Preliminary Draft

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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 TXD 01	Last date for receipt of comments 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:

a) The Scope of the standard has been modified;

b) Principle of skein test has been incorporated;
c) The use of Constant Rate of Extension based tensile testing machine for determining the skein breaking load has been incorporated;
d) The tolerance of relative humidity for atmospheric conditioning of samples has been modified;
e) Tolerance of rate of traverse of testing machine has been modified;
f) Test report has been modified; and
g) 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-I 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.