package looped together so that one length has both its ends in one clamp of the testing machine and the other length has both its ends in the other clamp.

4 PRINCIPLE

The specimen is gripped between two clamps of the tensile testing machine and continually extended longitudinally at a constant rate (100 percent per min) by moving one of the clamp; until the specimen ruptures. Values of the breaking load and elongation at break of the test specimen are read directly or from a chart attached.

5 SAMPLING

5.1 The sample shall be drawn according to the procedure given in the relevant material specification or as agreed to between the buyer and seller.

NOTE — For sampling cotton yarns, IS 3920 may be followed.

5.2 The minimum number of specimens to be tested shall be 50 for single-spun yarns and 20 for other yarns. The specimens shall be distributed as evenly as possible among the selected packages.

5.3 If specimens are to be extracted from fabrics then the fabric sample shall be large enough to furnish a sufficient number and length of specimens. The test specimens shall be taken so that the twist in the yarn is not changed during sampling. In woven fabrics, warp specimens shall be taken from different ends and weft specimens shall be taken at random from several

sections of the sample to be as representative of the yarn as possible. In knitted fabrics, specimens shall represent as many different yarns as possible.

6 CONDITIONING OF TEST SPECIMENS

6.1 Option 1: Conditioned Specimens

6.1.1 Prior to test, the specimens shall be conditioned to moisture equilibrium in the standard atmosphere of (65 ± 4) percent relative humidity and 27 ± 2°C temperature (*see* IS 6359).

6.1.2 When the test specimens have been exposed to standard atmosphere for at least as much time as given below in such a way as to expose as far as possible, all portions of the specimens to the atmosphere, they shall be deemed to have reached moisture equilibrium:

Equilibrium Moisture Regain Value of the Yarn at Standard Atmosphere	***Time***
percent	*h*
Less than 4	6
From 4 to 10	12 to 24
Above 10	24 to 48

6.1.3 The test shall be carried out in standard atmosphere as given in **6.1.1**.(*See also* IS 196)

6.2 Option 2: Wet Specimens

Using a reel, take one test skein from each package of the sample. The test skein shall be of sufficient length to give the required number and length of test specimens. Clamp a group of specimens by both ends to prevent loss of twist and submerge them in distilled or demineralised water at room temperature until they are thoroughly soaked and sink under their own weight. The time of immersion must be sufficient to wet out the specimens thoroughly. The time period will be at least 2 minutes for regenerated cellulose yarn and at least 10 minutes for acetate. For yarns that do not readily wet with water, such as those treated with water repellent or water-resistant materials, add a 0.1 percent solution of a non-ionic wetting agent to the water bath. Do not use any agent that will affect the physical properties of the yarn appreciably. If a wetting agent has been used, the specimen must be thoroughly rinsed in distilled or demineralised water before conducting the test.

7 APPARATUS

7.1 Constant rate of specimen extension (CRE) tester

7.1.1 The tester shall be capable of being set at gauge lengths of (500 ± 2) mm or (250 ± 1) mm, or preferably both. Generally, a gauge length of 500 mm is preferred over 250 mm. A gauge length of 250 mm can be used only if

a) the extension of the instrument is insufficient to accommodate a 500 mm specimen, or

b) by agreement between the interested parties.

NOTES

1 By mutual agreement, the nominal gauge length of 200 ± l mm may be used though under these conditions, results for breaking load are likely to be slightly higher than those obtained with a gauge length of 500 mm.

2 Traditionally the jute trade uses a test length of 610 ± 2 mm for testing of jute yarns.

3 Traditionally the silk trade uses a test length of 100 ± 2 mm for testing of silk yarns.

4 In case yarn removed from fabrics is to be tested, a test length of 200 ± 2 mm shall be used.

5 Because of the difficulty of securing the same tension in all the filaments and slippage of the specimen in the clamps, erratic results are frequently obtained with zero twist multifilament yarns unless a small amount of twist is inserted before testing. A twist of 120 ± 10 turns per metre is usually satisfactory. Twist a specimen about 225 mm longer than the gauge length to be tested.

7.1.2 The rate of extension of the moving clamp shall be (100 ± 2) percent per minute i.e. (500 ± 10) mm/min for 500 mm gauge length or (250 ± 5) mm/min for 250 mm gauge length, to an accuracy of ± 2 % . Higher rate of extension may be permitted as per the agreement between the interested parties.

7.1.3 The maximum error of the indicated force shall not exceed 2% of the true force. The load range of the tester shall be such that the observed value lies between 10 and 90 percent of the full-scale load.

7.1.4 The tester shall be equipped with Two clamps to grip the specimen, provided with a mechanical or pneumatic device so constructed that through its means it is possible to secure a specimen firmly between the jaws of the clamps so that it does not slip during the test and also does not break at the jaws. Also, the edge of the surface of each jaw as well as the jaw lining shall be such that it would not cut or damage the specimen during testing. Flat-faced unlined jaws shall be the normal type but, if these cannot prevent slippage, then other types of clamps may be used on agreement, such as lined jaws, bollard clamps or other types of snubbing devices. For comparison purposes, the same type of clamps shall be used by all the interested parties.

NOTES

1 Flat-faced clamps are usually used with fine yarns and the snubbing type clamps with high strength yarns or coarse yarns and when specimens slip in the clamps or the number of breaks at or close to the jaws exceeds statistical expectation. To check slippage, make a mark on the specimen as close as possible to the back of each clamp, operate the machine to break the specimens and observed whether the marks have been pulled towards or between the jaw faces of either clamp.

2 For sewing threads or similar yarns, clamps described as follows may be used:

For yarns of linear density up to 320 tex, use an inverted screw type clamp (Fig. 1) or pulleys with locking vices (Fig. 2) or pins. For yarns of linear density of 320 tex or higher, clamps of vice type (Fig. 3) may be used. With these clamps, specimen length is not determined precisely and consequently measurements of extension are not accurate and therefore the results should not be compared with those obtained with unlined flat jaws.

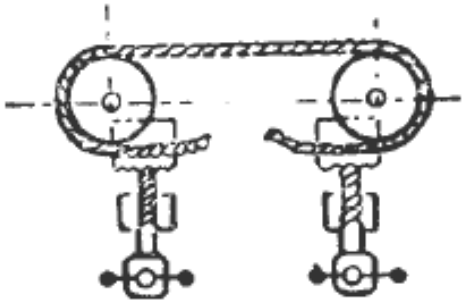

FIG. 1 INVERTED SCREW TYPE CLAMPS

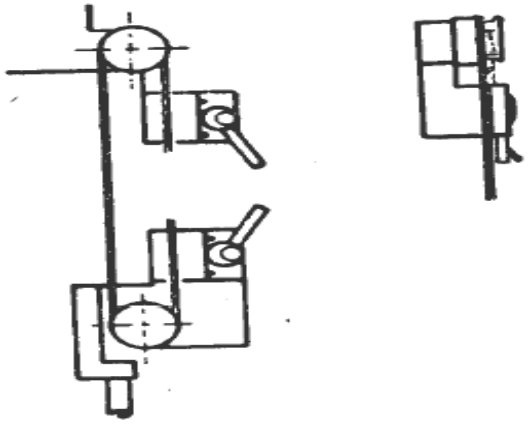

FIG. 2 PULLEYS WITH LOCKING VICES

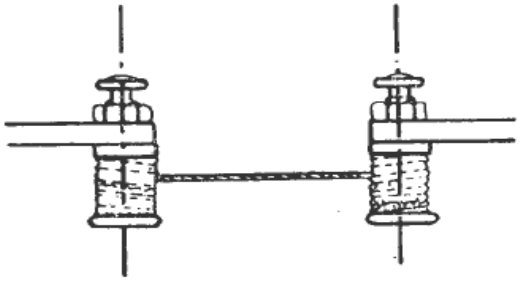

FIG. 3 CLAMPS OF VICE TYPE

7.1.5 The tester shall be equipped with an autographic force/elongation recording device of sufficiently fast response, or with a system directly recording the breaking force and elongation at break.

7.1.6 The tester shall be capable of setting a pretension either by means of a set of pre-tensioning weights or by using the force-measuring device. The pre-tension shall be as follows:

a) For conditioned specimens — 0.50 ± 0.1 cN /tex, and

b) For wet specimens — 0.25 ± 0.05 cN/tex.

c) For textured yarns — following pretensions are recommended (unless otherwise agreed), calculated on the nominal linear density of the yarn:

- 2.0 ± 0.2 cN/tex, for polyester and polyamide yarns;
- ± 0.1 cN/tex, for acetate, triacetate and viscose yarns;
- 0.5 ± 0.05 cN/tex, for bi-shrinkage and jet bulked yarns, except for carpet yarns heavier than 50 tex;

NOTE — This tension should not stretch the specimen more than 0.5 percent, otherwise a mutually acceptable lower tension should be applied.

7.2 Wrap Reel – for preparing test skeins from the test samples.

7.3 Container for Wetting Out Specimens

7.4 Swift or similar device - for holding the test skein under zero tension and permitting easy transfer of the yarn to the tensile tester

7.5 Distilled Water or Demineralized Water, *See* IS 1070.

7.6 Non-ionic Wetting Agent or Surfactant, for wet specimens only.

8 PROCEDURE

8.1 General

8.1.1 Set the clamps of the testing machine so that the distance between the nips of the clamps along the specimen axis (including any portion in contact with snubbing surfaces) shall be as per the gauge length specified in **7.1.1**.

8.1.2 Use a rate of extension as specified in **7.1.2** for extending the specimen longitudinally until the specimen ruptures. Higher or lower rate of extension may be used as per the agreement between the interested parties.

8.1.3 Unwind the yarn from the packages as is done in normal use. In case of yarn to be extracted from fabric, it shall be extracted in the way as specified in **5.3**.

8.1.4 Before clamping the specimen, check that the jaws are correctly aligned and parallel, so that the force applied produces no angular deviation.

8.1.5 Take the yarn, discard a first few metres of it, and secure its one end in the jaws of one clamp in such a way that the twist does not change.

8.1.6 Place the other end in the other clamp, apply the required pre-tension as mentioned in **7.1.6** from this free end to remove any slack or kink without appreciable stretching and secure it in the jaws of the clamp.

NOTE — For untwisted technical and industrial multifilament yarns, to ensure that all filaments have the same tension at the beginning of the test and to prevent slippage of individual filaments in the clamps during the test, a twist should be applied prior to the test. A twist of 60 ± 1 turns/m for yarns below 2 200 dtex and a twist of 30 ± 1 turns/m for yarns above 2 200 dtex are recommended. Other twist amounts may be allowed on agreement of the interested parties.

8.1.7 Perform the test under the standard atmosphere for testing, as specified in 6.1 (*See* IS 196).

8.1.8 During the test, check that the specimen does not slip between the jaws by more than 2 mm. If it does so repeatedly, change the clamps or jaw lining. Discard the results of the tests where slippage occurs. Also discard results involving jaw breaks where breaks occur 5 mm from the jaws or closer, but record the number of specimens for which the results were discarded.

8.1.9 Record the breaking force and elongation at break.

8.2 Option 1: Conditioned

8.2.1 Using the reel, take one test skein from each package of the sample. The test skeins shall be of sufficient length to give the required number and length of test specimens.

8.2.2 Using the swift, allow the test skeins to relax under minimal tension in the conditioning atmospheres (see 6.1).

8.2.3 Follow the procedures given in **8.1.1** to **8.1.9**. When taking a specimen from the test skein for insertion between the clamps, make sure that its length is at least 100 mm greater than the selected gauge length; an excess of 500 mm is recommended. Be careful not to change the twist.

NOTE — With suitable modifications (see **5.3**), this method can also be used for yarns from fabrics.

8.3 Option 2 : Wet

Test the thoroughly soaked specimens in the normal machine set up or immersed in a tank fitted to the machine. Mount the specimens and perform the test as described in **8.1.1** to **8.1.9**. Transfer the wet specimens directly from the water-bath to the testing machine and break the specimens at once, and in any case, within 2 minutes after removing them from the water-bath.

8.4 Option A: Straight or Single-Strand Breaking Load

Mount the specimen and perform the test as directed in 8.1.1 to 8.1.9 using a pre-tension as specified in 7.1.6. Operate the machine, carry the test to rupture and record the breaking load and elongation at break (*see* Note 1). If the specimen slips or breaks in the jaws or breaks within 5 mm from the edge of the jaws, the result shall be discarded and another test specimen taken in lieu thereof.

NOTES

1 In case of jute yarns where elongation tests are carried out separately, 10 tests for elongation may be sufficient.

2 Even if a test value is isolated on account of break near the jaw, the value shall be noted but not taken into account in calculations. If such breaks exceed 10 percent of the number of specimens tested, suitable corrective action on the machine should be taken.

3 Yarns made from blends or combinations of fibres may show elongation beyond the point of maximum load, particularly if one of the components is an elastomeric fibre. When the low elongation components of a yarn are broken, the load falls on the remaining fibres, which continue to elongate until they are broken. Breaking elongation is defined as that corresponding to the maximum load. If elongation continues after the maximum load has been passed, then elongation at rupture may be determined separately.

8.5 Option B : Knot Breaking Load

8.5.1 Place one end of the specimen in one clamp of the machine, tie a single overhand knot near the middle of the specimen. For a S-twisted yarn (*see* Note), a S-knot shall be used and for Z-twisted yarn a Z-knot shall be used (*see* Fig. 4 and 5). Place the other end in the second clamp and tighten the clamp.

NOTE — For plied and cabled yarns, the twist direction refers to the final twist.

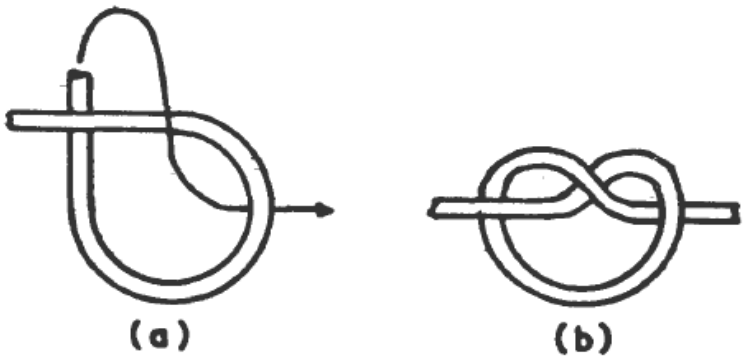

FIG. 4 Z-KNOT IN Z-TWIST YARN

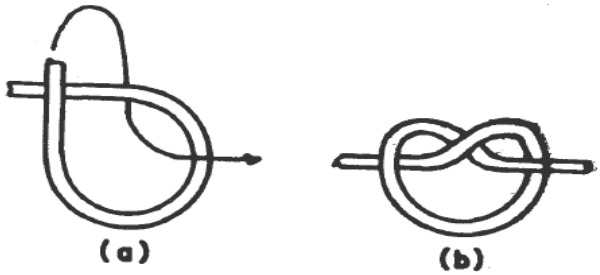

FIG. 5 S-KNOT IN S-TWIST YARN

8.5.2 Start the machine and observe and record the breaking load.

8.5.3 Repeat the procedure given in **8.5.1** and **8.5.2** until the required number of specimens have been broken.

8.6 Option C: Loop Breaking Load

8.6.1 Each specimen shall consist of two interlinked looped lengths of yarn taken from one package or end. Secure both ends of one piece in one clamp of the testing machine so that the length of the loop is about one half the gauge length. Pass one end of the second piece through the loop formed by the first, place both ends of the second piece in the other clamp of the machine and close the clamp.

8.6.2 Start the machine and observe and record the breaking load.

8.6.3 Repeat the procedure given in **8.6.1** and **8.6.2** until the number of specimens have been broken.

9 CALCULATIONS

9.1 Breaking Load

Calculate the mean breaking load in newtons from all the observed values expressing it to three significant figures. Also calculate the coefficient of variation.

9.2 Elongation (or Extension) at Break (Option A only)

Calculate the mean elongation at break in percent from all the observed values expressing it to two significant figures. Also calculate the coefficient of variation.

9.3 Tenacity

Calculate the tenacity by the following formula:

$$\textit{Tenacity in cN/tex or mN/tex} = \frac{(\textit{Mean breaking load in centinewtons or millinewtons})}{\textit{Mean linear density in tex}}$$

NOTE — The linear density of yarn or cord shall be determined from the same package in accordance with IS 570 or IS 681 or IS 1315.

10 REPORT

10.1 The test report shall include the following:

a) Description of the material tested;

b) Type of Method (options) used, for wet tests, the technique used for wetting;

c) Name of the instrument, capacity and load range operated;

d) Rate of Extension;

e) Gauge length;

f) Type of jaw and jaw faces, if other than flat metal;

g) Number of valid tests performed, number of tests rejected due to jaw breaks;

h) Mean breaking load and coefficient of variation, if required;

j) Mean elongation at break and coefficient of variation, if required; and

k) Mean tenacity.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	***Title***
196 : 2024	Atmospheric conditions for testing (*first revision*)
IS 570 : 2024	Textiles -Methods for determination of universal count of jute yarn (*second revision*)
681 : 2015	Textiles – Methods for determination of universal count of woollen and worsted yarn (*first revision*)
1070 : 1992	Reagent grade water - Specification (*third revision*)
1315 : 1977	Method for determination of linear density of yarns spun on cotton system (*first revision*)
3920 : 1985	Methods for sampling of cotton yarn for determination of physical characteristics (*first revision*)
6359 : 2023	Method for conditioning of textiles (*first revision*)

Preliminary Draft

भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26874) P
October 2024

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भारतीय मानक मसौदा

वस्त्रादि — कपास प्रणाली पर काते गए धागों की ताकत के मापदंड — परीक्षण पद्धतियाँ

(आई एस 1671 *का दूसरा पुनरीक्षण)*

Draft *Indian Standard*

TEXTILES — STRENGTH PARAMETERS OF YARNS SPUN ON COTTON SYSTEM — METHODS OF TEST

(Second Revision of IS 1671 *)*

ICS 59.080.20

Physical Methods of Test Sectional Committee	Last date for receipt of comments
TXD 01	15 Nov 2024

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1977. The standard for determination of lea breaking load and count strength product of cotton yarns, namely, IS 239 was prepared in 1951. After the introduction of metric system in the country, IS 1671 was prepared which prescribed the method for determination of breaking load of yarn of metric skeins, tenacity and yarn strength index. This standard also prescribed conversion factors for conversion of lea breaking load to skein breaking load in metric system and was intended to supersede IS 239. However, as the cotton count system is still in use in the industry, these standards have been combined and up-dated on the basis of the experience gained during their use and the developments which have taken place after the publication of these standards.

This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

i) The Scope of the standard has been modified;
j) Principle of skein test has been incorporated;

k) The use of Constant Rate of Extension based tensile testing machine for determining the skein breaking load has been incorporated;
l) The tolerance of relative humidity for atmospheric conditioning of samples has been modified;
m) Tolerance of rate of traverse of testing machine has been modified;
n) Test report has been modified; and
o) References to standards have been updated.

In the formulation of this standard, considerable assistance has been derived from ASTM D1578-93 : 2022 Standard test method for breaking strength of yarn in skein form.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft *Indian Standard*

TEXTILES — STRENGTH PARAMETERS OF YARNS SPUN ON COTTON SYSTEM — METHOD OF TEST

(Second Revision of IS 1671 *)*

1 SCOPE

1.1 This standard prescribes methods for determination of strength parameters of yarns spun on cotton system using cotton count and tex system.

1.2 In cotton count system, determination of lea breaking load and count strength product (CSP) have been prescribed and in the metric system, determination of skein breaking load, yarn strength index (YSI) and skein breaking tenacity (SBT) have been prescribed.

1.3 This test method is applicable to spun yarns, either single or plied, composed of any fiber or blend of fibers, but is not suitable for yarns which stretch more than 5 % when the tension is increased from 2.5 to 7.5 mN/tex.

2 REFERENCES

The standards listed in Annex A contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 232 and the following shall apply.

3.1 Breaking Load — The maximum load (or force) supported by a specimen in a tensile test carried to rupture. It is commonly expressed in grams or kilograms.

3.2 Cotton Count — The linear density expressed as number of 768.1 m hanks per 453.6 g (840 yd hanks/lb) of yarn.

3.3 Count Strength Product (CSP) — The product of the breaking load in pounds of a lea of yarn and its count (cotton count).

3.4 Skein — A continuous length of yarn in the form of a coil made on a reel of known girth. Usually 109.73 m (120 yd) skein made on 1.372 m (1.5 yd) girth reel is in use in cotton count system and is called ‘lea’; while skeins of 100 and 50 m made on 1 m girth reel are in use in tex system.

3.5 Skein Breaking Tenacity (SBT) — The breaking load, in grams, of a 50 m skein divided by the linear density of unstrained yarn in tex and number of strands in the skein, that is, 100. It is expressed in grams per tex.

3.6 Yarn Strength Index (YSI) — The breaking load, in grams, of a 100 m skein divided by the linear density of unstrained yarn in tex.

3.7 Tex — The linear density expressed as number of grams per kilometre of yarn. This is a primary unit in a system (*see* Note) of units for expressing the universal count of yarn.

NOTE —This system is also intended to be used for expressing the mass per unit length of fibres, yarns and other textile products like ropes and rovings. The following multiple and sub-multiple units may be used to avoid large numbers and small fractions, respectively:

1 ktex (kilotex) = 1 000 tex
1 mtex (millitex) = 0.001 tex
1 dtex (decitex) = 0.1 tex

4 PRINCIPLE

A test skein of pre-specified length is broken on a tensile testing machine and the breaking strength is observed. If the linear density is required for the calculation of skein breaking tenacity, the broken skein may be weighed and the linear density calculated according to IS 1315.

5 SAMPLING

The samples shall be drawn in accordance with the procedure laid down in IS 3920.

6 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

6.1 The samples shall be conditioned to moisture equilibrium in standard atmosphere of (65 ± 4) percent relative humidity and (27 ± 2) °C temperature (*see* also IS 6359).

6.2 The test shall be carried out in the standard atmosphere as specified in **6.1** (*see* also IS 196).

7 APPARATUS

7.1 Tensile Testing Machine

A tensile testing machine working on constant-rate-of-traverse (CRT) principle or constant rate of extension (CRE) principle shall be used for determining the breaking strength of skein. In case of CRT based tensile testing machine, the test shall be carried out at a uniform rate of traverse of (300 ± 10) mm/min. Whereas, in case of CRE based tensile testing machine, the

test shall be carried out at a rate that will break the skein in an average time of 20 ± 3 s from the start of application of tension on the skein. The load range of the machine shall be such that the observed values would lie between 10 percent and 90 percent of the full scale load. The permissible error in the machine at any point in this range shall not exceed ± 1 percent.

7.1.1 The machine shall be provided with the following arrangements:

a) Two pulleys or hooks for holding the skein with sufficient space to allow the even distribution of threads without much overlapping.
b) Means for adjusting distance between the pulleys or hooks.
c) A scale or dial or autograph recording chart graduated so as to give load in kilograms.

7.2 Wrap-Reel

A hand or motor-driven reel having a girth of 1.372 m (1.5 yd) or 1 m and capable of reeling known length of yarn (*see* Annex B).

7.3 Yarn Tensioning Device

An adjustable tensioning device capable of giving a reeling tension that will result in skeins of the specified length when measured on a skein gauge. The adjustment in reeling tension may be made, for example, by making more than one wrap around thread guides or by passing the yarn around tensioning bars. The reeling tension shall be the same at all reeling positions and may be checked as follows:

The yarn is wound from the same package at different reeling positions. The length of the skeins when measured on a skein gauge shall not differ by more than 0.1 percent.

7.4 Skein Gauge

A gauge for checking the length of the skein under a load of 0.5 gf/tex (5 mN/tex) and expressing the length as a plus or minus deviation from the nominal length. The sensitivity of the skein gauge shall be sufficient to permit rejection of skeins falling outside ± 0.25 percent tolerances. The skein-gauge length may be adjustable or non-adjustable. A non-adjustable skein gauge can be used when its nominal length differs by no more than 0.4 percent from the measured perimeter of the reel.

NOTE — For details of skein gauge, see Annex C.

8 PREPARATION OF TEST SPECIMENS

8.1 Prepare skeins of 109.73 m (120 yd), 100 m or 50 m as required, following the procedure as described in Annex B.

8.2 Prepare at least 30 test specimens and condition them as specified in **6.**

9 PROCEDURE

9.1 In case of CRE based tensile testing machine, break one or more preliminary skeins, and adjust the rate of extension as necessary until the time-to-break conforms to the specified limit of 20 ± 3 s. If the time-to-break for the preliminary skeins is within the specified limits and no adjustment is required, the observed values for the preliminary skeins may be included in the test report data.

9.2 Bring pulleys or the hooks of the testing machine to the zero position. Take the conditioned skein of yarn and fix it on the pulleys or hooks. Carefully separate the yarn on the pulleys or hooks to avoid the individual strands overlapping each other.

9.3 Start the machine and carry the test to rupture. Record the skein breaking load in kilograms as indicated on the scale, dial or recording chart.

9.4 Determine the mass in grams of the broken skein and calculate the linear density of yarn in cotton count or tex system (as the case may be) (*see* IS 1315).

9.5 Determine the skein breaking load and linear density of yarn of the remaining specimens following the procedure as laid down in **9.4.**

10 CALCULATIONS

10.1 Calculate the average breaking load and average linear density of all the observations taken (*see* **9.3, 9.4** and **9.5**).

10.1.1 Calculate the coefficient of variation (CV) of all the breaking load values taken.

10.2 Cotton Count System

10.2.1 *Count Strength Product (CSP)*

Calculate the count strength product or count strength product corrected to nominal count, correct to a whole number, from the following formulae:

a) CSP $= L_1 \times N_e$

b) CSP (Corrected) $= L_{1c} \times N_e^1$

where

L_1 = average breaking load, in pounds (kg × 2.2), of the lea (*see* **10.1**);

N_e = average cotton count (*see* 8.1);
L_{1c} = average breaking load, in pounds (kg × 2.2), corrected to nominal count (*see* Annex D); and
N_e^1= nominal cotton count.

10.3 Tex System

10.3.1 *Skein Breaking Tenacity (SBT)*

Calculate the tenacity or tenacity of yarn corrected to nominal linear density, correct to one decimal place, by the following formulae:

a) SBT in grams per tex = $\frac{L_2 \times 1000}{t \times 2 \times 50} = \frac{L_2 \times 10}{t}$

b) SBT (Corrected) = $\frac{L_{2c} \times 10}{t^1}$

Where

L_2 = average breaking load of 50 m skein, in kg (*see* **10.1**);
t = average linear density of yarn, in tex (*see* **10.1**);
L_{2C} = average breaking load of 50 m skein, in kg, corrected to nominal linear density (*see* Annex D); and
$t`$ = nominal linear density, in tex.

10.3.2 *Yarn Strength Index* (*YSI*)

Calculate the yarn strength index or yarn strength index corrected to nominal linear density, correct to a whole number by the following formulae:

a) YSI = $\frac{L_3 \times 1\,000}{t}$

b) YSI (Corrected) = $\frac{L_{3c} \times 1000}{t`}$

where

L_3 = average breaking load of 100 m skein, in kg (*see* **9.2**);
t = average linear density of yarn, in tex (*see* **10.1**);
L_{3c} = average breaking load of 100 m skein, in kg, corrected to nominal linear density, (*see* Annex D); and
t' = nominal linear density, in tex.

NOTE — It has been found that for a given yarn, the Yarn Strength Index and Count Strength Product are numerically the same for all practical purposes. However, to calculate the yarn strength index of a skein from the count strength product of a lea (or vice versa), the specified, observed or calculated breaking load value of the skein shall be converted into breaking load value of a lea (or vice versa), using the formula given in Annex E.

11 TEST REPORT

11.1 The test report shall include the following information:

a) Type of material;
b) Number of specimens tested;
c) Breaking load of skein [109.73 m (120 yds) 50 m or 100 m];

OR

Breaking load of skein corrected to nominal count/linear density;
d) Coefficient of variation (CV) of breaking load values;
e) Count strength product (CSP)/Count strength product (CSP) corrected to nominal count (correct to a whole number);

OR

Yarn strength index (YSI)/Yarn strength index (YSI) corrected to nominal linear density (correct to a whole number);

OR

Skein breaking tenacity (SBT)/Skein breaking tenacity (SBT) corrected to nominal linear density (correct to a whole number).

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 1315 : 1977	Method for determination of linear density of yarns spun on cotton system (*first revision)*
IS 196 : 2024	Atmospheric Conditions for Testing *(first revision*)
IS 232 : 2020	Glossary of textile terms - Natural fibres (*third revision*)
IS 3920 : 1985	Methods for sampling of cotton yarn for determination of physical characteristics *(first revision)*
IS 6359 : 2023	Method for conditioning of textiles (*first revision*)

ANNEX B

(*Clauses* 7.2; and 8.1)

PREPARATION OF SKEINS

B-l APPARATUS

B-1.1 A wrap reel having a girth of l.372 m (1.5 yd) or 1 m shall be used to reel off the skeins. The wrap reel shall be fitted with thread guides fixed on a horizontal bar which has a traverse of about 25 mm. The wrap reel shall also be provided with a counting device to indicate the length of yarn reeled out and a bell to ring just before the last revolution or a reel that automatically stops after the required number of revolutions.

B-2 PROCEDURE

B-2.1 Mount a test package on the wrap reel. Pass the end through the thread guides taking care that the yarn shall be kept under sufficient tension to avoid kinks, curls and slack in the yarn on the one hand and stretch on the other (*see* Note) and lead it to the reel.

NOTE — If necessary, the yarn may be wound full one turns around the thread guide.

B-2.2 Start the wrap reel. Running it at uniform speed, reel out a skein of required length. Cut and tie the trailing end of the skein to its leading end.

ANNEX C

(*Note under clause* 7.4)

SKEIN GAUGE

C-l APPARATUS

C-1.1 The gauge consists essentially of two round metal pegs of about 1.25 cm diameter and 5 to 6 cm long, located in the same vertical plane. One of the pegs is fixed to the rigid frame of the instrument and the other is carried on the lever of a simple loading system, the fulcrum of which is a low-friction bearing, which is also carried on the frame. At least one of the pegs should be free to rotate about its axis.

C-2 PROCEDURE

C-2.1 Place the skein without bunching, around the two pegs, and apply the appropriate load, for example, by hanging a weight on the end of the lever arm or by moving a &ding weight along the lever arm. The girth of the skein is indicated on a scale attached to the frame of the instrument, by a pointer attached to the lever arm or by an index line on the end of the lever arm. If L is the actual girth of the wrap reel, d the diameter of the pegs, and D the distance between the axes of the pegs when the indicator registers on the scale the actual girth of the wrap reel, then:

$$D = \frac{L}{2} - \frac{\pi d}{2}$$

ANNEX D

(*Clauses* 10.2.1; 10.3.1; and 10.3.2)

CORRECTION FOR NOMINAL YARN COUNT/LINEAR DENSITY

D-l To obtain the average breaking load corrected to nominal yarn count or linear density, use the following procedure.

D-l.1 Arrange the values of linear density and the corresponding breaking load of all the observations as obtained in 7, in the ascending order of the yarn count/linear density.

D-l.2 Find the average linear density and the average breaking load of:

	Indirect System	*Direct System*	
		50 m skein	*100m skein*
The first three skeins	N_{e1} L_1`	t_1 L_2'	L_3'
The last three skeins	N_{e2} L_1"	t_2 L_2"	L_3"
All the skeins	N_e L_1	t_1 L_2'	L_3'

D-1.3 Calculations

a) $K_1 = \frac{L_1` - L_1"}{Ne_2 - Ne_1}$

b) K_2 (50 m skein) $= \frac{L_2'' - L_3'}{\frac{1}{t_1} \quad \frac{1}{t_2}}$

c) K_3 (100 m skein) $= \frac{L_3'' - L_2'}{\frac{1}{t_1} \quad \frac{1}{t_2}}$

D-l.4 Find the average breaking load corrected (L, L_{2c} or L_{3e}) to nominal count N_e' or to nominal linear density t', by the following formulae:

a) $L_{1c} = L_1 - K_1 (N_e' - N_e)$
b) $L_{2c} = L_2 - K_2 (1/t - i/t')$
c) $L_{3c} = L_3 - K_3 (\frac{1}{t} - \frac{1}{t'})$

ANNEX E

(*Note under clause* 10.3.2)

CONVERSION OF BREAKING LOAD VALUES

E-l To convert observed breaking load value, in lb, of a lea of 109.73 m (120 yd) into breaking load, in kg of a skein (100 m), use the following empirical formula:

$$L_1 = 0.584\ 8\ L_2 + 0.500\ 0$$

Where

L_1 = breaking load, in kg, of skein made on a 1 m reel; and
L_2 = observed breaking load, in lb, of lea made on a $1\frac{1}{2}$ yd reel.

NOTE — The formula has been derived from the data collected at the Cotton Technological Research Laboratory (ICAR), Bombay on 77 samples of yarn of various counts ranging from 14s to 120s.

Preliminary Draft

भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26875) P
Nov 2024

भारतीय मानक मसौदा

वस्त्रादि — बुने हुए कपड़े — प्रति ईकाई लम्बाई में धागों की संख्या ज्ञात करना

(दूसरा पुनरीक्षण)

Draft Indian Standard

TEXTILES — WOVEN FABRICS — DETERMINATION OF NUMBER OF THREADS PER UNIT LENGTH

(Second Revision)

ICS 59.080.30

Physical Methods of Test Sectional Committee	Last date for receipt of comments
TXD 01	15 Nov 2024

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1961 and subsequently revised in 1969 and 1981. This standard was revised to made provision of determining the number of threads per centimetre in addition to per decimetre. This had become necessary with the adoption of SI units and also adoption of practice of expressing threads per centimetre in India and abroad.

This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

vi) The Scope of the standard has been modified;
vii) The tolerance of relative humidity for atmospheric conditioning has been modified;
viii) A new clause ‘Sampling’ has been incorporated;
ix) The provision of determining the number of threads per centimetre has been incorporated;
x) A new method ‘Counting Glass’ for determining the number of threads per unit length has been incorporated;

xi) The requirement for minimum distance across which the number of threads is to be counted has been modified;
xii) The clause ‘Test report’ has been modified; and
xiii) References to standards have been updated.

Jute industry is an export oriented industry and the overseas consumers use the terms ‘porter’ and ‘shots’ for expressing warp and weft threads per unit length of jute fabrics. For the convenience of the overseas consumer’s conversion factors for converting values of warp threads per decimetre to ‘porter’ and weft threads per decimetre to ‘shots per inch’ have been given in the standard. (*see* Note under 6.3).

In the formulation of this standard, considerable assistance has been derived from ISO 7211-2 : 2024 Textiles — Method for analysis of woven fabrics construction — Part 2: Determination of number of threads per unit length.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft Indian Standard

TEXTILES — WOVEN FABRICS — DETERMINATION OF NUMBER OF THREADS PER UNIT LENGTH

(*Second Revision*)

1 SCOPE

1.1 This standard prescribes three methods for determination of warp threads and weft threads per unit length (per centimetre, per decimetre and per inches) in woven fabrics.

- Method A: Traversing thread counter, suitable for all woven fabrics
- Method B: Counting glass, suitable for woven fabrics with more than 50 threads per centimetre
- Method C: Dissection of fabric, suitable for all woven fabrics, especially, for the examination of folded structures and complicate weaves.

1.2 The methods are applicable to all woven fabrics irrespective of their composition (that is, whether they are made of cotton, wool, silk, jute, man-made fibres or blends of two or more such fibres), manufacturing processes and finishing treatments.

2 REFERENCES

The Indian Standards given below contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS 196 : 2024	Atmospheric conditions for testing (*first revision*)
IS 232 : 2020	Glossary of textile terms - Natural fibres (*third revision*)
IS 3919 : 1966	Methods for sampling cotton fabrics for determination of physical characteristics
IS 6359 : 2023	Method for conditioning of textiles (*first revision*)

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 232 and the following shall apply:

3.1 Warp Threads — The threads which lie along the length of a woven fabric. A single warp thread in woven fabric is also called as End.

3.2 Weft Threads — The weft or filling threads which lie across the length of the fabric. A single weft thread in woven fabric is also called as Pick.

3.3 Porter — The value obtained by counting in jute fabric the number of warp threads per gauge length of 47 mm (or 37/20 in) and dividing it by the number of threads per split (2 for hessian, 3 for single warp twill cloth, 4 for double warp plain fabric and 6 for double warp twill cloth).

NOTE — This definition of 'porter' based on the Indian practice refers to the finished fabric, and has to be distinguished from the Dundee practice according to which 'porter' is evaluated in terms of loom reed used in weaving the cloth.

3.4 Shot — Single thread of weft yarn in jute fabrics running from selvedge to selvedge. It is inserted in one passage of the shuttle across the loom.

4 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

4.1 Prior to test, the fabric shall be conditioned to moisture equilibrium from dry side, in the standard atmosphere of (65 ± 4) percent relative humidity and (27 ± 2) °C temperature as prescribed in IS 6359.

4.2 The test shall be carried out in a standard atmosphere as in **4.1** (*see also IS 196*).

4.3 The conditioning and testing may also be carried out in prevailing atmosphere, if agreed between the parties.

5. SAMPLING

Follow the method of drawing the test sample from the lot as given in the relevant specification for the material or as agreed to between the buyer and the seller.

NOTE — For cotton fabrics, IS 3919 may be followed.

5.1 Preparation of Test Specimens

5.1.1 From each samples, as selected in **5**, take a full width swatch at least 2 m long as test sample. Consider each randomly designated place at which end counts and pick counts are made as a test specimen. The precautions taken while designating the places for considering test specimens are as follows:

a) For fabric widths of 100 cm or more, make no count closer than 15 cm from the selvedge edges, or within 50 cm from either ends of roll or piece or bolt.
b) For fabric width of less than 100 cm but greater than 12.5 cm, make no count closer than one tenth of the width of the fabric from the selvedge edge, or within 50 cm from the end of the roll or piece.
c) For narrow fabrics with width of 12.5 cm or less, use the full width of the fabric, but make no count with 50 cm from the end of the roll or piece.

5.1.2 In case of fancy weaves where one or more yarns do not appear at regular , short intervals, make count over at least one full pattern repeat of each design in the weave.

5.1.3 The minimum distance specified in **Table 1** shall be followed for measuring the number of threads per unit length in woven fabrics.

Table 1 Minimum Distance for Measuring Number of Threads
(*Clauses* 5.1.3, 6.1, 6.2, 8.1, *and* 8.2)

Sl. No.	Number of Threads per Unit Centimetre (per Inches)	Minimum Distance across which Number of Threads to be Counted (*L*)
(1)	(2)	(3)
i)	Less than 10 (25)	10 cm (4 inches)
ii)	10 to 25 (25 to 62)	5 cm (2 inches)
iii)	25 to 40 (62 to 100)	3 cm (1 inches)
iv)	More than 40 (100)	2 cm (1inches)

6 METHOD A — BY TRAVERSING THREAD COUNTER

6.1 Apparatus — A thread counter, equipped with a low power microscope of suitable magnification and a pointer which traverses by means of a screw over a graduated base sufficiently long to meet the minimum distance requirements, as specified in **Table 1**, shall be used. However, in the absence of such a thread counter, an ordinary counting glass with an aperture satisfying the requirements of **6.2** may be used.

NOTE — It is recommended that a table with a ground glass top illuminated from below should be used. Such a table greatly facilitates the work involved.

6.2 Procedure

6.2.1 Lay the test sample on a flat table and smoothen it out. Designate the test specimens on the test sample as specified in **5.1.1**. Place the thread counter with the pointer at zero on the test specimen in such a way that on turning the screw the pointer moves in a direction parallel or perpendicular to warp threads, depending upon which set of threads (warp or weft) is being counted, and the pointer shall coincide either with the right hand or the left-hand edge of a thread, depending on whether the counting is started from right to left or from left to right direction. Find the number of warp or weft threads by counting the number of units (normally comprising one thread and one space) and including as a fraction, any part of such unit in a distance specified in Table 1.

NOTE — Counting edge of the thread counter should be placed always either parallel to the warp threads or perpendicular to the warp threads as the case may be.

6.2.2 Following the procedure prescribed in **6.2.1,** determine the number of warp and weft threads in the minimum distance as specified in Table 1, in at least four more places evenly

distributed along the width and length of the test sample. Avoid counting same set of warp or weft threads more than once.

NOTE — In case of weft threads, it is preferable to have at least 10 readings, if the size of the sample permits.

6.2.3 Calculate the number of warp and weft threads per centimetre or decimetre or inches as the case may be by the following formula:

$$n = \frac{N}{L}$$

where

n = number of threads per cm or dm or inches;

N = observed number of threads in the minimum distance L; and

L = minimum distance, expressed in cm or dm or inches, across which the threads are counted as specified in Table 1.

6.3 Determine in a similar manner (*see* 6.2) warp threads and weft threads per centimetre or decimetre or inches as required of the remaining test specimens in the sample and find the mean of the value for warp threads per centimetre or decimetre or inches as required and the mean of the value for weft threads per centimetre or decimetre or inches, respectively.

NOTE — For converting 'warp threads per cm or dm' to 'porter' and 'weft threads per cm or dm' to 'shots per inch' in case of jute fabrics, the following conversion factors may be used:

i)	Porter:	Multiply		
		Threads/cm by	Threads/dm by	Threads/inches by
a)	For hessian (plain weave) cloth	2.349	0.2349	0.9248
b)	For double warp plain weave cloth	1.175	0.1175	0.4626
c)	For single warp 2/1 twill cloth	1.566	0.1566	0.6165
d)	For double warp 2/1 twill cloth	0.783	0.0783	0.3083
ii)	Shots/inch	2.54	0.2540	1

7 METHOD B — COUNTING GLASS

7.1 Apparatus — A counting glass with the aperture width of 20 ± 0.05 mm or 30 ± 0.05 mm or 1 ± 0.02 inches at all the places. The thickness of the base plate at the edges of the aperture shall not exceed 1 mm.

7.2 Procedure

7.2.1 Lay the test sample on a flat table and smoothen it out. Designate the test specimens on the test sample as specified in **5.1.1**.

7.2.2 Place the counting glass on the test specimen so that one of the edges of its aperture is parallel to the warp threads. Count the number of warp threads in the aperture width of counting glass.

7.2.3 Similarly, count the number of weft threads in the in the aperture width of counting glass by placing it on the test specimen in such a way that one of the edges of its aperture is parallel to the weft threads.

7.2.4 Determine the number of warp and weft threads of at least four more test specimens by following the procedure as laid down in **7.2.2** to **7.2.3.**

7.2.5 Calculate the number of warp and weft threads per centimetre or inches as the case may be by the formula given in **6.2.3**.

7.3 Determine in a similar manner (*see* **7.2**) warp threads and weft threads per centimetre or inches as required of the remaining test specimens in the sample and find the mean of the value for warp threads per centimetre or inches as required and the mean of the value for weft threads per centimetre or inches, respectively.

8. METHOD B — BY DISSECTION OF FABRIC

8.1 Apparatus

8.1.1 *Clamps* — comprises of two short pins parallel to each other and with their points being within $\pm$ 0.2 mm of the minimum measuring distance specified in Table1.

8.1.2 *Forceps* — One pair of pointed forceps for removing threads.

8.2 Procedure

8.2.1 Take the test sample and cut at least five test specimen randomly of the width and length longer than 4mm to 6mm than the minimum measuring distance as specified in Table 1. The length of the specimen shall be along the weft threads for determining number of warp threads per centimetre or decimetre or inches and along the warp threads for determining number of weft threads per centimetre or decimetre or inches. Lay the specimen on table with the length running from left to right. Take the clamp and position it centrally over the specimen. Then pass the pins on the clamp through the specimen. Remove the threads remaining outside of cloth pins using forceps, leaving only the length of specimen (equal to minimum distance specified in Table 1) between them, and such threads through which the pins pass. From this length of the specimen, remove the threads one by one and count the number of threads within the length.

8.2.2 Following the procedure prescribed in **8.2.1**, determine the number of warp and weft threads in the minimum distance for all the remaining four test specimens.

NOTE — In case of weft threads, it is preferable to have at least 10 readings, if the size of the sample permits.

8.2.3 Calculate the number of warp and weft threads per centimetre or decimetre or inches by the formula as given in **6.2.3**.

8.3 Determine in a similar manner (*see* **8.2**) warp threads and weft threads per centimetre or decimetre or inches as required of the remaining test specimens in the sample and find the mean of the values for warp threads per centimetre or decimetre and the mean of the values for weft threads per centimetre or decimetre respectively (*see also* Note under 6.3).

9 REPORT

9.1 The report shall include the following information:

a) Description of the material tested;
b) Method used (A, B or C);
c) Minimum distance used for counting threads;
d) The atmosphere used for conditioning and testing;
e) Number of specimens tested;
f) Mean and individual values of Number of warp threads per cm or dm or inches; and
g) Mean and individual values of Number of weft threads per cm or dm or inches.

NOTE — The value should be rounded off to first decimal place in the case when the results are reported for threads per centimetre or inches.

Preliminary Draft

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (26878) P
November 2024

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भारतीय मानक मसौदा

वस्त्रादि — कृत्रिम तन्तु फ्लैट धागे — परीक्षण पद्धतियाँ

भाग **1** रैखिक घनत्व

[आई एस 7703 (भाग 1) *का दूसरा पुनरीक्षण*]

Draft *Indian Standard*

TEXTILES — SYNTHETIC FILAMENT FLAT YARNS — METHODS OF TEST

PART 1 LINEAR DENSITY

[*Second Revision of* IS 7703 (Part 1)]

ICS 59.080.20

Physical Methods of Test Sectional Committee	Last date for receipt of comments
TXD 01	17 Nov 2024

FOREWORD

(*Formal clauses will be added later***)**

This standard was first published in 1975 and revised in 1990. The first revision to this standard was made to enlarge the scope to cover continuous filament flat yarns of all man-made fibres including rayon and acetate instead of polyester and polyamide only and also to supersede IS 1256 : 1957 'Method for determination of linear density (mass per unit length) in denier units (or tex units) of continuous filament rayon yarn and acetate yarn'.

This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

p) The Scope of the standard has been modified;
q) The provision of measuring linear density of synthetic filament yarns in 'dtex' system in place of 'tex' system has been incorporated;
r) The clause 'Terminology' has been modified;
s) The tolerance of relative humidity for atmospheric conditioning has been modified;
t) The clause 'Calculation' has been modified;
u) The clause 'Test report' has been modified; and

v) References to standards have been updated.

In the preparation of this standard due weightage has been given to the testing practices followed in the country in this field.

This standard forms a part of the series of standards on methods of test for synthetic filament flat yarn. The other parts in the series are:

Part 2 Dry and wet Tenacity and elongation
Part 3 Commercial mass
Part 4 Sampling
Part 5 Unevenness percentage

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft *Indian Standard*

TEXTILES — SYNTHETIC FILAMENT FLAT YARNS — METHODS OF TEST

PART 1 LINEAR DENSITY

[*Second Revision of* IS 7703 (Part 1)]

1 SCOPE

1.1 This standard (Part 1) prescribes the method for the determination of linear density of man-made fibres continuous filament flat yarn.

1.2 The test method is prescribed in this standard is not applicable, except by agreement, to yarns which stretch more than 0.5 percent when the tension, in centinewtons, per unit linear density of yarn, in tex, increases from 0.5 to 1.0. Such yarns may be tested under special conditions if they are accepted by all the parties interested in the test results.

1.3 The method is also not applicable to yarns having a linear density greater than 2 000 tex or for reinforcement yarns. For such yarns, other skein lengths and special conditions of reeling may be adopted by agreement of the interested parties.

2 REFERENCES

The Indian Standards given below contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	***Title***
1324 : 2021	Textiles — Man-made fibres, yarns and fabrics — Glossary (*second revision*)
196 : 2024	Atmospheric conditions for testing (*first revision*)
6239 : 2021	Textiles — Man-made fibres — Generic names (*third revision*)
6359 : 2023	Method for conditioning of textiles (*first revision*)
IS 13157 : 1991	Textile fibres - Commercial moisture regains - Specification

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1324 and IS 6239, and the following shall apply:

3.1.1 *Commercial Moisture Regain* — Arbitrary value formally adopted as the moisture regain to be used with oven-dry mass when calculating the linear density and/or the commercial mass of any specific textile material (*see* IS 13157).

3.1.2 *Linear Density* — It is expressed as the mass per unit length of a yarn. The linear density of synthetic filament flat yarns is measured majorly in dtex or denier.

3.1.2.1 *Denier* — A yarn count system equivalent to mass in grams of 9 kilometres length of yarn.
3.1.2.2 *dtex* — A yarn count system equivalent to mass in grams of 10 kilometres length of yarn.

3.1.3 *Moisture equilibrium* — Condition reached by a sample at a closely defined temperature and relative humidity when the net difference between the amount of moisture absorbed and the amount desorbed, as indicated by a change in mass, shows no trend and becomes insignificant.

NOTE — A textile material is in moisture equilibrium with the ambient atmosphere when it does not exchange water with this atmosphere; its mass then remains constant as long as the experiment is carried out in an unchanged atmosphere. For test purposes, moisture equilibrium is reached by absorption starting from a relatively low moisture content. Moisture equilibrium for testing is considered as having been reached when the rate of increase in mass of a Sample or specimen due to moisture uptake does not exceed that prescribed for the material being tested (see IS 6359).

3.1.4 *Oven-dry mass* — Constant mass of a specimen obtained by drying in an oven under prescribed conditions for temperature and humidity.

NOTE — Conditions most frequently used are a temperature of (105 ± 3) ℃ and an air supply having a relative humidity of (65 ± 2) percent at a temperature of (27 ± 2) ℃, under which conditions the specimens will not be moisture-free.

3.1.5 *Skein* — A continuous length of yarn in the form of a coil made on a reel of known girth.

4 PRINCIPLE

4.1 The linear density is determined from the mass of a specified length of yarn and expressed in denier or dtex ($1/10^{th}$ of Tex). The specimen is first conditioned free from tension and thereafter length is measured under standard pretension. The specimen is then oven-dried to constant mass and weighed. The commercial moisture regain is then added to the oven-dry mass and the resultant mass is used to calculate the specimen's linear density.

5 SAMPLING

5.1 Sample to test the conformity of a lot to a specification shall be selected to represent the lot.

5.2 Sample shall be drawn as per the procedure laid down in the relevant material specification or as agreed to between the buyer and the seller.

6 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

6.1 Unless otherwise agreed to between the buyer and the seller, the test sample shall be conditioned to a state of moisture equilibrium from the dry side in a standard atmosphere at (65 ± 4) percent relative humidity and (27 ± 2) °C temperature (*see* IS 6359)

NOTE — When a test sample under zero tension has been left in such a way as to expose, as far as possible, all portions of it to the standard atmosphere for 24 h, the test sample shall be deemed to have reached a state of moisture equilibrium.

6.2 The test shall be carried out in the standard atmosphere as laid down in 6.1 (*see also* IS 196).

7 APPARATUS

7.1 Pan Balance and Weights — Capable of weighing test specimens to an accuracy of 0.1 mg.

7.2 Drying Oven — Provided with forced ventilation and positive valve control and capable of maintaining a temperature of (105 ± 3) ºC and an air supply having a relative humidity of 65 percent at 20 °C, preferably provided with a weighing balance. In case the weighing balance is not provided, a desiccator with a suitable desiccant and sealed containers of known mass shall be made available.

7.3 Wrap Reel — A hand or motor driven reel with 1 meter circumference capable of winding specific length under required tension. The wrap reel should stop at the same position as it started without any backlash to an accuracy of ± 2.5 mm to avoid extra/less length of yarn in the skein.

8 PREPARATION OF TEST SPECIMENS

8.1 From each conditioned sample, draw suitable lengths of yarn preferably in multiples of 10 m for dtex and 9 m for denier measurement by the wrap reel without alteration of twist under a constant yarn tension of 0.5 ± 0.1 cN/tex so that the mass of each specimen is at least 5 g. Discard a few metres of yarn while taking each specimen. Operate the reel by hand or motor (preferably the latter) at a speed of 100 rev/min to 150 rev/min when reeling out yarn present in the skein form otherwise use a speed of 200 rev/min to 300 rev/min for reeling out yarn from packages other than skeins. Tie the tail end of the skein or other packages to its starting end.

9 PROCEDURE

9.1 Take at least six test specimens, two from each package, one drawn from the inside and one drawn from the outside of the package, except when the yarn is on pirns. When the yarn is on pirns, take at least ten test specimens each reeled off the middle portion of each pirn. Place each test specimen in the ventilated drying oven maintained at (105 ± 3) °C and fed with air from the standard atmosphere. Continue drying until the constant mass is obtained.

NOTE — The mass shall be taken as constant when the difference between any two successive weighing made at intervals of 20 minutes does not exceed 0.1 percent.

9.2 Record the oven-dry mass of each test specimen correct to 1 mg.

10 CALCULATION

10.1 Calculate the linear density for each test specimen by one of the following formulae:

a) dtex = $(100 + R) \times \frac{100\,M}{L}$

b) Denier = $(100 + R) \times \frac{90\,M}{L}$

where

R = percentage commercial moisture regain of the fibre used in the yarn being tested (*see* 13157),
M = oven-dry mass of the test specimen in grams, and
L = length of specimen in metres.

10.2 Find out the mean of the linear density values, obtained in **10.1**.

11 TEST REPORT

11.1 The test report shall include the following information:

a) The nature and composition of the material to be tested;
b) Month and year of manufacture of the material,
c) Number of specimens tested;
d) Commercial moisture regain used;
e) Length of yam taken for each test specimen;
f) Mean and Individual values of Linear density in dtex or denier units; and
g) Coefficient of Variation of the linear density, if determined.

Annex 7
(*Item* 6.1)

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BUREAU OF INDIAN STANDARDS

Minutes

First Working Group Meeting for "Preparation of Working draft for Smoothness test for fabrics" under TXD 01, Physical Methods of Test Sectional Committee

Date/Day	Time	Venue
08 November 2024 (Friday)	1100 hr	Through Video Conferencing

ATTENDEES:

1. **Dr M. S. Parmar (Convener)**	**NITRA, Ghaziabad**
2. Shri Sanjeev Shukla	NITRA, Ghaziabad
3. Dr A. Arputharaj	ICAR-CIRCOT, Mumbai
4. Ms Seema Patel	WRA, Thane
5. Shri Mayur Basuk	WRA, Thane

BIS DIRECTORATE GENERAL:

1. Shri Amit Pandey, Member Secretary (Textiles)	Bureau of Indian Standards, New Delhi

Item 0 WELCOME AND INTRODUCTORY REMARKS BY THE CONVENER

0.1 Dr M. S. Parmar, Convener, TXD 01/WG01, welcomed the member secretary, TXD 01 and the members present in the meeting. He also informs the working group that this meeting is being held for a brief discussion on the working draft for Smoothness testing of fabrics which covers an indigenously developed Fabric Smoothness tester.

0.2 Shri Amit Kumar Pandey, Member Secretary TXD 01, also welcomed the Convener and all the members of the working group and requested all for their precise inputs on the agenda item.

ITEM 1 COMPOSITION OF PANEL TXD23/P7

The working group examined its composition as given in the Agenda and CONFIRMED the same.

ITEM 2 PREPARATION OF WORKING DRAFT FOR SMOOTHNESS TEST FOR FABRICS

2.1 The Working group scrutinized the draft for "Smoothness test for fabrics" prepared by BIS in consultation with Dr M. S. Parmar, NITRA, Ghaziabad as given in **Annex 2** to the agenda along with the comparative data of the Smoothness results received from Smoothness tester developed by NITRA, Ghaziabad and surface roughness results received from KAWABATA EVALUATION SYSTEM KES-FB-4 and the test reports of specimens tested on Smoothness tester developed by NITRA as received from NITRA, Ghaziabad as given in **Annex 3** and **Annex 4** to the agenda respectively.

2.1.1 The following inputs were received during the meeting from the working group members:

a) Dr M. S. Parmar elaborates the working principle of the Fabric smoothness tester to the working group along with the working process that this test equipment is based on a pendulum type principle in which the fabric test specimens will be gripped on a specially designed arc-shape specimen holder and a revolving roller moves on the fabric test specimen. The free movement of revolving roller will be reduced due to surface friction of the fabric test specimen. The contact force between the fabric surface and revolving roller shall remain same which is maintained through a weight of 400 ± 20 grams using a load cell. Higher the time taken in stopping the pendulum, lower will be the surface friction. The time taken in stopping the pendulum, in milliseconds, is correlated with the grading systems as mentioned in Table 1 and Table 2 for woven and knitted fabrics respectively to achieve the smoothness grading of the test specimen. The test equipment can be calibrated using the Polyester sheet of 100 micron thickness whose process is explained in details in the Annexures. He also explained the aim to develop this instrument to prevent the issues being faced in subjective assessment which will depend on person's skill.
b) Dr Arputharaj, ICAR-CIRCOT, Mumbai inquired that the difference in the time between two grading level is only of 1 millisecond, which may lead to an error in grading. In addition to this, He also inquired that whether this equipment can also be used in evaluation of softness characteristics of fabric. Dr M.S Parmar clarified that this equipment only measures the surface property i.e. smoothness characteristics of fabrics. Regarding the difference in time gap between two grading levels, he clarified that the timer used in this equipment is sensitive enough to measure up to 1 millisecond and in case of any confusion in the obtained results, another test specimen from same fabric may be tested.
c) Smt. Seema Patel, WRA, Thane also asked the working group that whether the thrust level will remain same on the fabric test specimen during the test. She also asked that as the pendulum is revolving freely around a pivot so, there may be the chances that due to change in friction with bearing, the chances of getting error in measurement will happen with time. Dr M. S. Parmar clarified that the thrust level at the fabric test specimen will remain same during the test with a constant weight of 400 ± 20 grams. Regarding the issue of chances of error in results with time due to change in friction with bearing, he clarified that the equipment is needed to be calibrated to prevent this issue as happened in all other test equipments.

d) Shri Mayur Basuk, WRA, Thane requested that a video clip of the test equipment shall be shared with the working group for proper understanding.

2.1.2 After detailed deliberations, the working group decided to recommend the working draft for "Smoothness testing of fabrics", as given in Annex 2 to the agenda, to the TXD 01 Committee for formulation of Indian Standard. The working group also requested Dr M.S. Parmar, NITRA, Ghaziabad to provide the patent documents along with other relevant details to BIS for mentioning the same in the Forward of the Indian Standard. In addition to this, the working group further requested Dr M. S. Parmar to provide a video clip of the test equipment while performing the test for more clear understanding.

Item 3 ANY OTHER BUSINESS

3.1 There being no other business the meeting ended with a hearty vote of thanks to the ***Convener***.

Annex 8

(*Item* 6.1.2)

Preliminary Draft

भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDRADS

Draft For Comments Only Doc: TXD 01 (xxxxx)P

xxxx 2024

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भारतीय मानक मसौदा

वस्त्रादि — कपड़ों की स्मूथनेस विशेषताएं — परीक्षण पद्धतियाँ

Draft *Indian Standard*

TEXTILES — SMOOTHNESS CHARACTERISTICS OF FABRIC — METHODS OF TEST

ICS 59.080.30

Physical Methods of Test Sectional Committee TXD 01	Last date for receipt of comments xx xxx 2024

FOREWORD

(*Formal clauses will be added later***)**

Fabric smoothness-roughness has been considered as one of the most important factors of clothing comfort. Fabric smoothness behavior is influenced by many factors like weave particular, yarn characteristics, finishing treatments etc. These all factors may increase or decrease the fabric surface friction behavior, which ultimately influence fabric surface smoothness property. Fabric friction, which is defined as the resistance to motion, can be detected when a fabric is rubbed mechanically against itself or tactually between the finger and thumb. Friction is considered to be one property of cloth which has considerable importance in the fields of both technological and subjective assessment.

Subjective assessment of fabric handle is strongly influenced by the static and dynamic friction between the cloth surface and the thumb or finger, although other properties also play a role. The human finger, highly sensitive, can detect small differences in fabric frictional behavior, yet disputes often arise between buyers and manufacturers over the 'feel' of fabric. This is due to the lack of a cost-effective quantitative method that can accurately represent the tactile

properties. Objective measurement of fabric friction properties would facilitate clearer communication and help optimize specific processes.

This test method provides the scope of quantification of smoothness property of fabric using an indigenously developed smoothness tester. The data generated by this instrument will help the finishers to take appropriate decision to alter the recipe or process to meet the required smoothness characteristics of the fabric.

The procedures for calibration of Smoothness tester developed by NITRA is given in Annex A. The test results of smoothness characteristics of cotton fabric at various processing stages are given in Annex C for information only.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Draft *Indian Standard*

TEXTILES — SMOOTHNESS CHARACTERISTICS OF FABRIC — METHODS OF TEST

1 SCOPE

1.1 This standard prescribes a test method for determination of smoothness characteristics of fabrics including woven and knitted.

1.2 The test method prescribed in this standard may not be appropriate for fabrics that exhibits extensive compressive properties or have pile structure.

2 REFERENCES

The Indian Standards given below contain 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 subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS 196 : 2024	Atmospheric Conditions for Testing (*first revision*)
IS 6359 : 2023	Method for conditioning of Textiles (*first revision*)
IS 6489 (Part 1): 2011	Textiles - Tear properties of Fabrics Part 1- Determination of Tear Force using ballistic pendulum method (Elmendorf)

3 TERMS AND DEFINITIONS

For the purposes of this standard, the following definitions shall apply.

3.1 Time Required in Stopping Pendulum — It is a time in milliseconds taken by the pendulum assembly to stop on the arc type platform.

3.2 Smoothness Grading — The time required to stop pendulum is converted into grading. The smoothness grading is given in 1 to 5 scales. Smoothness grade-1 means fabric surface is very rough (smoothness is very poor), smoothness grade-5 means fabric smoothness is excellent. Complete grading system for smoothness characteristics of woven and knitted fabric is given in Table 1 and Table 2 respectively.

4 PRINCIPLE

This test method is based on the pendulum principle. In this method, a constant weight is subjected to swing too and fro as a pendulum on the test specimen and the time taken in stopping the weight due to reduction in the amplitude of the swing with surface friction is

measured. Higher the surface friction of the test specimen, lesser will be the time taken in stopping the weight and vice versa. The time taken in stopping the weight is then corelated with the grading system given in Table 1 and Table 2 for determining the smoothness characteristics of fabric. A typical illustration of working principle of the test method is given in Figure 1.

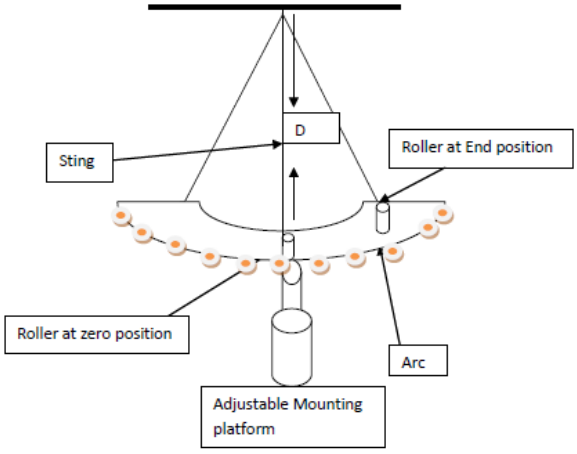


FIG.1 A TYPICAL ILLUSTRATION OF WORKING PRINCIPLE

5 SAMPLING

5.1 Select samples either in accordance with the procedure laid down in the material specification for the fabric or agreed between the interested parties.

5.2 In the absence of an appropriate material specification, an example of a suitable sampling procedure given in Annex B may be followed.

6 PREPARATION OF TEST SPECIMEN

6.1 Take the sample to be tested for smoothness characteristics and iron it so that there shall not be any crease/wrinkle.

6.2 Cut at least 10 specimens each from lengthwise (warp wise or course wise) and widthwise (weft wise or wale wise) with dimensions 10 cm x 20 cm respectively.

NOTE - Utmost care shall be made while cutting specimen from the sample. Sample shall be cut straight keeping in mind warp or course and weft or wale lines.

7 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

Prior to test, the specimens shall be conditioned to moisture equilibrium in the standard atmosphere of (65 ± 2) percent relative humidity and 27 °C ± 2 °C temperature from dry side as laid down in IS 6359 and the test shall be carried out in the standard atmosphere (*See also* IS 196). It is recommended that samples be conditioned for at least 24 h in the relaxed state.

8 APPARATUS

8.1 Fabric Smoothness tester

The smoothness tester should include three chambers namely top, middle and bottom chamber which comprises of the following:

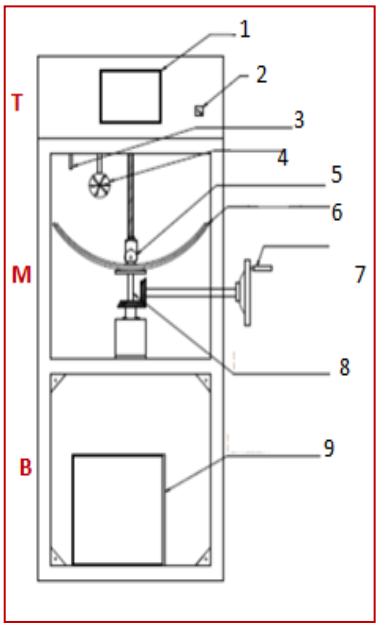
8.1.1 Top chamber (T) - This chamber accommodates display unit, on/off switch, geared motor with electromagnetic clutch, press button to actuate pendulum, rotor encoder in order to measure angle/amplitude and programmable logic controller (PLC) to control various parameters such as humidity, temperature etc. The display unit reflects information pertaining to humidity, amplitude, time of completion of cycle, air velocity etc. The on/off switch is provided to switch on or off the said apparatus. The geared motor with electromagnetic clutch controls oscillation of the roller hanging from the roof of the middle chamber with a rod.

The roller hanging from the roof by means of rod causes whole assembly to oscillate about the equilibrium position by swinging back and forth. This oscillation takes place with the help of geared motor. The electromagnetic clutch play role to shift the roller assembly at the maximum angle on one side. When this roller assembly attains the maximum angle, it is released by means of a release button. Upon release of the assembly, it starts oscillating about the equilibrium position swinging back and forth. Said rotary encoder is provided to measure angle/amplitude of the roller assembly.

8.1.2 The middle chamber (M) embodies temperature and humidity sensor, Anemometer, revolving roller assembly, Arc type sample holder and screw arrangement and height adjustment.

8.1.3 Bottom chamber (B): This chamber houses steam generator to generate steam for changing humidity. Beside the above three chambers, an air conditioning unit is also employed with the apparatus to maintain required temperature in the course of the testing.

NOTE — The schematic diagram of Fabric smoothness tester developed by NITRA (Northern Textile Research Association), Ghaziabad, U.P, India. is shown in Figure 2.



Keys:

1. Display unit
2. Switches
3. Temperature and Humidity sensor
4. Anemometer
5. Revolving roller assembly
6. Arc type specimen holder
7. Screw arrangement
8. Height adjustment
9. Steam Generator

FIG. 2 SCHEMATIC DIAGRAM OF FABRIC SMOOTHNESS TESTER DEVELOPED BY NITRA

9 PROCEDURE

9.1 First of all Pendulum assembly is moved upward to ensure that it is not touching the arc type platform, which also acts as specimen holding device and having sufficient distance from arc type platform so that the test specimen can be mounted easily on the platform using specimen holder.

9.2 Mount the specimen on the arc type platform using specimen holder ensuring that there shall not be any crease/fold/wrinkle on the specimen.

9.3 Lower the pendulum assembly slowly using load cell adjustment wheel so that it touches the specimen. Apply required load on the specimen using load cell. The recommended load shall be 400 ± 20 grams.

9.4 For knitted fabric or samples having high extensibility, instead of using sample holder, use 51 ± 1 mm width binder clip on all four sides of the fabric specimen with total load 400 ± 20 grams (per side per clip having hanging weight, shall be 100 g including clip weight).

9.5 Push the start button so that the pendulum device starts swinging to and fro on the arc type platform. After pushing the start button, time measuring device also start simultaneously. It measures time in milliseconds. Note down the reading. Repeat this procedure for all the specimens. Take average of all 10 readings of each side. Convert it into grading as per given in **Table 1** and **Table 2**.

NOTE- If any of the reading deviate from $\bar{x} \pm 3\sigma$, then the same shall be discarded and fresh sample shall be taken for further testing.

Table 1 Smoothness Grading Table for Woven Fabric

(*Clauses* 3.2, 9.5, 10)

Sl No. (1)	**Time (millisec) to stop pendulum** (2)	**Smoothness grade** (3)
i)	Up to 400	Grade 1 (Very poor)
ii)	401 to 500	Grade 2 (Poor)
iii)	501 to 600	Grade 3 (Good)
iv)	601 to 700	Grade 4 (Very good)
v)	> 701	Grade 5 (Excellent)

Table 2 Smoothness Grading Table for Knitted Fabric

(*Clauses* 3.2, 9.5, 10)

Sl No.	Time (millisec) to stop pendulum	Smoothness grade
(1)	(2)	(3)
i)	Up to 300	Grade 1 (Very poor)
ii)	301 to 400	Grade 2 (Poor)
iii)	401 to 500	Grade 3 (Good)
iv)	501 to 600	Grade 4 (Very good)
v)	> 601	Grade 5 (Excellent)

10 CALCULATION

The calculation of smoothness characteristics are based on mean of at least 10 test specimen readings, each side (lengthwise and widthwise) of time taken to stop pendulum device in milliseconds.

The mean value of these reading is converted into smoothness grading as per Table 1 and Table 2.

11 TEST RESULTS

The test report shall include the following information:

a) Type of sample i.e. woven or knitted
b) Side of surface taken for test
c) Number of test specimens and if needed, number of tests rejected with reasons.
d) Mean of 10 readings of specimen for time taken to stop pendulum device in milliseconds in lengthwise and widthwise.
e) the coefficient of variation of time taken to stop pendulum device, in percentage.
f) Grading of smoothness (Specimen - lengthwise and widthwise).
g) Any deviation from the test procedure

ANNEX A
(Foreword)

ADJUSTMENTS AND CALIBRATION OF FABRIC SMOOTHNESS TESTER

A-1 With the pendulum in the raised position, starting position, check the alignment of the arc type platform. For this purpose, lower the pendulum device in such a way that the wheel provided at lower end start touching the center position of arc type platform. At this position the weight impose on the center position of arc type platform shall be 0.4 kg using load cell. Now move this whole pendulum assembly on the arc type platform by hand and note down the readings of weight displayed on the displayed unit. Change in reading at any place shall not be more than ± 20 grams than the center position. If change in reading is more than ± 20 grams, adjust the platform.

A-2 The metallic wheel provided at the end of the pendulum device shall be smooth, scratch free and free to move. To check its proper working, a polyester transparent film of same size of arch type platform shall be taken and fix over the platform using tapes. Tape shall not be put in middle part of the film otherwise movement of wheel may hinder and true reading of smoothness of film may not reflect. Push the start button so that the pendulum device starts swinging to and fro on the arc type platform. Measure the total time taken by the pendulum device to stop. Note down the reading. Repeat this procedure 10 times on the same polyester transparent film. Take average of all 10 readings. If any of the individual value deviate from the mean by ± 20 %, the complete set of values shall be discarded and fresh reading on a new polyester transparent film shall be taken. This average of the 10 readings in millisec shall be 2600 ± 5%. The above procedure shall be followed for any subsequently working on the apparatus.

NOTES –
1 This is an important part of the apparatus which actually touch the specimen and move on the specimen. If some scratches are found then it may be electroplated, to have a smooth and clear surface.
2 Oddy overhead projector polyester film of 100 micron shall be used for the verification of the apparatus.

A-3 The levelness of the apparatus is essential. Movement of the instrument during the swinging of the pendulum device is significant source of error. Securely anchor the apparatus so that it is sufficiently rigid and that there shall not be perceptible movement of the apparatus during the swing of the pendulum device. Adjust the apparatus accordingly to the built-in level.

A-4 Whole assembly shall be placed in the closed chamber so there shall not be any effect of air current.

ANNEX B

(*Clause* 5.2, Foreword)

RECOMMENDATORY SAMPLING PROCEDURE

B-1 Bulk sampling (Number of pieces taken from shipment or lot)

Take at random from the shipment or lot the appropriate number of pieces shown in the table 3. Ensure that no piece shall show signs of damage or dampness incurred during transit is included in the bulk sample.

Table 3 Bulk Sampling

(*Clause* B-1)

Sl No.	Number of pieces in shipment or lot	Number of pieces comprising bulk sample, *Min.*
(1)	(2)	(3)
i)	3 or less	1
ii)	4 to 10	2
iii)	11 to 30	3
iv)	31 to 75	4
v)	76 or more	5

B-2 Number of laboratory samples

From each piece in the bulk sample, if it is a fabric roll, cut (from a position taken at random but at least 3 meters from the end piece) a laboratory sample of length at least 1/2 meter and full width. Ensure that areas that are creased or that have a visible fault, or faults, are not included in the laboratory sample.

If the test is carried out on a garment, at least three garments from same lot shall be taken and specimen is cut from all the three garment samples.

ANNEX C

(*Foreword*)

EXAMPLE FOR TESTING FABRIC SAMPLES

C.1 To further explain testing procedure, an example of cotton fabric is taken over here. For the study, 100% cotton grey fabric was desized, singed, scoured, bleached and mercerized in the mill using standard recipe. The mercerized fabric sample was given various finishing treatments. All these samples were evaluated for smoothness characteristics using NITRA-Fabric smoothness tester. The results are shown in Table-4 and Table-5 with smoothness grade.

Table 4 Smoothness Behavior of Cotton Fabric at Various Stages of Wet Processing

Sl. No.	Time required to stop pendulum, millisecond											
	Gray		Singed		Desized		Scoured		Bleached		Mercerized	
	Wp	Wt	Wp	Wt	Wp	Wt	Wp	Wt	Wp	Wt	Wp	Wt
i)	470	420	419	411	519	449	448	439	432	439	599	559
ii)	486	434	429	419	519	419	439	440	418	438	539	569
iii)	488	428	439	418	518	459	439	438	428	420	599	559
iv)	447	430	418	429	528	479	440	448	438	428	589	569
v)	445	440	399	420	529	418	438	439	418	438	560	611
vi)	466	430	399	419	519	478	436	449	448	439	539	559
vii)	454	434	418	419	519	479	432	448	438	429	500	558
viii)	442	442	419	429	522	479	441	438	438	428	579	559
ix)	439	438	420	428	519	479	439	449	429	439	500	499
x)	447	444	429	418	528	468	438	448	419	439	499	499
Mean	**458**	**434**	**419**	**421**	**522**	**460**	**439**	**444**	**430**	**434**	**550**	**554**
Grade	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**

Wp: Waprwise, Wt: Weftwise

Table 5 Smoothness behaviour after treatment of mercerized cotton fabric

Sl.No	Time required to stop pendulum, millisecond							
	Treatment-1		Treatement-2		Treatment-3		Treatment-4	
	Wp	Wt	Wp	Wt	Wp	Wt	Wp	Wt
i)	610	602	650	646	710	701	740	680
ii)	620	621	652	642	1720	706	734	688
iii)	622	608	640	638	1725	690	729	690
iv)	625	610	642	635	702	698	720	680
v)	605	615	647	632	704	692	724	682
vi)	610	616	646	630	710	696	725	698
vii)	609	618	647	640	722	697	722	690
viii)	606	610	652	645	710	694	718	675
ix)	620	611	654	633	715	699	732	680
x)	623	612	640	638	716	695	730	682
Mean	**615**	**612**	**647**	**638**	**713**	**697**	**727**	**685**
Grade	4	4	4	4	5	4	5	4

Wp: Waprwise, Wt: Weftwise