

भारतीय मानक ब्यूरो  
BUREAU OF INDIAN STANDARDS

*Draft for comments only*

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*भारतीय मानक मसौदा*

**वस्त्रादि — विमानों और ग्लाइडर को ढकने के लिए मर्करीकृत सूती कपड़े – विशिष्टि**

*( आई एस 514 का चौथा पुनरीक्षण )*

*Draft Indian Standard*

**TEXTILES — MERCERIZED COTTON FABRICS FOR COVERING  
AIRCRAFTS AND GLIDERS — SPECIFICATION**

*( Fourth Revision of IS 514 )*

ICS: 59.080.30

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Textile Materials for Aerospace Purposes  
Sectional Committee, TXD 13

last date for receipt of comments is  
23 November 2024

**FOREWORD**

*(Formal clauses will be added later)*

The second revision of this standard was published in the year 1978 and was subsequently revised in 1992. This standard has been revised to incorporate the following changes:

- Tolerance to ends and picks per dm has been modified;
- Amendment has been incorporated;
- References to Indian Standards have been updated;
- Marking clause has been modified;

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**1 SCOPE**

**1.1** This standard prescribes the requirements of four grades of mercerized cotton fabrics for covering aircraft and glider surfaces such as wings, fuselage, ailerons, elevators and other airfoil surfaces.

## **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 MANUFACTURE**

### **3.1 Yarn**

The cotton yarn used shall be combed, evenly spun and preferably mercerized, and it shall be free from leaf particles, neps, snarls, slubs, etc.

### **3.2 Fabric**

The fabric shall be woven in plain weave with firm and regular selvages. It shall be calendared and mercerized (if yarn used is not mercerized). The calendaring shall be sufficient to lay any nap present to provide smooth and even surface. Nap, if present, shall be removed by singeing.

**3.2.1** The fabric shall be rot-proofed or finished for doping as required by the buyer.

### **3.3 Rot-Proofing**

The fabric shall be rendered rot-proofed by treating with pentachlorophenyl laurate (PCPL), (normal process) in accordance with IS 11662.

## **4 REQUIREMENT**

**4.1** The fabric shall conform to the requirements specified in Table 1 and Table 2.

### **4.2 Dimensions**

Unless otherwise specified, the length and width of the fabric shall be as given in Table 1.

**4.3** If required by the buyer, the fabric, after dope finish shall withstand the tests and corresponding requirements given in Annex B.

#### 4.4 Sealed Sample

If in order to determine characteristics such as appearance, smoothness and other requirements not covered under this standard, a sample has been agreed and sealed, the supply shall also conform to the sealed sample in such respects.

**4.4.1** The custody of sealed sample shall be a matter of prior agreement between the buyer and the seller.

#### 5 INSPECTION

**5.1** The cloth shall be inspected by the method given in Annex C. The permissible number of defects shall be 1 major and 3 minor per 20 metres of continuous fabric length.

NOTE — When calculating from the observed number of defects in a roll of fabric, the number of defects per 20 m shall be rounded off to the nearest whole number.

**Table 1 Physical Requirements of Air Craft Fabrics**

(Clause 4.1 and 4.2)

Sl No.	Grade	Length	Width	Nominal Count of Yarn (for Guidance only)		Ends/ dm Min	Picks/ dm Min	Mass, Max	Breaking Load on 5 cm × 20 cm Strips, Min	Suitable for Aircraft Surface with Wind Loading
				Wrap	Weft					
			mm	tex (cotton count)	tex (cotton count)			g/m <sup>2</sup>	N	N/m <sup>2</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	1	50 m unless otherwise specified	900 ± 12 or 1100 ± 15 or 1500 ± 25 or as specified in the contract or order	10 tex × 2 (60s/2)	10 tex × 2 (60s/2)	330	330	140	715	431 and above
ii)	2			10 tex × 2 (60s/2)	10 tex × 2 (60s/2)	330	330	140	530	382 to 430
iii)	3			10 tex (60s)	8.5 tex (70s)	390	390	100	440	Up to 382
iv)	4			10 tex (60s)	9 tex (65s)	380	380	85	295	
Tolerance		—	—	—	—			—	—	—
Methods of Test, Ref to		—	IS 1954	IS 1315		IS 1963		IS 1964	IS 1969 (Part 1)	—

**Table 2 Chemical Requirements of Aircraft Fabric**

(Clause 4.1)

SI No.	Characteristics	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	pH value	6.0 to 8.0	IS 1390
ii)	Sizing, finishing, other non-fibrous materials, percent, <i>Max</i>	3.5	IS 199
iii)	Rot-proofness: Pentachlorophenyl laurate content, percent	1.7 to 2.5	IS 3522 (Part 2)

## 6 PACKING

**6.1** The fabric shall be packed in roll form in such a manner so as to prevent permanent distortion and damage from exposure to moisture, weathering, etc, during transportation and storage; or according to requirements of the buyer.

## 7 MARKING

**7.1** Each package of fabric shall be marked with the following informations:

- a) Name of the fabric and grade;
- b) Length (m), width (mm);
- c) Indication of the source of manufacturer; and
- d) Lot number and date of manufacture.

### 7.2 BIS Certification Marking

The product conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the product may be marked with the Standard Mark.

## 8 SAMPLING

**8.1** Unless otherwise agreed, the procedure for sampling for testing physical and chemical characteristics shall be as given in IS 3919 and IS 5463 respectively.

(Clause 2)

### LIST OF REFFERED STANDARDS

<i>IS NO.</i>	<i>Title</i>
IS 199 : 1989	Textiles — Estimation of moisture, total size or finish, ash, and fatty matter in grey and finished cotton textile materials ( <i>third revision</i> )
IS 1390 : 2022	Textiles — Determination of pH of aqueous extract ( <i>third revision</i> )
IS 1954 : 2024	Textiles — Fabrics — Determination of Width and Length ( <i>third revision</i> )
IS 1963 : 1981	Methods for determination of threads per unit length in woven fabrics ( <i>second revision</i> )
IS 1964 : 2001	Textiles — Methods of determination of mass per unit length and mass per unit area of fabrics ( <i>second revision</i> )
IS 1969 (Part 1) : 2018	Textiles — Tensile Properties of Fabrics Part 1 Determination of Maximum force and Elongation at Maximum Force Using the Strip Method ( <i>fourth revision</i> )
IS 3522 (Part 2) : 1989	Textiles – Estimation of common preservatives – Part 2 ( <i>first revision</i> )
IS 3919 : 1966	Methods for sampling of cotton fabrics for determination of physical characteristics
IS 5463 : 2022	Methods of sampling of cotton fabrics for chemical tests ( <i>first revision</i> )
IS 6359 : 2023	Methods for conditioning of textiles ( <i>first revision</i> )
IS 11662 : 2024	Preservative Treatments of Textiles — Code of Practice ( <i>first revision</i> )

**ANNEX B**  
(Clause 4.3)

**DOPING SPECIFICATIONS AND TESTS**

**B-1 TEST FRAME**

**B-1.1** The test frame should be strong rectangular wooden frame reinforced with metal to prevent warping. It shall measure 25 cm × 25 cm internally and have 2 holes, 5 cm in diameter, bored through one of the sides. A piece of 13 mm thick 5-ply plywood with a central hole 25 mm in diameter, shall be screwed to one face (see Fig. 1). The frame shall be covered on the plywood face with linen fabric under a tension of approximately 360 gf/cm width in the warp direction and 180 gf/cm width in the weft direction.

**B-2 CONDITIONING**

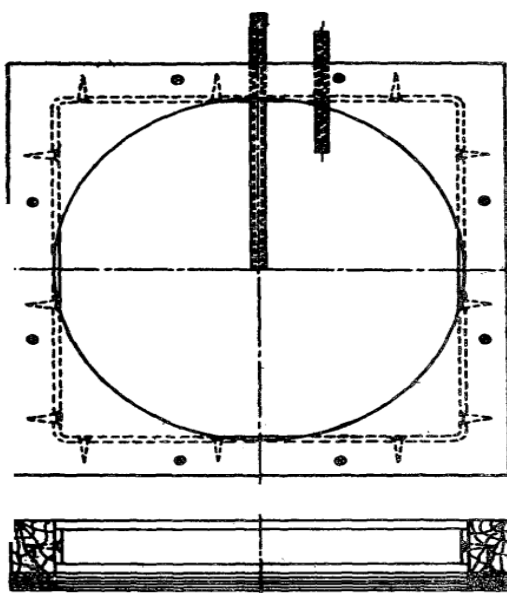


FIG. 1 TEST FRAME FOR DOPED FABRIC

**B-2.1** Condition the test specimens for the stipulated time, in the standard atmosphere (65 percent  $\pm$  2 percent relative humidity and temperature of  $27\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ).

NOTE — Guidance on conditioning is available in IS 6359.

**B-3 RESISTANCE TO HIGH TEMPERATURE**

**B-3.1** The number of test specimens shall be one for each tautening dope included in the doping scheme in addition to the one for complete doping scheme.

### B-3.2 Procedure

Apply tautening dope uniformly on each of the test specimens held on individual test frames (*see C-1.1*) to impart the coating mass of  $120 \text{ g/m}^2 \pm 15 \text{ g/m}^2$  when measured after drying to constant tautening with both the fabric surfaces freely exposed to air.

**B-3.2.1** Apply the complete doping scheme (*see Table 3*) to the test specimen meant for it,

**B-3.2.2** Cut a strip  $15 \text{ cm} \times 2.5 \text{ cm}$  Min in the warp direction from each of the doped test specimens and heat it for 4 days (96 hours, *Min*) at a temperature of  $95 \text{ }^\circ\text{C}$  *Min*, cool to room temperature and bend it along weft around a mandrel moving the strip through minimum of 15 cm over it during bending operation. The diameter of the mandrel shall be 3.2 mm in the case of black finish and 1.6 mm in other cases.

**B-3.3** There shall be no sign of cracking of the dope film(s).

**Table 3 Doping Specifications**  
(*Clause B-3.2.1*)

SI No.	Description of Components	Tautnes					
		Low		Medium		High	
		Dry mass	Normal number of coats	Dry mass	Normal number of coats	Dry mass	Normal number of coats
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
a)	<i>For all finishes other than aluminium</i>	$\text{g/m}^2$		$\text{g/m}^2$		$\text{g/m}^2$	
i)	Red oxide tautening dope	—	—	$68.0 \pm 13.5$	3	$25.5 \pm 5.0$	1
ii)	Transparent tautening dope	$68.0 \pm 13.5$	3 or 4	—	—	$61.0 \pm 32.0$	6 or 7
iii)	Aluminium non-tautening finish	$34.0 \pm 7.0$	2	—	—	—	—
iv)	Aluminium tautening dope	—	—	$34.0 \pm 7.0$	2	$34.0 \pm 7.0$	2
v)	Pigmented non-tautening finish (Note 1)	$34.0 \pm 7.0$	1 or 2	$34.0 \pm 7.0$	1 or 2	$34.0 \pm 7.0$	1 or 2
vi)	Transparent non-tautening finish (Note 2)	$34.0 \pm 7.0$	1 or 2	$34.0 \pm 7.0$	1 or 2	$34.0 \pm 7.0$	1 or 2
b)	<i>For an aluminium finish</i>						
i)	Red oxide tautening dope	—	—	$102.0 \pm 20.5$	4	$25.5 \pm 5.0$	1
ii)	Transparent tautening dope	$68.0 \pm 13.5$	3 or 4	—	—	$195.0 \pm 39.0$	8
iii)	Aluminium non-tautening finish	$34.0 \pm 7.0$	2	$34.0 \pm 7.0$	2	$34.0 \pm 7.0$	2
iv)	Transparent non-tautening finish (Note 2)	$34.0 \pm 7.0$	1 or 2	$34.0 \pm 7.0$	1 or 2	$34.0 \pm 7.0$	1 or 2
NOTES							

1 For colour and finish matching purposes only, a mass addition of not more than 68 g/m<sup>2</sup> shall be permitted for yellow, white and sky-blue finishes.  
2 Only when a glossy finish is required.

## **B-4 RESISTANCE TO NATURAL WEATHERING**

**B-4.1** There shall be only one specimen for this test, protected at the back of the frame with a covering of waterproof material.

### **B-4.2 Procedure**

**B-4.2.1** Freely expose the frame to maximum sunlight in the open for 6 months including at least 2 months from the period of May to August.

**B-4.2.2** During exposure period, examine the frame at least once a day for adhesion of dope, cracks, etc, and its behaviour in dry and wet weather. Also examine tautness once a week.

**B-4.2.3** After exposure for 6 months, cut from the fabric in the warp direction, 6 test specimen 2.5 cm wide and sufficient long to allow 20 cm between the jaws of a suitable tensile testing machine, condition them for 24 hours in standard atmosphere and then determine the tensile strength. Also determine, by the same method and under the same atmospheric conditions, the tensile strength of a piece of untreated fabric cut from the same length of fabric which was held on frame.

**B-4.3** There shall be no cracking, clipping, flaking or blistering of the film, slight chalking be disregarded. The change in colour shall not be too apparent and the underlying coats shall not be visible through final finishing colour. The breaking strength and tautness shall not be impaired.

## **B-5 TAUTNESS PROPERTIES**

**B-5.1** The number of test specimens shall be one each for the tautening dopes included in the doping scheme.

### **B-5.2 Procedure**

**B-5.2.1** Apply each tautening dope uniformly to the individual test specimen held on the frame to impart it a coating mass of  $120 \text{ g/m}^2 \pm 15 \text{ g/m}^2$  measured after drying to constant tautness, both the surfaces of the fabric freely exposed to air.

**B-5.2.2** Measure tautness by any approved method, however, in case of dispute the following reference method shall be used:

After conditioning the test specimen in the standard atmosphere for 2 hours, minimum, fit the frame with an air-tight back in a conditioned room. Connect it, through the holes at its side, to a suitable manometer and a water pump, adjusted to reduce the air pressure inside the frame by 5 cm H<sub>2</sub>O, including a large air reservoir to smooth out variations in the



pressure. Measure the resulting depression ( $d$ ) at the centre of the circle of unsupported fabric, using any instrument accurate to read in 0.025 mm units and that does not impose a load exceeding 5 g on the area of unsupported fabric.

The tautness ( $T$ ) in the doped fabric is given by the equation:

$$T = \frac{2}{d} \text{ kgf/cm}^2$$

Where,  $d$  is depression read in millimetres.

**B-5.2.3** Determine the mass of added dope by the following method:

Cut minimum area of 250 cm<sup>2</sup> from the circle of unsupported doped fabric. Weigh it, remove the dope by suitable solvents and weigh it again. Record the difference in mass ( $A$ ). Cut a piece of undoped fabric of the same area from the same length as was used to cover the test frame. Weigh it, apply the same solvent treatment as before under the same atmospheric conditions and weigh it again. Record the difference in mass ( $B$ ); apply ( $B$ ) as a correction to ( $A$ ) and calculate the mass in g/m<sup>2</sup> of the dope.

**B-5.3** The tautness acquired by the mercerized fabric shall be 0.002 kgf/cm<sup>2</sup> to 0.003 kgf/cm<sup>2</sup> per g/m<sup>2</sup> of the dope in case of low doping and 0.003 kgf/cm<sup>2</sup> to 0.004 kgf/cm<sup>2</sup> per g/m<sup>2</sup> of the dope for medium and high doping.

## **B-6 FREEDOM FROM FILM DEFECTS**

### **B-6.1 Testing Atmosphere**

The test shall be conducted at

- a) Relative humidity of 65 percent to 70 percent.
- b) Temperature of 25 °C to 29 °C, and
- c) Air speed of a 1 m/s.

### **B-6.2 Procedure**

**B-6.2.1** Condition the test frames, samples of the dopes and finishes to be tested, and the brushes to be used for application in the testing atmosphere in **B-6.1** for 2 hours, *Min.*

**B-6.2.2** Dope the fabric with the materials as follows:

- a) Apply by brush application, one full coat of each taughtening dope included in the doping scheme to an individual test piece.

- b) When testing non-tautening finishes, apply one full coat of the finish, thinning wherever appropriate, to a test piece previously tautened with the doping scheme in accordance with Table 3.

**B-6.2.3** Allow to dry under the test conditions and then examine visually.

**B-6.3** The dopes shall be free from blushing, wrinkling, gubbling, etc

## **B-7 KEEPING QUALITIES**

**B-7.1** The doped mercerized fabric stored in the original sealed condition shall retain its original properties for a minimum of 6 months in tropical climate and minimum of 12 months in temperate climate.

**ANNEX C**  
(Clause 5.1)

**INSPECTION AND TAGGING OF DEFECTS**

**C-1 INSPECTION**

**C-1.1** Each cut shall be inspected under transmitted light for defects by passing the fabric, metre by metre, over light rails or an artificial light table.

**C-2 CATEGORIES OF DEFECTS**

**C-2.1 Major Defects**

The following shall constitute major defects:

- a) Bad floats of more than one end or more than one picks;
- b) Bad slubs (warp or weft);
- c) Weft snarls;
- d) Thin places (due to starting or stopping the loom or rip cuts);
- e) Broken ends or picks;
- f) Torn or wavy selvages;
- g) Holes;
- h) Spots of oil, and
- J) Such other defects as are obviously detrimental to strength, durability or use of the fabric.

NOTE — Such of the above defects as are obviously not detrimental to strength, durability or use of the fabric, shall be considered as minor defects.

**C-2.2 Minor Defects**

The following shall constitute as minor defects:

- a) Neps;
- b) Small slubs;
- c) Small snarls;
- d) Loose ends;
- e) Single end cut; and
- f) Such other defects as are obviously not detrimental to strength, durability or use of the fabric.

**C-3 TAGGING**

**C-3.1** All major defects shall be tagged by sewing red thread in the selvedge opposite the defects.

**C-3.2** All minor defects shall be tagged by sewing blue thread in the selvedge opposite the defects.

**C-3.3** All tags shall be affixed only on one side of the roll.