IS 1969 (1985): Methods for Determination of Breaking load and Elongation of Woven Textile Fabrics [TXD 1: Physical Methods of Tests]

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IS : 1969 - 1985

Indian Standard

METHODS FOR DETERMINATION OF BREAKING LOAD AND ELONGATION OF WOVEN TEXTILE FABRICS

(Second Revision)

Second Reprint MARCH 1995

UDC 677·074 ; 677·017·424·5

BUREAU OF INDIAN STANDARDS
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Gr 4 *January* 1986

AMENDMENT NO. 1 AUGUST 2000
TO
IS 1969 : 1985 METHODS FOR DETERMINATION OF BREAKING LOAD AND ELONGATION OF WOVEN TEXTILE FABRICS

(Second Revision)

This amendment is intended to clarify the rate of traverse to be used in case of constant-rate-of-traverse machines for heavier fabrics such as cotton duck, canvas and laminated jute fabrics. Further both the terms 'breaking load' and 'breaking strength' have been used in various Indian Standards which convey the same meaning except for their numerical values. Accordingly the title of the standard has been modified to read 'breaking strength' in place of 'breaking load'.

(*Cover page, pages* 1 *and* 3, *Title*) — Substitute the following for the existing:

'METHOD FOR DETERMINATION OF BREAKING STRENGTH AND ELONGATION OF WOVEN TEXTILE FABRICS

(Second Revision)'

(*Page* 4, *clause* 1.1, *line* 1) — Substitute 'breaking strength' *for* 'breaking load'.

(*Page* 4, *clause* 2.1, *line* 5) — Substitute 'breaking strength' *for* 'breaking load'.

(*Page* 4, *clause* 3.1, *heading*) — Substitute **'Breaking Strength'** *for* **'Breaking Load'**.

(*Page* 5, *clause* 3.6, *line* 3) — Substitute 'breaking strength' *for* 'breaking load'.

[*Page* 7, *clause* 7.1(c), *Note*] — Substitute the following for the existing:

'NOTE — If the arrangement for breaking the specimen within 20 ± 3 seconds is not there, the test shall be carried out at a constant-rate-of-traverse machine (which is very popular and widely used in India) at the rate of traverse of 300 ± 15 mm/min.'

(*Page* 8, *Table* 1, *Note* 1) — Substitute 'breaking strength' *for* 'breaking load'.

[*Page* 11, *clause* 8.3.1(a)] — Substitute 'breaking strength' *for* 'breaking load'.

(*Page* 13, *clause* 10.1, *line* 5) — Substitute 'breaking strength' *for* 'breaking load'.

(*Page* 13, *clause* 10.3, *line* 2) — Substitute 'breaking strength' *for* 'breaking load.'

(*Page* 14, *clause* 10.4, *line* 2) — Substitute 'breaking strength' *for* 'breaking load'.

(*Page* 14, *clause* 11.1, *first line and formula*) — Substitute 'breaking strength' *for* 'breaking load' wherever existing.

[*Page* 14, *clause* 12.0(m)] — Substitute 'breaking strength' for 'breaking load'.

(TX 01)

Reprography Unit, BIS, New Delhi, India

Indian Standard

METHODS FOR DETERMINATION OF BREAKING LOAD AND ELONGATION OF WOVEN TEXTILE FABRICS

(Second Revision)

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(*Continued on page* 2)

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Indian Standard

METHODS FOR DETERMINATION OF BREAKING LOAD AND ELONGATION OF WOVEN TEXTILE FABRICS

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 29 July 1985, after the draft finalized by the Physical Methods of Test Sectional Committee had been approved by the Textile Division Council.

0.2 This Indian Standard, first publised in 1961, was revised in 1968 to include constant-rate of extension, constant-rate of loading machines and grab method. The standard has been revised again to make it uptodate on the basis of experience gained during its use and also to align it with ISO standards namely, ISO 5081-1977 Textiles — Woven fabrics — Determination of breaking strength and elongation (strip method) and ISO 5082-1982 Textiles — Woven fabrics — Determination of breaking strength — Grab method, published by International Organization for Standardization.

0.3 Most of the textile fabrics are tested for their tensile strength on constant-rate-of-extension (CRE), constant-rate-of-traverse (CRT) and constant-rate-of-loading (CRL) machines by grab, ravelled-strip or cut-strip methods. The results obtained by using different test specimens on different tensile testing machines may differ. No simple relationship could generally be given between the strip and grab tests, however, definite relations have been found to be valid for certain types of fabrics. When time-to-break has been the same, excellent experimental agreement has been reported between results obtained with CRE and CRT testers, but results given by CRL tester have in some cases been reported to differ somewhat from other results. This standard has been prepared with a view to eliminating, as far as possible, the variations in testing procedures when one specific kind of test specimen is used on a specific machine.

0.4 In reporting the results 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 : 2-1960*.

1. SCOPE

1.1 This standard prescribes methods for determination of breaking load and elongation at break of woven fabrics (conditioned or wet) using grab, ravelled-strip and cut-strip methods on constant-rate-of-loading, constant-rate-of-extension and constant-rate-of-traverse machines.

1.1.1 The methods are applicable to all woven textile fabrics irrespective of their composition (that is, whether they are made of cotton, wool, silk, jute or man-made fibres or blends or two or more such fibres), manufacturing processes and finishing treatments. It is also applicable to laminated fabrics but not to fabrics coated with rubber or plastics.

2. PRINCIPLE

2.1 The specimen is gripped between two clamps of the tensile testing machine in such a manner that the same set of yarns is gripped by both the clamps and a continual increasing load is applied longitudinally to the specimen by moving one of the clamps until the specimen ruptures. Values of breaking load and elongation of the test specimen are read from the indications of the machine.

3. TERMINOLOGY

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

3.1 Breaking Load — The maximum load (or force), supported by a specimen in a tensile test carried to rupture. It is usually expressed in Newton or kilogram (1 kgf = 9·8 N).

3.2 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 a percentage of the latter.

NOTE — The result of elongation obtained in the test may have slight error on account of the possibility of slippage during testing.

3.3 Grab Test — A test in which only a part of the width of the specimen is centrally gripped in the clamps for testing.

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

3.3.1 *Modified Grab Test* — Grab test in which lateral slits are made in the specimen to sever all yarns bordering the portion, the strength of which is to be tested; thus reducing the effect of the threads which are not directly gripped by the jaws to a practical minimum.

3.4 Strip Test — A test in which the full width of the specimen is gripped in the clamps for testing.

3.4.1 *Ravelled-Strip Test* — Strip test in which the specified width of the specimen is obtained by ravelling away yarns at the edges.

3.4.2 *Cut-Strip Test* — Strip test in which the specified width of the specimen is obtained by cutting the fabric.

3.5 Nominal Gauge Length — The length of a specimen under specified pre-tension, measured from nip to nip of the jaws of the holding clamps in their starting position.

3.6 Time-to-Break — The interval, measured in suitable units, such as seconds, during which the specimen is under a (generally increasing) tension, that is, absorbing the energy supplied before the breaking load is reached.

NOTE — Time-to-break does not include the time required to remove slack from the specimen. On machines supplied with an autographic recorder the time to break is indicated by the time elapsing after the pen registers the initial force sustained by the specimen until the pen registers the maximum force.

4. SELECTION OF THE TEST

4.1 The type of test to be done in any specific case depends on what has been specified in the material specification or as has been agreed to between the parties.

4.2 Grab Test Method — This method is used when it is desired to determine the effective strength of the fabric in use, that is, the strength of the yarns in a specific width together with the strength contributed by the adjacent yarns. The method is particularly suitable for heavy fabrics as well as those with high cover factor and in cases where ravelling is difficult or when the ravelled-strip starts ravelling further under stress.

4.3 Modified Grab Test Method — This method is used especially for fabrics with very high strength or for fabrics constructions where application of stress on ravelled strip specimen produces further unravelling.

4.4 Ravelled-Strip Test Method — This method is generally used when it is desired to determine the breaking load required to rupture specific width of fabric. This information is useful for comparing the effective strength of yarns in woven fabric with the strength of yarn before weaving.

4.4.1 *Full Width* — Tapes, ribbons and other narrow fabrics of less than 50 mm width are tested full width by this method.

4.5 Cut Strip Test Method — This method is used in case of heavily sized, felted, laminated fabrics or fabrics in which ravelling is not easy.

5. SAMPLING

5.1 The quantity of fabrics purporting to be of one definite composition, construction and quality delivered to one buyer against one despatch shall not constitute the lot.

5.2 Sample to test conformity of a lot to a specification as regards to breaking load and elongation at break shall be selected so as to be representative of the lot.

5.3 Sample drawn in compliance with the specification for the material or as agreed to between the buyer and the seller shall be held to be representative of the lot.

5.4 Test at least five warpway and five weftway test specimens. As far as possible, only one test specimen shall be drawn from a piece in the test sample. The pieces in the test sample may be drawn from as many bales (or cases) in the lot as possible.

NOTE — Results of tests performed on small samples should be considered as representative of that small sample but should not be taken as representative of the fabric piece or lot from which the small sample was taken.

6. ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

6.1 Prior to test, the specimens shall be conditioned to moisture equilibrium from dry side and tested in the standard atmosphere of 65 ± 2 percent relative humidity and 27 ± 2°C temperature as laid down in IS : 6359-1971*.

6.2 The test shall be carried out in a standard atmosphere (*see* **6.1**).

6.3 Wet Test — (*see* **9.4**).

7. TESTING APPARATUS

7.1 A tensile testing machine provided with the following arrangements shall be used for testing:

a) Two clamps with the following provisions to grip the specimens:

i) Each clamp of the machine shall consist of two metallic jaws and each jaw face shall be in line both with respect to its

*Method for conditioning of textiles.

mate in the same clamp and to the corresponding jaws of the other clamp.

ii) Each clamp shall be provided with a mechanical device so constructed that through its means a specimen can be secured firmly between the jaws of the clamps so that it does not slip during the test. Also, the edge of the surface of each jaws shall be such that it would not cut or damage the specimen during testing.

NOTE — The faces of the jaws are generally, flat, engraved or corrugated. To avoid the chances of slippage or damage to the specimen, packing materials like paper, felt, leather, plastic or rubber sheet may be used.

b) Means for adjusting the distance between the clamps such that the specimens can be tested at 75 mm gauge length for grab test and at 200 mm gauge length for strip test.

c) Means for driving by power one of the pair of clamps at a specified constant-rate-of-traverse, loading or extension as the case may be, so that the test specimen breaks in 20 ± 3 seconds (average-time-to-break).

NOTE — If the arrangement for breaking the specimen within 20 ± 3 seconds is not there, the test shall be carried out at a constant-rate-of-traverse machine (which is very popular and widely used in India) at the rate of 300 ± 15 mm/min. In the case of jute and laminated fabrics, the rate of traverse shall be 300 ± 15 mm per minute for grab and modified grab methods of test and 450 ± 15 mm/min for ravelled-strip and cut strip methods of test.

d) A scale or dial or authographic recording chart graduated so as to give load in a newtons (kilograms) and elongation in millimetres.

7.1.1 The load range of the machine shall be such that all the observed values would lie between 20 and 80 percent of the full-scale load. The permissible error in the machine at any point in this range shall not exceed ± 1 percent.

7.2 A pair of scissors or a sharp blade, measuring scale, stop watch, etc.

8. SIZES OF TEST SPECIMENS, JAW FACES AND METHODS OF MOUNTING THE SPECIMENS

8.1 Sizes of Test Specimens and Jaw Faces — The sizes of test specimens and jaws faces for different types are given in Table 1.

8.2 Methods of Mounting the Specimen

8.2.1 *Grab Test* — The test specimen shall be centrally clamped with the same set of yarns gripped in the two clamps so that the longitudinal axis of the specimen is at right angles to the edges of the clamps after pretensioning (*see* **8.3**). Same length of specimen should extend beyond the ends of each jaw.

TABLE 1 SIZES OF TEST SPECIMENS AND JAW FACES

(*Clause* 8.1)

(All dimensions in millimetres)

Sl No.	Type of Fabric	Type of Test	Size of Test Specimen Length (*Min*) × Width	Size of Jaw Faces (*See* Note 3)		Gauge Length
				Upper (or Front) Jaw Face $A \times B$	Lower (or Rear) Jaw Face $A \times B$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	All fabrics except jute	a) Grab test	150 × 100	25 × 25	25 × 25	75
		b) Modified grab test	200 × 100 400 × 100 (for high strength fabrics)	30 × 50	50 × 50	75
		c) Ravelled-strip test[a] (*see* Notes 1, 2 and 4)	325 × 60 (for close weave) 325 × 70 (for open weave)	75 × 25	75 × 25	200
		d) Cut-strip test (*see* Notes 1, 2 and 4)	325 × 50	75 × 25	75 × 25	200
ii)	Jute fabrics	a) Grab test	180 × 120	25 × 25 to 50	Equal to or bigger than the front jaw (col 5)	75
		b) Modified grab test	200 × 100 400 × 100 (for fabrics of high strength)	30 × 50	50 × 50	75

	c) Ravelled-strip test† (*see* Notes 1, 2 and 4)	325 × 120 (close weave) 325 × 140 (open weave)	100 × 25	100 × 25	200
	d) Cut-strip test (*see* Notes 1, 2 and 4)	325 × 100	100 × 25	100 × 25	200
iii) Narrow fabrics and tapes	Full width (*see* Notes 1, 2 and 4)	325 × Full width	*See* Note 4		200

NOTE 1 — For determining breaking load of fabric having elongation at break greater than 75 percent, the gauge lengths may be reduced to 50 percent of the values given in col 7.

NOTE 2 — This method is likely to give variable results on fabrics having less than 20 threads across the width of the specimen. However, if, it is agreed to perform a test on strips with less than 20 threads across the width, the actual number of threads shall be stated in the report.

NOTE 3 — The side of the jaw at right angles to the direction of application of load has been taken as *A* and that parallel to the direction of application of load has been taken as *B*.

NOTE 4 — For all types of strip tests, narrow fabrics and types being tested full width, jaw-faces shall be wider than the specimen width by at least 10 mm.

*Width after ravelling — 50 mm.
†Width after ravelling — 100 mm.

Example:

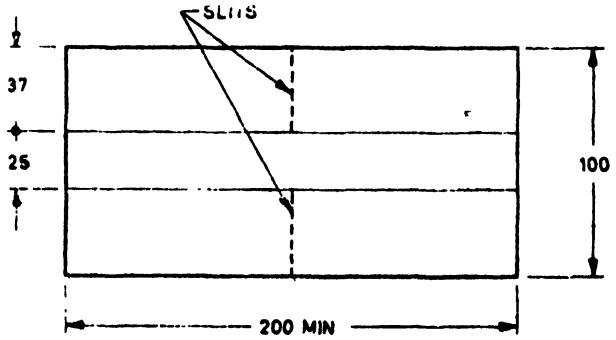
To ensure that the specimen is centrally clamped with the same yarns in the two clamps, draw a longitudinal line at about 37 mm from one edge perfectly parallel to the lengthwise yarns. Position the specimen in the lengthwise direction in the clamps such that the line drawn on the specimen runs adjacent to the sides of upper and lower edges of the clamps which are nearest to this edge.

8.2.2 *Modified Grab Test* — The test specimen shall be centrally clamped with the same yarns gripped in the two clamps after cutting the slits at the middle portion severing all yarns except those comprising the central 25 mm portion as shown in Fig. 1. The specimen should extend through the jaws and project at least 10 mm at each end. The test specimen having very high strength and requiring special mounting device shall be mounted in a manner given in Fig. 2.

Example:

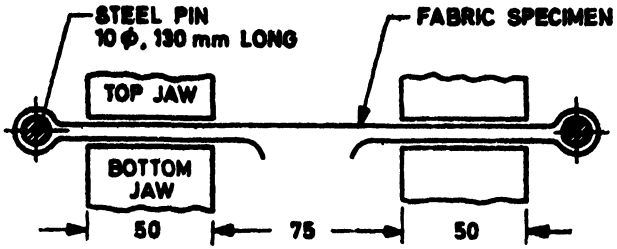
To ensure that the slits cut on the two sides leave the central portion of 25 mm width, draw two longitudinal lines at about 37 mm from each edge perfectly parallel to the lengthwise yarn leaving 25 mm width in the centre. Position the specimen in the lengthwise direction in the clamps such that one of the lines drawn on the specimen runs adjacent to the sides of upper and lower edges of the clamps which are nearest to that edge.

8.2.3 *Ravelled and Cut Strip Tests* — Mount the test specimen centrally in the clamps with the longitudinal threads parallel to the direction of application of load, after pre-tensioning (*see* **8.3**).



All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR MODIFIED GRAB TEST



All dimensions in millimetres.

FIG. 2 MOUNTING OF TEST SPECIMEN (HIGH STRENGTH FABRICS) — MODIFIED GRAB TEST METHOD

8.3 Pre-tensioning

8.3.1 Unless the use of a lower tension is necessary (*see* **8.3.2**) apply either of the following tensions:

a) a tension equal to 1 ± 0·25 percent of the probable breaking load, and

b) the tensioning given in Table 2 appropriate to the mass per unit area of the fabric under test.

TABLE 2 PRE-TENSIONING OF SPECIMENS

MASS, g/m²	FORCE, N
Up to and including 150	2
Over 150 to and including 500	5
Over 500	10

8.3.2 If the tension chosen in terms of **8.3.1** elongates the specimen by more than 0·5 percent, use a lower tension that is acceptable to the parties interested in the test results.

NOTE — If owing to the construction of the testing machine or for other reasons, no pre-tension is applied, this shall be stated in the test report.

9. PREPARATION OF TEST SPECIMENS

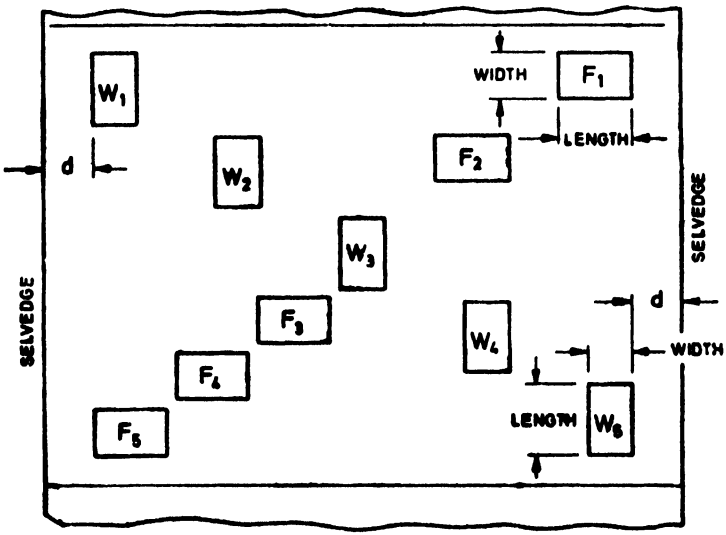
9.1 From each piece in the sample selected as in **5**, cut (from a position taken at random but at least 3 m from an end of the piece) a test sample of length at least 1 m and of full width. Ensure that areas that are creased or that have visible faults are not included in the sample.

9.2 From the test samples two sets of test specimens of required size shall be cut, one set in the warp direction and the other in the weft direction. Each set shall consist of at least five specimens, except that if a higher

degree of precision is required, more specimens shall be tested. The specimens shall be as representative of the test sample as possible. No two specimens shall contain the same longitudinal threads, and no warp direction specimen shall be cut from near either selvedge then one-tenth of the width of the test sample. As far as possible, only one test specimen shall be drawn from a piece in the test sample. Additional specimens shall be used for adjusting the time-to-break of testing machine.

NOTE — In case the lot size is small, more than one test specimen may be drawn from a piece in the test sample.

9.3 The lengthwise direction shall be parallel to the warp or weft direction for which the breaking load is required. Specimens cut in each direction shall be distributed as far as possible so that no two warpway specimens contain the same set of warp yarn and no two weft way specimens contain the same set of weft yarns. One possible lay out of cutting five warpway and five weftway test specimens from one test sample is given in Fig. 3.



W = Warp test specimens and *F* = Weft test specimens. The distance *d* shall not be less than 100 mm.

FIG. 3 LAYOUT OF TEST SPECIMENS

NOTE — The test specimens may be marked as shown in Fig. 3 to avoid mix-up of samples of warp and weft.

9.4 Wet Test Specimens

9.4.1 When the wet breaking load of the fabric is required in addition to the dry breaking load, specimens of same width and of at least twice as long as the specimens required for a dry test shall be cut. Each

specimen then shall be cut crosswise in two parts, one for determining the dry breaking load and the other for determining the wet breaking load to ensure that each pair of specimens contains the same longitudinal yarns. For fabrics which shrink excessively when wet, the initial length of test specimens for the determination of wet breaking load must be greater than that of specimens for dry breaking load tests.

9.4.2 The specimens meant for testing wet strength shall be immersed in distilled water for at least 1 hour. If necessary, 0·5 g/l of nonionic neutral wetting agent may be added.

9.4.3 The test should be completed within two minutes after the removal of test specimens from distilled water or aqueous solution containing the wetting agent.

10. PROCEDURE

10.1 Set the clamps of the testing machine so that the distance between them is 75 mm for grab test and 200 mm for strip test. Use an additional specimen (**9.2**) and, after pre-tensioning (if relevant), set the moving clamp in motion at a rate estimated to result in an average time to break as specified (**7.1**). Note the breaking load and the time-to-break. Return the moving clamps to its zero position, remove the ends of the broken specimen, and repeat the above procedure on two additional specimens. If the average time-to-break of these three specimens does not fall within 20 ± 3 s, discard the results and, using a suitable different rate of operation of the moving clamp, repeat the procedure described above. Continue in this way until the average time-to-break is 20 ± 3 s.

10.2 Set the clamps of the testing machine so that the distance between them is 75 mm for grab test and 200 mm for strip test. Take a test specimen, say W_1, as prepared in **9** and insert it in the clamps of the testing machine so that its longer side is parallel to the direction of application of load with approximately the same length of the fabric extending beyond the jaws of at each end. Secure the test specimen between the jaws of upper clamps. Through the free end of the specimen, apply an appropriate tension as in **8.3** and secure it between the jaws of the other clamps.

10.3 Operate the machine and carry the test to rupture and record the breaking load and elongation of the specimen. In case a fabric breaks in two or more stages record only the maximum load.

NOTE — If the specimen slips in the jaws or breaks inside the jaws, the reading should be discarded. If the break takes place within 5 mm from the edge of either of the jaws and the value of the break is appreciably below, say 50 percent of the average value of all other breaks, it should be discarded. If some yarns in a specimen fail to break due to improper tensioning, the reading shall be discarded. In case of rejection another specimen is to be tested in lieu thereof.

10.4 Open both the clamps and remove the broken specimen. Take a fresh specimen and determine its breaking load and elongation as given in **10.2** and **10.3** and repeat the test with the remaining test specimens.

10.5 In a similar manner test weftway specimens.

11. CALCULATIONS

11.1 Calculate the mean breaking load separately for warpway and weftway test specimens as follows:

$$\bar{L} = \frac{\Sigma L_1}{n}$$

where

$\bar{L}$ = the mean breaking load,

L_1 = the sum of the observed values of breaking load, and

n = the number of observations.

11.2 Calculate the elongation at break separately for warpway and weftway test specimens and calculate the mean percentage elongation at as follows:

$$\bar{E} = \frac{\bar{E}e \times 100}{n \times \text{Gauge Length}}$$

where

$\bar{E}$ = the mean elongation percent at break,

Ee = observed values of elongation at break, and

n = number of observations.

12. REPORT

12.0 The report shall include the following information:

a) Description of the material tested (width of tape if tested full width);

b) Condition of test (conditioned at standard atmosphere or wet, or both);

c) Type of test (grab, modified grab, ravelled-strip or cut-strip);

d) Gauge length;

e) Width of specimen;

f) Number of the threads in the strip (warp or weft if less than 20 threads);

g) Dimensions of jaws;

h) Tensioned — (a) or (b)
(*see* **8.3.1**)

j) Number of specimens tested and number of rejects:

1) Warpway

..... tested, and
..... rejects.

2) Weftway

..... tested, and
..... rejects.

k) Type and capacity of machine used (rate of traverse in CRT machine or average time-to-break in case of CRL and CRE machines).

m) Mean breaking load (conditioned or wet or both):

1) Weftway

..... (conditioned), and
..... (wet).

2) Weftway

..... (conditioned), and
..... (wet).

n) Mean percentage of elongation (conditioned or wet or both);

1) Warpway

..... (conditioned), and
..... (wet).

2) Weftway

..... (conditioned), and
..... (wet).

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Savitri Complex, 116 G. T. Road, GHAZIABAD 201001	8-71 19 96
53/5 Ward No. 29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003	4 11 37
5-8-56C L. N. Gupta Marg, (Nampally Station Road) HYDERABAD 500001	20 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	52 13 74
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76
Plot No. A-9, House No. 561/63, Sindhu Nagar, Kanpur Road, LUCKNOW 226005	5 55 07
Patliputra Industrial Estate, PATNA 800013	26 23 05
C/o Smt. Sunita Mirakhar, 66 D/C Annexe, Gandhi Nagar, JAMMU (TAWI) 180004	—
T. C. No. 14/1421, University P. O., Palayam THIRUVANANTHAPURAM 695034	6 21 04
Inspection Offices (With Sale Point) :	
Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010	52 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

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