*भारतीय मानक* **IS 2196 : 2024**

***Indian Standard***

# वस्त्रादि — वायु आकाशीय प्रयोजनों के लिए लिनन (फ्लैक्स) का सिलाई धागा — विशिष्टि

*( तीसरा पुनरीक्षण )*

# Textiles — Linen (Flax) Sewing Thread for Aerospace Purposes — Specification

*( Third Revision )*

ICS 49.025.60



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**October 2024** **Price Group 7**

Textile Materials for Aeronautical and Related Products Sectional Committee, TXD 13

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Textile Materials for Aeronautical and Related Products Sectional Committee had been approved by the Textiles Division Council.

This Standard was first published in 1962 and subsequently revised in 1966 and 1985. This revision has been brought out in the light of experience gained since its publication and to incorporate the following major changes:

a) Breaking strength for unwaxed and waxed varieties has been modified;

b) Tolerance for the universal count of sewing thread has been modified;

c) Marking clause has been updated; and

d) References to standards have been updated.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

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 or analysis, 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.

*Indian Standard*

# TEXTILES — LINEN (FLAX) SEWING THREAD FOR AEROSPACE PURPOSES — SPECIFICATION

*( Third Revision )*

## 1 SCOPE

This standard specifies the constructional details and other particulars of three varieties of linen (flax) sewing thread for aerospace purposes which are to be used for all sewing operations.

## 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 these standards.

## 3 TERMINOLOGY

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

**3.1 Linen Count** — The number of 300 yard hanks per pound.

**3.2 Universal Count, in tex** — A number indicating the mass in grams of one kilometre length of yarn.

## 4 CONDITIONING AND TESTING

**4.1** Unless otherwise specified in the individual test procedure, all test samples or specimens cut therefrom shall be freely exposed in standard atmosphere of 65 percent ± 2 percent relative humidity and a temperature of 27 °C ± 2 °C for not less than 24 h (*see* IS 6359).

**4.2** Unless otherwise specified in the individual test procedure, the conditioned test specimens as obtained in **4.1** shall be tested in the standard atmosphere of 65 percent ± 2 percent relative humidity and 27 °C ± 2 °C temperature.

## 5 GENERAL REQUIREMENTS

### 5.1 Yarn

The sewing thread shall be manufactured from linen (flax fibre) (Linum usitatissimum) and shall be evenly spun. It shall be uniform in thickness throughout and shall be reasonably free from defects, such as slubs, knots, kinks, projections, broken or loose ends and other manufacturing imperfections which would affect its appearance or serviceability. It shall work satisfactorily in hand or power-driven sewing machines.

## 6 FINISH

### 6.1 General

The thread shall be supplied in one of the following conditions:

a) undyed and rot-proofed;
b) undyed, rot-proofed and wax finished;
c) dyed and rot-proofed; and
d) dyed, rot-proofed, and wax finished.

### 6.2 Rot-proofing

The thread shall be treated with pentachlorophyenyl laurate (PCPL) from aqueous emulsion according to the procedure given in Annex B.

### 6.3 Dyeing

**6.3.1** If the thread is required to be dyed, it shall be dyed with suitable dyes to shades as agreed to between the buyer and the seller.

**6.3.2** Sulphur dyes shall not be used.

**6.3.3** Dyes known to accelerate actinic damage shall not be used.

NOTE — The following are the colour index numbers of some of the dyestuffs that are known to accelerate actinic damage:

a) Vat yellow 2, 3, 4, 9, 11, 14, 18, 21, 26 and 28;
b) Vat orange 1, 2, 5, and 9;
c) Vat reds l, 2, 42, 47 and 48;
d) Vat brown 5; and
e) Vat violet 2.

**6.3.4** The dyed thread shall meet the requirements of colour fastness to light and washing as given in Table 1.

### 6.4 Wax Finishing

**6.4.1** Where wax finishing of the thread is required, bees wax substitute micro-crystalline hydrocarbon wax shall be used and the mass added by the wax finishing shall be 20 percent ± 5 percent.

**6.4.1.1** Prior to waxing, the threads shall have been rot-proofed in accordance with **6.2**.

### 6.5 Surface Finish

Thread supplied in accordance with **6.1 (a)** or **6.1 (c)** shall have a soft and smooth finish but substances which may promote microbiological growth (for example, starch or modified starch) shall not be applied.

### 6.6 Residual Alkali Solubility

The residual alkali solubility of the sewing thread, when determined according to method given in Annex C, shall not exceed 10 percent.

### 6.7 *p*H of Aqueous Extract

The *p*H of the aqueous extract of the thread when tested according to IS 1390 shall be 6.0 to 8.5.

## 7 CONSTRUCTION AND OTHER REQUIREMENTS

**7.1** The thread shall comply with the requirements given in Table 2 unless vat dyed thread is supplied in which case the minimum breaking strengths given in Table 2 shall be reduced by 10 percent.

### 7.2 Balance of Twist

When approximately 1.5 m length of sewing thread is extended between the hands and the ends brought together slowly, the loop so formed shall not kink, double or re-twist. A maximum of 5 turns in the loop shall, however, be permissible.

## 8 SEALED SAMPLE

If, in order to illustrate or specify, the type of finish, feel, etc, of sewing thread, a sample as agreed upon between the buyer and the seller shall be sealed, the supply shall be in conformity with the sample in such respects.

**Table 1 Colour Fastness Ratings**

(*Clause* 6.3.4)

| Sl No. | Characteristic | Requirement | Method of Test, Ref to |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| i) | Colour fastness to:<br>a) Light | 5 or better | IS/ISO 105-B02 |
| | b) Washing, test C (3) | 4 or better | IS/ISO 105-C10 |

**Table 2 Constructional Particulars of Linen (Flax) Sewing Thread for Aerospace Purposes**

(*Clause* 7.1 *and* D-5)

| Sl No. | Variety No (*see* Note 1) | Universal Count in Tex (or Linen Count) | Direction of Twist | Length, in m/kg of Finished Thread | Breaking Strength, on 50 cm Test Length of Finished Thread, N, *Min* | |
|---|---|---|---|---|---|---|
| | | | | | Unwaxed | Waxed |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| i) | 1 or 1R | 92 tex × 3 (or 18s/3) | S/Z | 3 620 ± 170 | 75 | 60 |
| ii) | 2 or 2R | 42 tex × 3 (or 40s/3) | S/Z | 7 940 ± 340 | 36 | 30 |
| iii) | 3 or 3R | 92 tex × 8 (or 18s/8) | Z/S | 1 360 ± 80 | 225 | 190 |
| **Tolerance** | | ± 10 percent | — | — | — | — |
| **Method of Test, Ref to** | | IS 1315 for universal count (for linen count *see* Note 2) | — | Annex D | IS 1670 | |

NOTES

**1** The suffix R indicates that the thread has been rot-proofed.

**2** For converting universal count in tex to linen count divide 1 654 by the value obtained for universal count in tex.

## 9 IDENTIFICATION

The thread shall be identified for ordering purposes by the number of this Indian Standard together with the finish and, if required, dyed the colour. This identification may be codified. For example, thread required dyed khaki and rot-proofed may be identified as Indian Standard 2196/ Khaki/PCPL.

## 10 PACKAGING

Linen sewing thread shall be compactly wound in the form of reels, cheeses, etc, as agreed to between the buyer and the seller in lengths of 500 m.

## 11 MARKING

**11.1** All packages shall be wrapped in kraft paper and marked with the following information:

a) Name of the material;

b) Variety No.;

c) Length;

d) Colour fastness ratings in the case of dyed thread;

e) Manufacturer's name, initials or trade-mark; and

f) Month and year of manufacture.

### 11.2 BIS Certification Marking

The product(s) 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 there under, and the products may be marked with the Standard Mark.

**11.3** For sewing threads supplied in packages of 250 g and above, the marking shall be on each individual package. Packages less than 250 g shall be boxed and the markings shall be on the outside of the box.

## 12 PACKING

**12.1** Unless otherwise agreed to between the buyer and the seller, the sewing threads shall be packed as given in **12.2**.

**12.2** The packages shall be packed in cardboard cartons or wooden cases of suitable size. The weight of a cardboard carton or wooden case, when packed, shall not exceed 50 kg.

## 13 SAMPLING

### 13.1 Lot

The quantity of linen sewing thread of the same variety and quality delivered to a buyer against one despatch note shall constitute a lot.

**13.2** The conformity of a lot to the requirements of this standard shall be determined on the basis of the tests carried out on the samples selected from the lot.

**13.3** Unless otherwise agreed to between the buyer and the seller, the number of reels, cheeses, etc, to be selected at random from the lot shall be in accordance with col (2) of Table 3.

**13.4** The reels, cheeses, etc., selected according to **13.3** shall constitute the test sample for all the requirements except colour fastness. One test specimen shall be selected from each of the reels, cheeses, etc, selected for carrying out the test for each requirement.

**13.5** The number of test specimens to be selected at random for testing colour fastness from the test sample shall be 3.

## 14 CRITERIA FOR CONFORMITY

The lot shall be considered to be in conformity with the requirements of this standard, if the following conditions are satisfied:

a) None of the test specimens is found defective when tested for the requirement mentioned in **7.2**.

b) None of the test specimens tested for colour fastness shall fail to satisfy the corresponding requirements.

c) From the results in respect of any of the requirements, namely, count, length per kilogram, breaking strength, wax finishing, rot-proofing, pH of aqueous extract and residual alkali, the average x and the range R or the mean range R are calculated and the applicable condition(s) from amongst those given below is/are satisfied:

1) The value of the expression $\bar{X} + k\bar{R}$ or $\bar{x} + kR$ is less than or equal to U where the upper specification limit U is given.

2) The value of the expression $X — \bar{x}R$ or $\bar{X} — k\bar{R}$ is greater than or equal to $L$ where the lower specification limit $L$ is given.

3) If both the upper and lower specification limits $U$ and $L$ are given, the conditions (1) and (2) as well as the following conditions are satisfied.

The value of the expression

$$\frac{R}{U-L} \text{ or } \frac{\bar{R}}{U-L} \leq B$$

NOTES

**1** The constant $k$ and $B$ shall be as given below:

| *Sl No.* | *No. of Test Result* (n) | $k$ | $B$ |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| i) | less than 10 | 0.6 | 0.8 |
| ii) | 10 or 15 | 0.7 | 0.6 |

**2** Average $\bar{X}$s the value obtained by dividing the turn of the observed values by the number of tests.

**3** Range $R$ is the difference between the maximum and the minimum in a set of observed values.

**4** When the number of test results is 10 or 15, they shall be grouped in groups of 5. The mean range $\bar{R}$is the value obtained by taking the average of the groups.

**Table 3 Sample Size**

(*Clause* 13.3)

| Sl No. | Lot Size (Reels, Cheeses, etc) | Sample Size Number of Reels or Cheeses to be Selected |
|---|---|---|
| (1) | (2) | (3) |
| i) | Up to 150 | 3 |
| ii) | 151 to 300 | 5 |
| iii) | 301 to 500 | 7 |
| iv) | 501 to 1 000 | 10 |

## ANNEX A

(*Clause* 2)

## LIST OF REFERRED STANDARDS

| *IS No.* | *Title* |
|---|---|
| IS/ISO 105-B02 : 2014 | Textiles — Tests for colour fastness: Part B02 Colour fastness to artificial light: Xenon arc fading lamp test |
| IS/ISO 105-C10 : 2006 | Textiles — Tests for colour fastness: Part C10 Colour fastness to washing with soap or soap and soda |
| IS 296 : 2023 | Sodium carbonate, anhydrous — Specification (*fourth revision*) |
| IS 1070 : 2023 | Reagent grade water — Specification (*fourth revision*) |
| IS 1315 : 1977 | Method for determination of linear density of yarns spun on cotton system (*first revision*) |
| IS 1390 : 2022/ ISO 3071 : 2020 | Textiles — Determination of *p*H of aqueous extract (*third revision*) |
| IS 1670 : 1991 | Textiles — Yarn — Determination of breaking load and elongation at break of single strand (*second revision*) |
| IS 3522 (Part 1) : 1989 | Methods for estimation of common preservatives on textiles: Part 1 (*first revision*) |
| IS 6359 : 2023 | Method for conditioning of textiles (*first revision*) |

## ANNEX B

(*Clause* 6.2)

## PROCEDURE AND TEST METHOD FOR ROT-PROOFING BY PENTACHLOROPHENYL LAURATE

**B-1 PERSERVATIVE AGENT** — The preservative agent shall be pentachlorophenyl laurate.

**B-2 APPLICATION** — The process shall consist of an even and thorough impregnation of the textile with either:

a) a solvent solution of agent; or
b) an aqueous emulsion of the agent.

This shall be followed by removal of excess and subsequent drying or thorough solvent removal. The treated textile shall be dry in handling and non-tacky.

**B-2.1 Amount of Preservative Agent** — The amount of preservative agent shall be as follows.

The pentachlorophenyl laurate content of the treated textile shall be not less than 1.7 percent nor more than 3.5 percent.

**B-2.2** In neither case shall the free PCP content of the treated textile exceed 10 percent of the pentachlorophenyl laurate content.

### B-3 DETERMINATION OF PENTACHLOROPHENYL LAURATE (PCPL) CONTENT

#### B-3.1 General

The method is applicable to the determination of PCPL in the absence of added pentachlorophenol. The proofing is hydrolyzed, acidified and steam distilled and the pentachlorophenol in the distillate extracted with 1,1,1 trichloroethane and complexed in 1,1,1 trichloroethane is measured on a suitable spectrophotometer at 450 nm.

#### B-3.2 Reagents

**B-3.2.1** *Ethanediol* (*Ethylene glycol*)

**B-3.2.2** *1,1,1-Erichloroethane*

**B-3.2.3** *Pyridine* (*AR, GRP Grade*)

**B-3.2.4** *Sodium Hydroxide, Pellet*

**B-3.2.5** *Copper Sulphate Reagent Solution 50 g/1*

**B-3.2.6** *Pentachlorophenol* (*Standard Reagent, Melting Point* 188 °C *minimum*)

**B-3.2.7** *Hydrochloric Acid* — concentrated 36 percent, (m/v) (11M)

**B-3.2.8** *Copper Sulphate-pyridine Reagent Solution* — prepared by mixing 4 ml pyridine with 6 ml copper sulphate solution immediately before use.

#### B-3.3 Procedure

Weigh 2.5 g ± 0.05 g of the material, cut into small pieces of not more than 5 mm square and place in a dry 250 ml round bottomed flask (B24/29 socket). Add 30 ml of ethanediol, 4 g of sodium hydroxide (pellet form), 2.4 ml of water, in that order and a few anti bumping granules. Connect the flask with a double surface condenser, bring the contents to boiling point on a sand bath and boil them vigorously for 30 min under reflex. After this allow the contents of the flask to cool, remove the reflux condenser and add through a funnel 60 ml water followed by 20 ml hydrochloric acid. Steam distil the contents of the flask ensuring that a constant volume is maintained by applying gentle heat as necessary. Collect 300 ml of distillate in a suitable receiver, applying care to prevent loss of pentachlorophenol in the distillate by adequate cooling. Discontinue the external heating of the flask a few minutes before disconnecting the steam supply. Disconnect the condenser and fit it vertically over the distillate receiver. Wash down the condenser with 25 ml to 30 ml of trichloroethane and collect the washings in the distillate. Transfer the distillate and trichloroethane washing to a 500 ml separating funnel and shake thoroughly. Allow the layers of water and trichloroethane to separate completely before running off the trichloroethane layer into a 100 ml separating funnel. Wash the condenser and distillate receiver with a further 25 ml to 30 ml trichloroethane and add this to the aqueous solution into the 500 ml separating funnel. Repeat the extraction as given above and add the trichloroethane layer to the first trichloroethane extract in the 100 ml separating funnel. Add to the

bulked trichloroethane extract 10 ml of copper sulphate-pyridinc reagent and shake well. After complete separation of the aqueous and trichloroethane layers, run the lower trichloroethane layer into a 100 ml volumetric flask via a small funnel containing anhydrous sodium sulphate supported by means of a quartz wool plug. Add small quantity of trichloroethane to the copper sulphate-pyridine solution remaining in the separating funnel, shake and allow the layers to separate. Filter the trichloroethane layer through quartz wool plug and collect in the volumetric flask. Wash the filter with further small quantities of trichloroethane and finally make up to 100 ml trichloroethane.

Determine the optical density of the solution using a suitable spectrophotometer at 450 nm using trichloroethane as a blank. Estimate the PCPL content by reference to a calibration graph prepared from known standards of pentachlorophenol (1.0 percent pentachlorophenol 1.71 percent PCPL).

NOTE — If the proofing is expected to contain both pentachlorophenol and PCPL then the free pentachlorophenol content should be determined as given in IS 3522 (Part 1), and the amount found deducted from the apparent PCPL content.

**B-3.4 Calibration**

**B-3.4.1 Direct**

Prepare a calibration graph using 5 ml, 10 ml, 15 ml aliquots of a standard solution of pentachlorophenol reagent (1 g/200 ml) in trichloroethane to cover a range of 1 percent, 2 percent and 3 percent, respectively. Dilute each aliquot to 50 ml to 60 ml with trichloroethane, and 10 ml of copper sulphatepyridine reagent, shake well and then follow the described procedure. Plot optical density against concentration of PCPL.

**B-3.4.2 Indirect**

Prepare a calibration graph using 5 ml, 10 ml and 15 ml aliquots of a standard solution of pentachlorophenol reagent (1 g/200 ml) in dilute sodium hydroxide solution (sufficient for complete solution of pentachlorophenol). Place each aliquot in a round bottomed flask, add 60 ml water and 20 ml hydrochloric acid. Fit the flask for steam distillation and then follow the described procedure. If the distillation technique is satisfactory then the graphs obtained as in **B-3.4.1** and **B-3.4.2** should be the same.

## ANNEX C

(*Clause* 6.6)

## DETERMINATION OF RESIDUAL ALKALI SOLUBILITY

### C-1 TEST SPECIMENS

For the purpose of this test approximately 10 g of sewing thread, taken from each reel or cheese in the test sample (*see* **13.4**) shall constitute the test specimens.

### C-2 APPARATUS

**C-2.1 Buchner Funnel** — about 15 cm diameter

**C-2.2 Reflux Condenser**

**C-2.3 Flask, 500 ml Capacity, with Ground Glass Joint**

**C-2.4 Filter Paper Hardened**

**C-2.5 Stoppered Weighing Bottles, Three, Tared and Dry**

### C-3 REAGENTS

**C-3.1 Quality of Reagents**

Unless otherwise specified, pure chemicals shall be employed in tests and distilled water (*see* IS 1070) shall be used where the use of water or distilled water as a reagent is intended.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the experimental results.

**C-3.2 Sodium Carbonate** — anhydrous, conforming to IS 296

### C-4 PROCEDURE

**C-4.1** Divide one test specimen into approximate three equal portions. Weigh them separately in dry stoppered weighing bottles. Take 250 ml of a five percent solution of anhydrous sodium carbonate in distilled water, in a 500 ml conical flask fitted with a reflux condenser and bring to boil. Add the first portion of the test specimen kept in one of the weighing bottles to the boiling solution and continue the boiling gently for two and a half hours. Pour out the liquid and filter it through a hardened filter paper on a Buchner funnel. Wash the test specimen four times by decantation with 200 ml of hot distilled water and filter the washings through the filter. Transfer the test specimen to the filter. Wash three times with 200 ml of distilled water and dry in a water heated oven at 98 °C for about an hour. Transfer the test specimen along with any fragment of fibre detachable from the filter paper to the weighing bottle and dry to constant weight in an oven at 105 °C to 110 °C.

**C-4.2** Treat the second portion of the test specimen in the same way as the first portion excepting that distilled water shall be used instead of sodium carbonate solution.

**C-4.3** Dry the third portion to constant weight in an oven at 105 °C to 110 °C.

**C-4.4** Calculate the percentage loss in weight produced by the carbonate, boil and distilled water boil on the basis of oven dry weight. The difference between these two expressed as percentage of oven dry weight is the percentage alkali solubility of the test specimen.

**C-4.5** Determine similarly the alkali solubility of the remaining test specimens.

### C-5 REPORT

Report the lot to be in conformity with the requirements of **6.6** if the test value satisfies the condition prescribed in **14(c) (1)**.

## ANNEX D

(*Table 2*)

## METHOD FOR DETERMINATION OF LENGTH IN METRES PER KILOGRAM

### D-1 TEST SPECIMENS

For the purpose of this test, all reels, cheeses, etc, in the sample under test (*see* **13.4**) shall constitute the test specimens.

### D-2 CONDITIONING OF TEST SPECIMENS

Prior to test, specimens shall be conditioned in a standard atmosphere of 65 percent ± 2 percent relative humidity and 27 °C ± 2 °C temperature (*see* IS 6359) for 24 h.

### D-3 APPARATUS

**D-3.1 Wrap Reel** — equipped with a dial showing the number of revolutions and to wind precisely one metre per revolution.

**D-3.2 Analytical Balance**

### D-4 PROCEDURE

**D-4.1** Place one reel, cheese, etc, constituting the test specimen on the wrap reel and wind 100 m of sewing thread. Apply sufficient tension on the thread during winding so as to keep it tight without stretching it. Remove the thread so wound from the wrap reel and determine its weight in grams.

**D-4.2** Calculate the length in metres per kilogram by the following formula:

$$\text{Length, in m per kg} = \frac{100 \times 1\,000}{W}$$

where

$W$ = mass, in g, of 100 m of sewing thread.

**D-4.3** Repeat the test with the remaining reels, cheeses, etc, in the test specimen.

### D-5 REPORT

Report the lot to be conformity with the relevant requirement of Table 2 if the test value satisfies the conditions prescribed in **14(c) (1), (2)** and **(3)**.

## ANNEX E

(*Foreword*)

## COMMITTEE COMPOSITION

Textile Materials for Aeronautical and Related Products Sectional Committee, TXD 13

| *Organization* | *Representative(s)* |
|---|---|
| Aerial Delivery Research and Development Establishment (DRDO), Agra | DR MANOJ KUMAR **(*Chairperson*)** |
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**Bureau of Indian Standards**

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**Review of Indian Standards**

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: TXD 13 (24777).

## Amendments Issued Since Publication

| Amend No. | Date of Issue | Text Affected |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

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