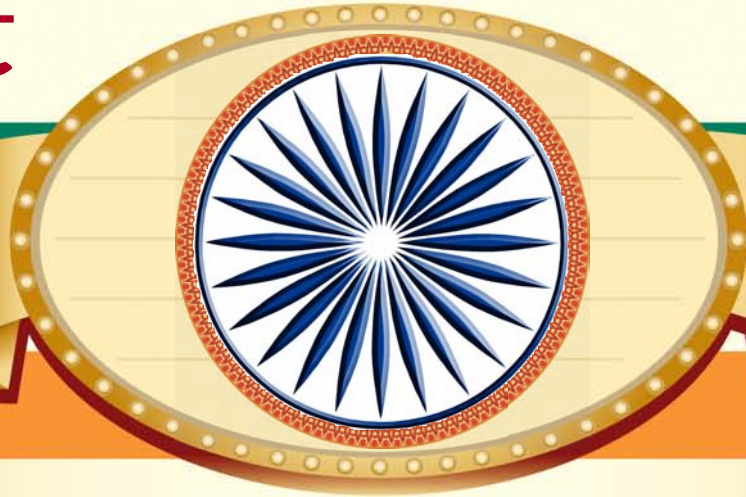


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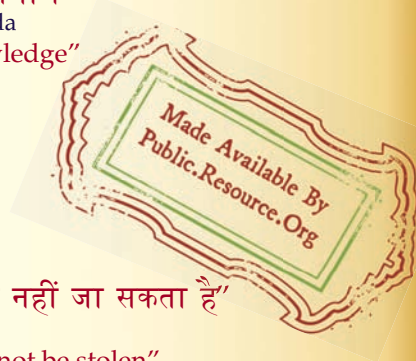
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*Indian Standard*  
METHOD FOR  
DETERMINATION OF LINEAR DENSITY OF  
TEXTILE FIBRES (GRAVIMETRIC METHOD)  
( *First Revision* )

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# Indian Standard

## METHOD FOR DETERMINATION OF LINEAR DENSITY OF TEXTILE FIBRES (GRAVIMETRIC METHOD)

( *First Revision* )

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*Indian Standard*  
**METHOD FOR**  
**DETERMINATION OF LINEAR DENSITY OF**  
**TEXTILE FIBRES ( GRAVIMETRIC METHOD )**  
*( First Revision )*

**0. FOREWORD**

**0.1** This Indian Standard ( First Revision ) was adopted by the Indian Standards Institution on 26 March 1973, after the draft finalized by the Physical Methods of Test Sectional Committee had been approved by the Textile Division Council.

**0.2** This standard was first published in 1952 which prescribed the use of some patented instruments for the measurement of linear density ( mean fibre weight per unit length ) of cotton fibre. This standard has been revised to cover many other textile fibres also and to accommodate the developments which have taken place since the publication of this standard. Reference to patented instruments has been dropped to accommodate other instruments available for the purpose. Opportunity has also been taken to align the standard with ISO Recommendation R-1973 ' Determination of linear density of textile fibres — Gravimetric Method '. Assistance has also been drawn from ASTM. Designation : D 1769-1967 ' Method of test for linear density of cotton fibres ( array sample ) ' issued by American Society for Testing and Materials.

**0.3** In reporting the result of a test 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 : 2-1960\*.

---

**1. SCOPE**

**1.1** This standard prescribes two methods for determination of linear density of textile fibres. One method is applicable to cut fibre bundles and the other to whole fibres.

**1.1.1** Both the methods given are applicable only for discrete fibres ( excluding fibres like jute ) which can be kept straight and parallel

\*Rules for rounding off numerical values ( revised ).

during the preparation of bundles. They are not applicable to fibres having pronounced crimp ( such as Indian wools ).

## **2. PRINCIPLE**

**2.1 Method I**— A tuft having known number of fibres is cut in the middle to a known length and the mass of the cut-middle portion is determined. From the mass and total length of fibres the linear density is calculated.

**2.2 Method II**— Fibres which have been sorted previously into groups of known length are weighed and then counted. Then the mass per unit length is calculated from the number, mass and length of fibres.

## **3. TERMINOLOGY**

**3.0** For the purpose of this standard, following definitions shall apply ( *see also* IS: 232-1967\* ).

**3.1 Linear Density**— Mass per unit length; the quotient obtained by dividing the mass of the fibre by its length. It is expressed in millitex or decitex.

**3.2 Array**— Sorted fibres placed in order of length.

## **4. ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING**

**4.1** The test sample shall be conditioned as laid down in IS: 6359-1971† and test carried out in the standard atmospheric conditions of  $65 \pm 2$  per cent relative humidity and  $27 \pm 2^\circ\text{C}$  temperature.

## **5. SAMPLING**

**5.1** The test samples of fibres shall be so selected as to be the representatives of the lot. The samples drawn in accordance with the procedure laid down in the material specification or in compliance with an agreement between the buyer and the seller shall be held to be the representative of the lot.

**NOTE**— In case of cotton fibre reference to IS: 4952-1962‡ be made.

## **6. PREPARATION OF TEST SAMPLE**

**6.1** The test sample from the gross sample shall be prepared as given in 6.2 and 6.3.

---

\*Glossary of textile terms — natural fibres (*first revision*).

†Method for conditioning of textiles.

‡Methods for sampling of cotton bales, slivers and rovings.

**6.2** The gross sample approximately 1 kg shall be spread out evenly on a level ground in the form of either a square with each side slightly greater than 1 m or in the case of a larger sample, a rectangle with the shorter side slightly greater than 1 m and the larger side slightly greater than 2 m. Over this, a metallic framework of size 1 × 1 m with 25 sub-squares or 1 × 2 m with 50 sub-squares, as the case may be, shall be placed. From each of these sub-squares one bunch ( or more ) of fibres shall be pulled out at random, taking care (a) not to exercise any bias in favour of or against any particular place within a sub-square, and (b) that the fibres drawn from each sub-square weigh about the same amount. The total quantity of about 5 to 10 g of fibres drawn shall constitute the reduced sample.

**6.3** The reduced sample shall be divided into 25 or 50 approximately equal groups. From a different portion of each of these groups, one small tuft ( or more ) of fibres shall be extracted at random, taking care that the fibres drawn are nearly equal in weight, and the total weight of fibres thus drawn is not less than 200 mg. This shall constitute the 'test sample'.

## 7. TESTING

**7.1** After pre-conditioning, bring the sample to constant mass in the standard atmosphere. Carry out the test without removal from the standard atmosphere by Method I ( *see 8* ) or Method II ( *see 9* ).

## 8. METHOD I— CUT-BUNDLES

### 8.1 Apparatus

**8.1.1 Balance** — Suitable for weighing the bundles of fibres to an accuracy of 0.02 mg and having 2 mg capacity.

**8.1.2 Device for Cutting the Fibres or Bundles of Fibres** — To a known length with an accuracy of 1 percent and allowing of adjustment of the tension of the bundles to be cut.

**NOTE** — It is convenient to use two razor blades set parallel in a holder.

**8.1.3 Velvet Board** — of convenient size covered with velvet of black or any other contrasting colour.

**8.1.4 Glass Plate** — of convenient size, with one polished edge.

**8.1.5 Forceps**

### 8.2 Procedure

**8.2.1** From the final laboratory sample take ten tufts of several milligrammes and parallelize the fibres of each tuft by carefully combing them several times.

**8.2.2** Cut the middle part of each combed tuft to a given length (as great as possible) under the minimum tension necessary to remove crimp, by means of the cutting device. Take the necessary precautions so that there are no free fibre ends anywhere except at the two ends of the cut tufts.

**8.2.3** Place the ten tufts so obtained on the velvet board and cover them with the glass plate from the edge of which they should protrude slightly.

**8.2.4** From each of the ten tufts in turn, take out sufficient number of fibres, so as to form a tuft, weighing about 0.2 mg, in each case drawing the fibres from one cut end. Make sufficient number of tufts, so that a total number of at least 1 000 fibres in the case of natural fibres and 200 fibres in the case of man-made fibres are covered. Condition these tufts in the standard atmosphere and then weigh them individually, using the balance to an accuracy of 0.02 mg.

**8.3 Calculations** — Calculate the linear density of the fibres by dividing mass by the total length of cut fibres in the each tuft. Then determine the mean linear density for all the tufts from the values obtained for each tuft.

## 9. METHOD II — WHOLE FIBRES

### 9.1 Apparatus

**9.1.1 Microscope** — with mechanical stage and magnification of at least 100 ×.

**9.1.2 Glass Slides**

**9.1.3 Cover Glasses**

**9.1.4 Tweezers**

**9.1.5 Balance** — suitable for weighing bundles of fibres to an accuracy of 0.02 mg and having 2 mg capacity.

**9.1.6 Mounting Medium** — Water or mineral oil.

### 9.2 Procedure

**9.2.1** From the final laboratory sample, prepare two complete fibre length arrays. Discard length groups less than 5 mm and those weighing less than 1 mg and treat these two sets as two sub-samples.

**9.2.2** From each sub-sample prepare test specimens which shall consist of a set of bundles of approximately 100 fibres each taken by separating them length-wise from each length group of a sub-sample.

**9.2.3** Take a bundle of fibre from a specimen (see 9.2.2) beginning with the longest group and weigh it to an accuracy of 0.02 mg and record the mass. Then mount the fibres on the glass slides and cover them with the glass covers using some suitable mounting medium, if required. Mark the slides for the length-group identification.

**9.2.4** Complete the preparation of the specimen by mounting the bundles from each length group.

**9.2.5** Place each slide on the microscope stage turn by turn and count all the fibres in the slide. For reference see record sheet in Appendix A showing a typical data of a cotton fibre specimen.

**9.2.6** Similarly, prepare the slides and count the number of fibres on each slide for the second sub-sample also.

### 9.3 Calculations

**9.3.1** Calculate the linear density of the fibres in the sub-sample as follows (see Appendix A also):

Let

$M_1$  = total mass of fibres in  $i$ th length group, in mg, to the nearest 0.2 mg;

$m_1$  = mass of counted fibres in  $i$ th length group, in mg, to the nearest 0.2 mg;

$n_1$  = number of these fibres;

$l_1$  = length of fibres in  $i$ th length group;

$H_1$  = linear density (in  $m$  tex) of fibres in  $i$ th length group;

$H$  = linear density (in  $m$  tex) of all the fibres;

Then

$$H_1, m \text{ tex} = 10^6 \times \frac{m_1}{n_1 l_1}$$

$H$  is given by the weighted harmonic means

$$H, m \text{ tex} = \frac{\Sigma M_1}{\Sigma \left( \frac{M_1}{H_1} \right)}$$

**9.3.2** Calculate the average linear density of the sample in  $m$  tex as the arithmetic mean of the linear densities of the two sub-samples.

## 10. REPORT

**10.1** The report should include the following information:

- Type of fibres,
- Method followed ( I or II ), and
- Mean linear density.

**APPENDIX A**  
( *Clauses 9.2.5 and 9.3.1* )

**RECORD SHEET SHOWING A TYPICAL DATA OF COTTON  
FIBRE SPECIMEN**

Length Group $L_1$ , mm	Mass of Array Length Group $M_1$ , mg	Number of Fibres Counted $n_1$	Mass of Fibres Counted $m_1$ , mg	$H_1 = \frac{m_1}{n_1 L_1} \times 10^6$	$\frac{M_1}{H_1}$
(1)	(2)	(3)	(4)	(5)	(6)
60	—	—	—	—	—
57	—	—	—	—	—
54	—	—	—	—	—
51	—	—	—	—	—
48	—	—	—	—	—
45	—	—	—	—	—
42	—	—	—	—	—
39	—	—	—	—	—
36	4.0	100	0.51	141.7	0.028 2
33	11.6	96	0.50	162.9	0.071 2
30	18.9	102	0.52	170.0	0.111 1
27	13.2	110	0.54	181.8	0.072 6
24	9.0	96	0.49	212.6	0.042 3
21	5.1	115	0.41	169.8	0.030 0
18	3.8	95	0.34	198.8	0.019 1
15	1.7	109	0.26	159.0	0.010 6
12	3.2	101	0.22	181.5	0.017 6
9	2.3	99	0.16	179.6	0.012 6
<b>Total</b>	<b>72.8</b>		<b>3.95</b>		<b>0.415 3</b>

$$H, \text{ m tex} = \frac{\Sigma M_1}{\Sigma \left( \frac{M_1}{H_1} \right)} = \frac{72.8}{0.415 3} = 175.168 \text{ or } \underline{175}$$

# INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

## Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

Quantity	Unit	Symbol	Conversion
Force	newton	N	1 N = 1 kg·1 m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N·m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V·s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>

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