भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDRADS

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भारतीय मानक मसौदा

वस्त्रादि — कपास प्रणाली पर काते गए धागों के रैखिक घनत्व को निर्धारण की विधि

(आई एस 1315 *का दूसरा पुनरीक्षण*)

Draft *Indian Standard*

TEXTILES — METHOD FOR DETERMINATION OF LINEAR DENSITY OF YARNS SPUN ON COTTON SYSTEM

(*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*)’.

TEXTILES — METHOD FOR DETERMINATION OF LINEAR DENSITY OF YARNS SPUN ON COTTON SYSTEM

(*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.l % 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) ℃. 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.