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भारतीय मानक मसौदा

वस्त्रादि – वस्त्रों के प्रस्फोटन संबंधी गुणधर्म: बॉल बर्स्टिंग विधि द्‍वारा प्रस्फोट सामर्थ्य एवं प्रस्फोटन विस्तार ज्ञात करना

Draft *Indian Standard*

TEXTILES – BURSTING PROPERTIES OF FABRICS: BALL BURSTING METHOD FOR DETERMINATION OF BURSTING STRENGTH AND BURSTING DISTENSION

ICS 59.080.30

Physical Methods of Test Sectional Committee TXD 01	Last date for receipt of comments **17 November 2025**

FOREWORD

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

This standard was prepared to prescribe the test method for the determination of the bursting strength of fabrics using a ball burst tensile testing machine, operating on the constant-rate-of-extension (CRE) principle. The CRE-based ball burst testing machine is particularly suited for testing of both woven and knitted fabrics.

The measurement of bursting strength employing hydraulic and pneumatic diaphragm-type machines, respectively, is well established for fabrics with limited extensibility. However, these methods have certain limitations. The use of a flexible membrane (diaphragm) may not accurately simulate localized point stresses encountered in actual service. Additionally, such systems are prone to calibration drift, leakage, diaphragm fatigue, and slow dynamic response, affecting the accuracy and reproducibility of results. To overcome these limitations, the ball burst method has been adopted. In this method, a rigid spherical plunger applies a direct, multi-axial load on the specimen, ensuring uniform stress distribution and improved test control, leading to enhanced precision and reliability.

In the preparation of this standard, considerable assistance was drawn from the following references:

ASTM D6797 - 24 (2024): Standard Test Method for Bursting Strength of Fabrics — Constant-Rate-of-Extension (CRE) Ball Burst Test

This standard forms a part of the series of standards on methods of test for bursting strength of fabrics. This is Part 3 of the series, other parts are:

Part 1 Hydraulic method for determination of bursting strength
Part 2 Pneumatic method for determination of bursting strength

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 – BURSTING PROPERTIES OF FABRICS: BALL BURSTING METHOD FOR DETERMINATION OF BURSTING STRENGTH AND BURSTING DISTENSION

1 SCOPE

1.1 This standard specifies a method for determining the bursting strength of fabrics, including both woven and knitted structures, by the ball burst test using the Constant Rate of Extension (CRE) principle. The method is applicable to fabrics intended for use where functional performance characteristics are of primary importance, rather than aesthetic properties.

1.2 This standard applies to fabrics taken from rolls, bolts, or garments and provide standardized procedures for sampling, preparation, testing, and reporting.

1.3 For the measurement of bursting strength using hydraulic and pneumatic machines, refer to Test Method IS 1966 (Part 1) and IS 1966 (Part 2), respectively.

2 REFERENCES

The 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 Conditioning for testing (*second revision*)
IS 6359: 2023	Method for conditioning of textiles (*first revision*)
IS 1966 (Part 1)	Textiles - Bursting properties of fabrics Part 1: Hydraulic method for determination of bursting strength and bursting distension (third revision)
IS 1966 (Part 2)	Textiles - Bursting properties of fabrics Part 2: Pneumatic method for determination of bursting strength and bursting distension

3. TERMINOLOGY

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

3.1 Constant-Rate-of-Extension (CRE) testing machine — A tensile-testing machine provided with one clamp which is stationary and another clamp which moves with a constant speed throughout the test, the entire testing system being virtually free from deflection.

3.2 Bursting strength — The maximum force required to rupture a fabric specimen when a polished steel ball is pushed perpendicularly through the specimen using a CRE testing machine. The result shall be reported to the nearest 0.5 N.

3.4 Bursting distension — The perpendicular distance, measured from the original plane of the fabric, that the apex of the steel ball travels through the specimen up to the point of rupture. It represents the extent of deformation the fabric undergoes before failure under localized force. The value shall be expressed to the nearest 0.1 mm.

4. PRINCIPLE

A fabric test specimen is securely clamped, without tension, between grooved circular plates of the ball burst attachment and a perpendicular force is applied using a steel ball to the clamped fabric specimen till the specimen ruptures. The maximum force required to cause failure and the corresponding displacement of the steel ball at the point of rupture are recorded.

5 APPARATUS

For the purpose of this test, the following apparatus shall be used:

5.1. Tensile Testing Machine

5.1.1 The tensile testing machines used for conducting this test shall be based on Constant-Rate-of-Extension (CRE) principles.

5.1.2 These tensile testing machines shall have the following general characteristics:

a) The tensile-testing machine shall be provided with means for indicating or recording the force applied to the test specimen until rupture occurs and the corresponding displacement of the polished steel ball at the point of rupture.

b) The machine shall be capable of maintaining a substantially constant rate of extension of the moving clamp during the test based on tensile testing machine principles at the rate of 305 mm/min, with an accuracy of ± 13 mm/min.

c) The error of the indicated or recorded maximum force and displacement at any point in the range in which the machine is used shall not exceed ± 1 percent.

d) The load range of the machine shall be such that all the observed values would lie between 10 percent and 90 percent of the full-scale load.

e) A pair of scissors or a sharp blade along with a measuring scale, etc, shall be provided along with the tensile-testing machine.

5.2 Ball Burst Attachment

5.2.1 The ball attachment shall consist of the following —

a) **Steel Ball —** a polished steel ball with a diameter of 25.400 mm ± 0.005 mm and shall be spherical in shape.
b) **Ring Clamp —** a metallic clamp with an internal diameter of 44.450 mm ± 0.025 mm which shall be capable to grip the test specimen tightly using a lever or screw specimen so that no slippage occurs during testing.

5.2.2 In the ball bursting strength testing machine, the polished steel ball shall be mounted on the movable clamp, while the ring-clamp mechanism shall be secured to the fixed clamp of the machine.

5.2.3 The clamping mechanism shall be aligned such that the centre of the ring clamp and the centre of the steel ball lie on the same axis as the applied force. The clamping surfaces shall be oriented perpendicular to the direction of the applied force and shall lie in the same plane to ensure uniform application of force to the test specimen.

5.2.4 A suitable schematic diagram of ball burst attachment is shown in Figure 1.

6 SAMPLING, SELECTION, AND SPECIMEN PREPARATION

6.1 Lot sample — The samples shall be drawn randomly from the given lot so that the drawn samples shall be the representative of entire lot. The quantity of samples to be drawn shall be either in accordance with the material specification for the fabric or as agreed to between the interested parties.

NOTE — The lot may consist of rolls, bolts, or individual pieces of fabric. For fabricated systems such as garments, the lot refers to cartons containing fabric components, as applicable.

6.2 Test sample — Draw at least one full-width piece of fabric from the lot sample. This piece should be 1 meter (1 yard) in length along the selvedge (machine direction), excluding the first 1 meter (1 yard) of fabric. For circular knit fabrics, cut a band at least 300 mm wide. If the sample is part of a fabricated system, use the entire fabric component when applicable.

6.3 Test specimen preparation

6.3.1 The selection of test specimens from the test sample shall be conducted as follows —

- **a)** For fabric components from fabricated systems, take specimens from different areas of the component. For garments intended for the upper body, specimens shall be taken from areas such as the shoulder, shirt tail, shirt back, shirt front, and sleeve.
- **b)** For fabric widths of 125 mm or more, no specimen shall be taken closer than 25 mm from the selvedge edge.
- **c)** For fabric widths less than 125 mm, the entire width shall be utilized for specimens.
- **d)** Specimens shall be cut to represent a broad diagonal distribution across the width of the test sample.
- **e)** Ensure specimens are free from folds, creases, or wrinkles. During handling, avoid contaminating specimens with oil, water, grease, or other foreign substances.
- **f)** If the fabric has a pattern, ensure that the specimens are a representative sampling of the pattern.

6.3.2 From each test sample selected in accordance with Clause **6.3.1**, cut at least five test specimens. Each test specimen shall be a square in shape, measuring at least 125 mm × 125 mm. In the case of garments, cutting may be omitted if the testing equipment can accommodate the entire garment. A minimum of five tests shall be performed on each garment.

NOTES

1 Test specimens shall be taken across the width in such a manner that no two specimens contain the same yarn, either in the warp or weft direction.

2 An example of a suitable pattern for cutting test specimens from the test sample is provided in Annex A.

3 Take no specimens nearer the selvedge than one-tenth the fabric width. This restriction does not apply to tubular knitted fabric.

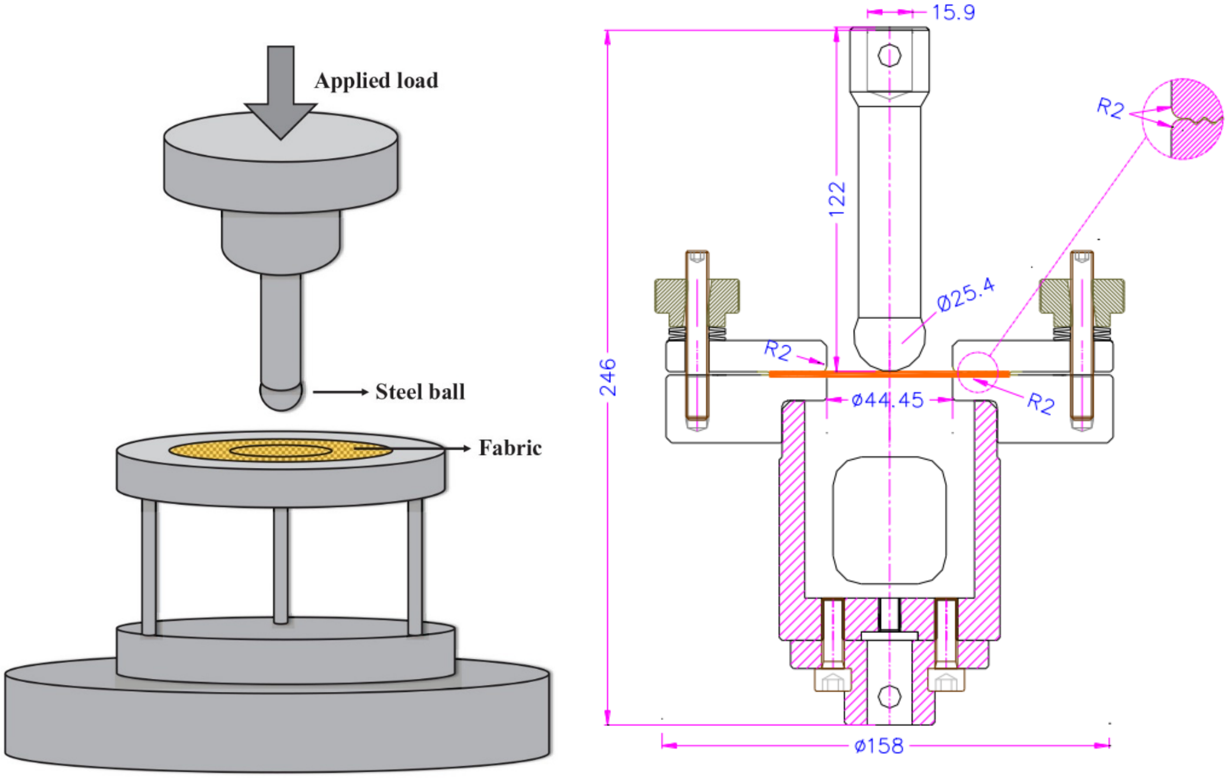


Figure 1 — Schematic diagram for Ball burst attachment.

7 CONDITIONING

7.1 The test sample shall be conditioned to moisture equilibrium from dry side in the standard atmosphere of (65 ± 4) percent relative humidity and (27 ± 2) °C temperature or as laid down in IS 6359.

7.2 The test shall be carried out in standard atmosphere as laid down in **7.1** (see also IS 196).

8 PROCEDURE

8.1 Prior to test, the sample shall be conditioned in a relaxed state in the standard atmosphere for testing as specified in Clause **7.1**

8.2 Place the conditioned specimen in the ring clamp without applying tension, and fasten it securely using the screw or lever mechanism, ensuring that no slippage occurs during the test.

8.3 Start the tensile testing machine to move the movable jaw, attached to the steel ball, at a constant speed of 305 ± 15 mm/min until the specimen ruptures under the applied Force.

8.4 Record the maximum bursting force (bursting strength) in Newtons to the nearest 0.5 N and the displacement of the steel ball at fabric rupture (bursting distension) in millimetres to the nearest 0.1 mm.

8.5 Test at least five specimens by repeating the procedures laid down in **8.1** to **8.4**.

8.6 Disregard any test results where the specimen ruptures at the edge of the clamp or if slippage occurs during the test. In such cases, repeat the test using a new specimen.

8.7 Calculate and record the mean bursting strength and mean bursting distension from the five valid test results.

9 CALCULATION

9.1 Calculate the average bursting strength of the test sample to the nearest 0.5 N.

9.2 Calculation of the Standard deviation (σ_B) and Coefficient of variation (CV_B) of Bursting strength

The coefficient of variation of bursting strength can be calculated using the classical formula based on the standard deviation of the bursting force values.

$$\text{Standard deviation of bursting strength } (\sigma_B) = \sqrt{\frac{\sum_{i=1}^{n}(B_i - \bar{B})^2}{n-1}}$$

$$\text{Coefficient of variation of Bursting strength (as a percentage)} = \left(\frac{\sigma_B}{\bar{B}}\right) \times 100$$

where,

n = no. of specimens tested

B_i = individual bursting strength value

$\bar{B}$ = mean bursting strength, rounded to the nearest 0.5 N (0.1 lbf)

9.3 Calculate the average bursting distension of the test sample to the nearest 0.1 mm.

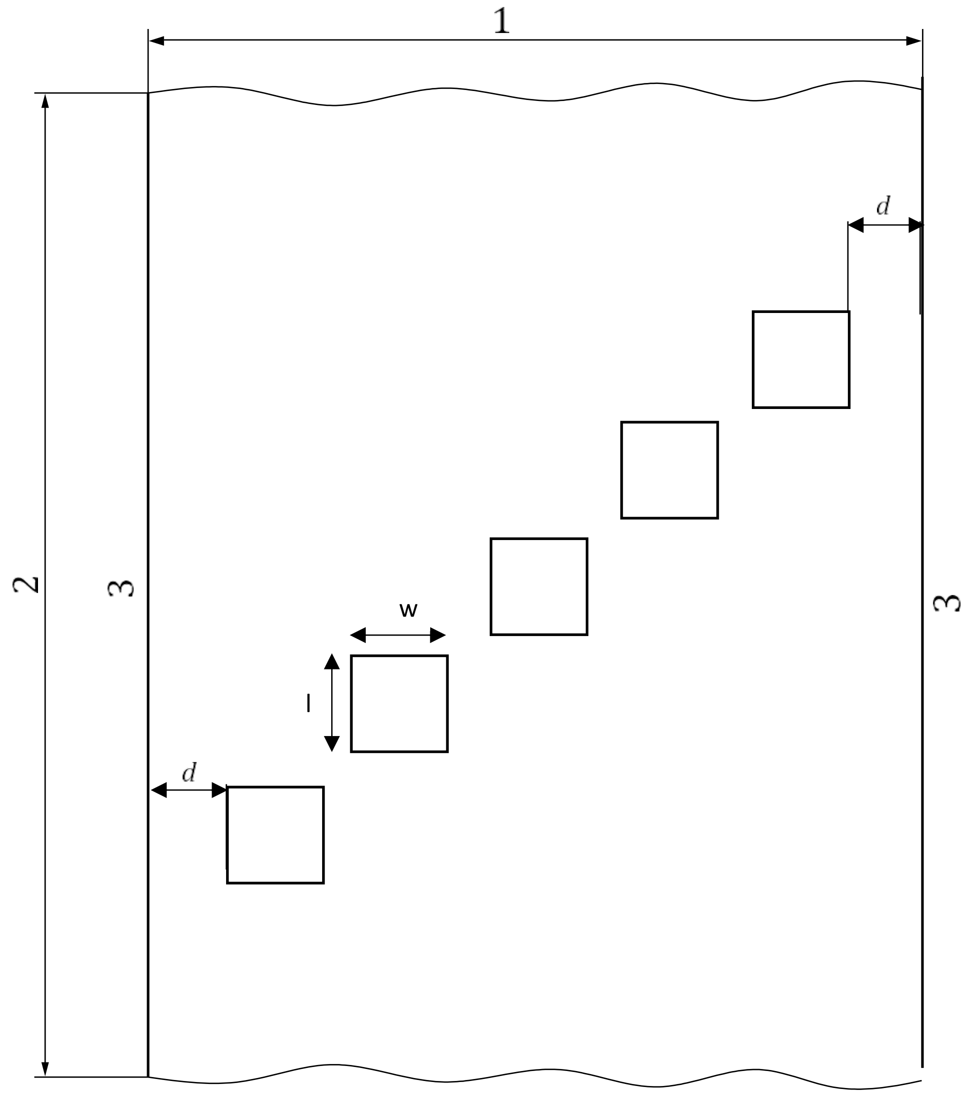
10 TEST REPORT

10.1 The report shall include the following:

a) Reference to this standard;
b) Description of material tested;
c) Number of specimens tested;
d) Average bursting strength to the nearest 0.5 N;
e) If required, Coefficient of variation, CV_B and standard deviation, σ_B of bursting strength;
f) Average bursting distension to the nearest 0.1 mm; and
g) Remark on any irregular ruptures or slippage observed.

Annex A
(informative)

Locations of test specimens cut from a laboratory sample



Key

1 width of fabric
2 length of fabric
3 edge
d 150 mm
l length of test specimen (125 mm)
w width of test specimen (125 mm)

FIGURE 2 — LOCATIONS OF TEST SPECIMENS CUT FROM A LABORATORY SAMPLE