

वस्त्रादि — सूक्ष्म जीवों के आक्रमण प्रतिरोध
के लिए पटसन डोरियों के परीक्षण की
पद्धति
(दूसरा पुनरीक्षण)

**Textiles — Method for Testing Jute
Cordages for Resistance to Attack
by Micro-organisms**

(*Second Revision*)

ICS 59.060.10

© BIS 2024



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Chemical Methods of Test Sectional Committee had been approved by the Textiles Division Council.

This standard was first published in 1960 and revised in 1979. Jute cordages are liable to deterioration by micro-organisms. Since they are often stored, transported and used under conditions favorable for the growth of micro-organisms, various preservative treatments have been developed and their number is constantly increasing and hence, the need for standard methods for testing resistance of the cordage to attack by micro-organisms.

This second revision has been brought out in the light of experience gained since its last revision and to incorporate the following changes:

- a) Apparatus and reagents has been updated;
- b) Aperture size has been updated; and
- c) References to the Indian Standards have been updated.

Two methods are prescribed in this standard, namely: (a) Mixed culture inoculation method and (b) Soil incubation method. In the first method, a mixture of spores of five different fungi, which are frequently the cause of deterioration of jute cordages, is used. In the second method, the cordage is subjected to the action of a much greater variety of microorganisms, both fungi and bacteria, normally found in the soil. The first method serves to assess the behavior of jute cordages under exposure to humid and warm atmosphere whereas the second method serves to assess their behavior under conditions of contact or contamination with soil. Since, often a combination of the above two conditions exists in practice in relation to the use of the cordages, the assessment is based on testing by both the methods.

Assistance has been taken from research work carried out by the Indian Jute Industries Research Association (IJIRA). To facilitate supply, the culture numbers, as set out below should be mentioned:

<i>Sl No.</i>	<i>Species</i>	<i>Culture No.</i>
(1)	(2)	(3)
i)	<i>Chaetomium indicum</i> Corda	75
ii)	<i>Curvularia lunata</i> (Wakker) Boedijn	10
iii)	<i>Aspergillus fumigatus</i> Fresenius (<i>see Note</i>)	14
iv)	<i>Penicillium rubrum</i> Stoll	127
v)	<i>Penicillium wortmanni</i> Klocker	130.64

NOTE — *Aspergillus fumigatus* Fresenius has been found to cause infection of lungs and of external ear in human beings. Great care should, therefore, be taken in handling the organism not to inhale the spore dust from the culture tube when preparing the mixed spore suspension (*see Annex B*).

The methods prescribed in this standard can also be used for evaluating preservatives or treatments designed to protect jute cordages from damage by micro-organisms. In such cases, the preservative or treatment has to be applied to a uniformly good quality jute cordage by the procedure recommended by the supplier or the originator and the treated cordage then tested.

The composition of the Committee responsible for the formulation of this standard is given in [Annex D](#).

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 : 2022 'Rules for rounding off numerical values (*second revision*).

*Indian Standard***TEXTILES — METHOD FOR TESTING JUTE CORDAGES FOR RESISTANCE TO ATTACK BY MICRO-ORGANISMS***(Second Revision)***1 SCOPE**

This standard prescribes two methods for evaluating jute cordages for resistance to attack by micro-organisms.

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 edition of these standards.

<i>IS No.</i>	<i>Title</i>
IS 460 (Part 1) : 2020	Test sieves — Specification: Part 1 Wire cloth test sieves (<i>fourth revision</i>)
IS 6359 : 2023	Method for conditioning of textiles (<i>first revision</i>)

3 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

3.1 The tests shall be carried out under the conditions laid down in respective test procedures. However, the specimens for breaking load testing shall be conditioned and tested in the standard atmosphere of 65 percent \pm 2 percent relative humidity and 27 °C \pm 2 °C temperature (*see IS 63*).

3.2 When the specimens have been left in such an atmosphere for 24 h in such a way as to expose, as far as possible, all portions of the specimens to the atmosphere, they shall be deemed to have reached moisture equilibrium.

4 SAMPLING

4.1 Samples shall be drawn so as to be representative of the lot. Samples drawn in accordance with the procedures laid down in material specification or as agreed to between the buyer and the seller shall be taken as representative of the lot.

4.2 From the selected samples of cordage, take a piece or pieces at least 1 500 cm in length. Cut at random 36 pieces of 25 cm length. Separate them into two sets of 18 pieces each. Mark one set to be identified as test specimens (*see Note*).

NOTE — The ends of each specimen should be tied up before carrying out the test. If the specimen is drawn from a strand, it should be given a slight twist so as to bring it back to the original condition and the ends then tied up.

4.2.1 Take the other set of 18 specimens. Coil each specimen in the form of a loose spiral and leach the specimens, one by one, according to the method given in [Annex A](#). Dry them in air. Mark each specimen to be identified as leached test specimens (*see 4.2*).

4.3 From the basic untreated cordage (*see Note*) take a piece of at least 500 cm in length. Cut at random a set of eighteen specimens 25 cm long and mark them to be identified as control specimens.

NOTE — If an authentic sample of the basic cordage is not available, a cordage similar in construction to the one under test should be used.

5 MIXED CULTURE INOCULATION METHOD**5.1 Apparatus**

5.1.1 *Small Petri Dishes* — 9, each 10 cm in diameter and without cover

5.1.2 *Large Petri Dishes* — 9, each 15 cm in diameter and 3 cm high provided with cover

5.1.3 *Atomizer* — of 10 ml capacity

5.1.4 *Vertical or Horizontal Type Strength Testing Machine*

5.2 Test Organisms

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

- Chaetomium indicum* Corda;
- Curvularia lunata* (Wakker) Boedijn;

To access Indian Standards click on the link below:

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/knownyourstandards/Indian_standards/isdetails/

- c) *Aspergillus fumigatus* Fresenius;
- d) *Penicillium rubrum* Stoll; and
- e) *Penicillium wortmannii* Klocker.

5.3 Procedure

5.3.1 Draw at random six test specimens (*see* 4.2). Condition them to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine keeping the distance between the grips of the machine at 12.5 cm. Find the average of all the values.

5.3.2 Draw at random six control specimens (*see* 4.3). Condition them to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type testing machine keeping the distance between the grips of the machine at 12.5 cm. Find the average of all the values.

5.3.3 From the leached test sample, draw at random six specimens, condition them to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine keeping the distance between the grips at 12.5 cm. Find the average of all the values.

5.3.4 Prepare, in the manner prescribed in Annex B, a mixed suspension of spores of the test organisms prescribed in 5.2.

5.3.5 Draw from the test specimens (4.2) another set of six specimens.

Carefully cut off the fibres projecting from the surface of each specimen. Take a pair of specimens and fasten them by a strand of yarn drawn from one of the specimens on the small petri dish across the middle, so that the centre of each specimen lies near the centre of the dish on its upper side (*see* Fig. 1). In a similar manner, place four specimens (in pairs) on two other small . Place each dish in a large 'petri dish. Spray by means of an atomizer approximately 1.5 ml of the mixed spore suspension (*see* Note 1) on the pair of specimens in each small petri dish. Place the petri dish assemblies in an incubator until

excess moisture is driven off (*see* Note 3). Finally cover each of the outer petri dishes. Put all the Petri dish assemblies in an incubator at $30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 21 days. At the end of this period, add a few drops of methyl alcohol on a small piece of cotton wool and place it in each of the outer dishes and allow them to rest for 2 h outside the incubator. Condition the specimens to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine keeping the distance between the grips of the machine at 12.5 cm. Find the average of all the values.

NOTES

1 Sterilization of the specimens is not necessary as it has been found that when density of the mixed spore suspension is as high as has been prescribed for this test, both sterilized and unsterilized specimens yield nearly similar results.

2 Allowing the specimens to stand overnight at $30\text{ }^{\circ}\text{C}$ would drive off excess moisture.

3 Wetting of the specimens should be avoided. The supporting thread prevents their sagging and if the fibres projecting laterally from the surface have been cut off carefully, the specimens should not get wet.

5.3.6 Draw six leached test specimens from the leached test sample (*see* 4.2.1) and test them in the manner prescribed in 5.3.6.

5.3.7 Draw six control specimens from the control sample (*see* 4.3) and test them in the manner prescribed in 5.3.6 (*see* Note).

NOTE — If the control specimens are not covered with profuse visible growth of micro-organisms, the test shall be repeated.

5.3.8 Calculate the loss in strength, percent, of the basis cordage on incubation by the following formula:

$$L = \frac{100(a-b)}{a}$$

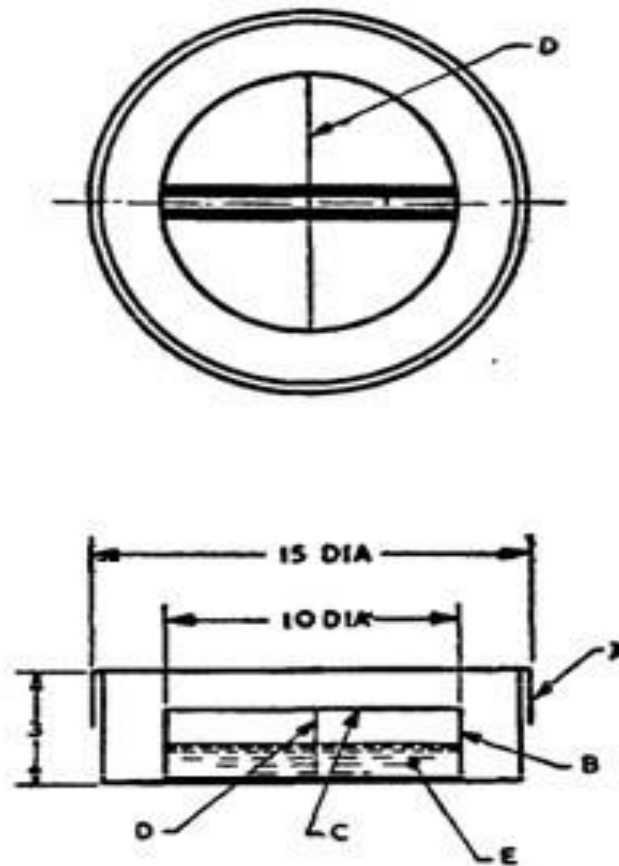
where

L = loss in strength, percent, of the basic cordage on incubation;

a = breaking strength value obtained as in 5.3.2; and

b = breaking strength value obtained as in 5.3.8.

NOTE — The value of L should be 60 percent or more. If this value is less than 60 percent, the test shall be repeated.



A — Large petri dish
B — Small petri dish
C — Specimen

D — Supporting thread
E — Water

All dimensions in centimetres.

FIG. 1 PETRI DISH ASSEMBLY

5.3.9 Calculate in the manner prescribed in [5.3.9](#), the loss in strength, percent, of the cordage under test, on incubation prior to leaching.

where

a = breaking strength value obtained as in [5.3.1](#); and

b = breaking strength value obtained as in [5.3.6](#).

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms, if the value of L does not exceed 20 percent.

5.3.10 Calculate in the manner prescribed in [5.3.9](#), the loss in strength, percent, of the cordage under test, on incubation after leaching,

where

a = breaking strength value obtained as in [5.3.3](#); and

b = breaking strength value obtained as in [5.3.7](#).

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms if the value of L does not exceed 20 percent.

6 SOIL INCUBATION METHOD

6.1 Apparatus

6.1.1 Glass Jars — round, wide mouth, flat bottomed

6.1.2 Petri Dishes — as covers

6.1.3 Incubator — capable of being maintained at $30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and provided with trays full of water at the bottom.

6.2 Test Soil

Prepared in the manner prescribed in [Annex C](#).

6.3 Procedure

6.3.1 Take the remaining six test specimens (*see* [4.2](#)).

6.3.2 Coil each specimen into a flat spiral and tie it with thread so that it does not uncoil and yet a small length of its ends is left free. Put the test soil in each of the six glass jars of suitable size and bury one coiled specimen in each jar so that the specimen is in a horizontal plane and is covered on all sides (except the free ends) with test soil. The soil inside the jars should cover about three-fourth of its height and the samples should be about 5 cm to 6 cm below the soil surface. Close the jars with petri dishes and keep them in the incubator at $30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. Incubate the specimens for 21 days if size is smaller than 3.2 cm and 42 days if specimens are of bigger size. After 21 days of incubation, check the moisture of the soil and, if need be, adjust the moisture to 25 percent to 27 percent. At the end of this period, remove the specimens, wash gently to free them from soil and dry them in air (*see* Note). Condition the specimens to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine, keeping the distance between the grips at 12.5 cm. Find the average of all the values.

NOTE — Exposure of test samples after washing to methyl alcohol fumes in a desiccator for 2 h to 4 h for drying gives better results.

6.3.3 Take the remaining six leached test specimens (*see* [4.2.1](#)) and test them in the manner prescribed in [6.3.2](#).

6.3.4 Take the remaining six control test specimens (*see* [4.3](#)) and test them in the manner prescribed in [6.3.2](#).

6.3.5 Calculate the loss in strength, percent, of the basic cordage on *soil incubation* by the following formula:

$$L = \frac{100(a-b)}{a}$$

where

L = loss in strength, percent, of the basic cordage on soil incubation;

a = breaking strength value obtained as in [5.3.2](#); and

b = breaking strength value obtained as in [6.3.4](#).

NOTE — The value of L should be 80 percent or more. If this value is less than 80 percent, the test shall be repeated.

6.3.6 Calculate in the manner prescribed in [6.3.5](#) the loss in strength, percent, of the cordage under test on soil incubation prior to leaching,

where

a = breaking strength value obtained as in [5.3.1](#); and

b = breaking strength value obtained as in [6.3.2](#).

NOTE—The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms if the value of L does not exceed 28 percent.

6.3.7 Calculate in the manner prescribed in [6.3.5](#), the loss in strength percent, of the cordage under test on soil incubation after leaching.

where

a = breaking strength value obtained as in [5.3.3](#); and

b = breaking strength value obtained as in [6.3.3](#).

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms if the value of L does not exceed 20 percent.

7 REPORT

7.1 Report shall include the following:

- a) Type of specimen
- b) Mixed culture inoculation method:
 - 1) Loss in strength, percent, of the basic cordage on incubation (*see* [5.3.8](#));
 - 2) Loss in strength, percent, of the cordage under test, on incubation prior leaching (*see* [5.3.9](#)); and
 - 3) Loss in strength, percent, of the cordage under test, on incubation after leaching (*see* [5.3.10](#)).
- c) *Soil incubation method*:
 - 1) Loss in strength, percent, of the basic cordage on soil incubation (*see* [6.3.5](#));
 - 2) Loss in strength, percent, of the cordage under test on soil incubation prior leaching (*see* [6.3.6](#)); and
 - 3) Loss in strength, percent, of the cordage under test on soil incubation after leaching (*see* [6.3.7](#)).

ANNEX A

(Clause 4.2.1)

METHOD OF LEACHING

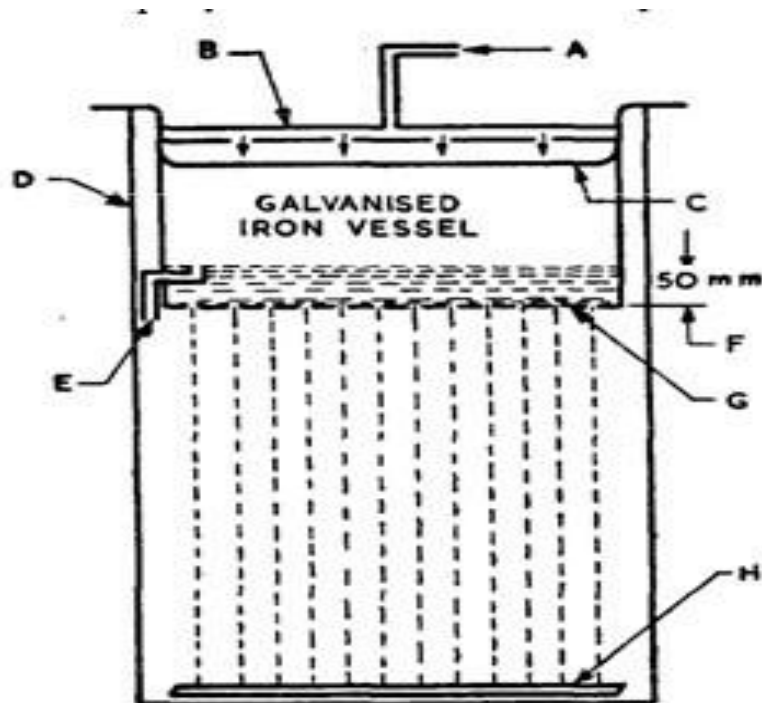
A-1 APPARATUS

A-1.1 Leaching Apparatus (see Fig. 2) — Consisting of a rectangular galvanized iron vessel of convenient size (see Note) provided with a copper bottom with perforations 0.4 mm in diameter and 20 mm apart and an automatic device to maintain the level of water inside the vessel at a height of 5 cm; the vessel being so fixed that its bottom is 30 cm above the horizontal glass base of the apparatus, which is of the same size as the perforated bottom of the vessel.

NOTE —The size of the vessel should be such as to enable the whole leaching operation to be completed within a reasonable period of time.

A-2 PROCEDURE

A-2.1 Place the specimen under test on the horizontal glass base. Feed tap water (pH 6.5 to 7.5 and temperature $30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) continuously for 4 h into the vessel of the apparatus and let it fall in a shower on the specimen. Turn over the specimen after 2 h and remove it at the end of 4 h.



Key

- A- Water inlet
- B - Supply tube with evenly distributed holes at the bottom
- C - Baffle sheet
- D - Wooden stand
- E - Constant level outlet
- F - Level of water
- G - Perforated bottom of vessel
- H - Glass base (27 cm × 55 cm) for holding the sample

FIG. 2 LEACHING APPARATUS

ANNEX B

(Foreword and Clause 5.3.4)

PREPARATION OF MIXED SPORE SUSPENSION

B-1 REAGENTS

B-1.1 Quadruple Strength Salt Solution — prepared by mixing, in the quantities indicated, the materials listed below:

Sodium nitrate (NaNO ₃)	8.0 g
Potassium dihydrogen phosphate (KH ₂ PO ₄)	1.0 g
Dipotassium hydrogen phosphate (K ₂ HPO ₄)	3.0 g
Potassium chloride (KC)	2.0 g
Magnesium sulphate (MgSO ₄ 7H ₂ O)	2.0 g
Distilled water	1 000 ml

NOTE — pH of the solution should be 7.0.

B-1.2 Jute Extract Medium — prepared as prescribed below:

Extract 10 g of jute fibres in 100 ml of distilled water for 30 min under reflux and filter. Take 2.5 ml of the salt solution (see [B-1.1](#)), 2.5 ml of distilled water and 5 ml of the jute extract in each of four 15 cm × 2 cm test tubes and insert a strip of filter paper about 2 cm × 7 cm so that half of it is immersed in the medium. Plug the tubes with non-absorbent cotton and sterilize them with steam in an autoclave at 0.7 kg/cm² pressure for 15 min.

B-1.3 Malt Extract Medium — prepared as prescribed below:

Mix, in the quantities indicated, the materials listed below:

Malt extract	25 g
Distilled water	1 000 ml

Put 5 ml of this solution and a strip of filter paper about 2 cm × 7 cm into a 15 cm × 2 cm test tube so that half of it is immersed in the medium. Sterilize it with steam in an autoclave at 0.7 kg/cm² pressure for 15 min.

B-2 SUB-CULTURES

B-2.1 The sub-cultures shall be prepared as

prescribed in [B-2.2](#) and [B-2.3](#).

B-2.2 Inoculate the filter paper in the tubes containing jute extract medium (see [B-1.2](#)) separately with well-sporulated cultures of the following organisms:

Chaetomium indicum Corda
Curoullaria lunata (Wakker) Boedijn
Aspergillus fumigatus Fresenius
Penicillium rubrum Stoll

B-2.3 Similarly inoculate the filter paper in the tube containing malt extract medium (see [B-1.3](#)) with a well-sporulated culture of the organism *Penicillium wortmanni* Klocker. Incubate the tubes at 30 °C ± 2 °C for 2 weeks to 3 weeks until mature growth of the organisms is obtained.

B-2.4 The sub-cultures are now ready for use (see [B-3](#)).

B-3 PREPARATION OF MIXED SPORE SUSPENSION

B-3.1 Decant the medium from the tubes and add 6 ml of the quadruple strength salt solution to each tube. Break the perithecia of the organisms *Chaetomium indicum* Corda and *Penicillium wortmanni* Klocker by means of glass rods and shake the tubes well in order to get uniform suspension of spores. Loosen the spores of the organisms *Curuullaria lunata* (Wakker) Boedijn, *Aspergillus fumigatus* Fresenius scraping lightly with glass rod. Filter each suspension through cotton wool to remove particles of filter paper and fungal mycelia. Take sporecounts of each suspension by means of a haemocytometer and dilute the suspension of the spores of *Aspergillus fumigatus* Fresenius, *Penicillium rubrum* Stoll and *Penicillium wortmanni* Klocker with quadruple strength salt solution to the same count as that of the spores of *Chaetomium indicum* Corda or *Curuullaria lunata* (Wakker) Boedijn (see Note) and then mix the suspensions in equal volumes.

NOTE — Suspensions of spores of the organisms *Chaetomium indicum* Corda and *Curuullaria lunata* (Wakker) Boedijn give the lowest counts.

ANNEX C

(Clause 6.2)

PREPARATION OF TEST SOIL

C-1 Prepare a compost by mixing thoroughly fertile garden soil, cow dung manure and sand in the proportion of 2 : 1 : 1. Pass it through IS Sieve 355 (see IS : 460 Part 1) Adjust its moisture content to 25 percent to 27 percent and test it in the manner prescribed in [C-2](#) to [C-4](#).

C-2 Take a sufficiently long piece of hessian cloth of the following construction:

Ends/cm	4
Picks/cm	4
Mass, g/m ²	270

Draw twelve 25 cm × 4 cm pieces from it. Take six pieces, condition them to moisture equilibrium in standard atmosphere (see [3](#)) and determine the

breaking strength of each individual piece in a horizontal or vertical type strength testing machine keeping the distance between the grips at 12.5 cm. Find the average of all the values.

C-3 Test the remaining six pieces in the manner prescribed in [5.3.2](#) but burying them without coiling and incubating them for 7 days only; record the average value for breaking strength.

C-4 Calculate the loss in strength of the cloth after soil burial by subtracting the breaking strength value obtained as in [C-3](#) from the value obtained as in [C-2](#) and express it as percentage loss on the value in [C-2](#).

NOTE — The soil should be deemed to be suitable for test if the percentage loss in strength of the cloth after soil burial is 80 percent or more.

ANNEX D

(Foreword)

COMMITTEE COMPOSITION

Chemical Methods of Test Sectional Committee, TXD 05

<i>Organization</i>	<i>Representative(s)</i>
The Synthetics & Art Silk Mills Research Association, Mumbai	DR MANISHA MATHUR (<i>Chairperson</i>)
Agilent Technology India Pvt Ltd, New Delhi	SHRI PRAVEEN ARYA DR MANOJ SURWADE (<i>Alternate</i>)
Ahmedabad Textile Industry's Research Association, Ahmedabad	SHRIMATI DEEPALI PLAWAT SHRIMATI FAHIMUNNISA KHATIB (<i>Alternate</i>)
Bidhata Industries Pvt Ltd, Mumbai	SHRI ROHIT PACHERIWALA SHRI R. K. PACHERIWALA (<i>Alternate</i>)
Central Coir Research Institute, Kochi	DIRECTOR, RDTE SENIOR SCIENTIFIC OFFICER (POLYMER) (<i>Alternate</i>)
Central Institute for Research on Cotton Technology, Mumbai	DR SUJATA SAXENA DR A. S. M. RAJA (<i>Alternate</i>)
Central Silk Technological Research Institute (CSTRI), Bengaluru	DR NIVEDITA S. SHRIMATI BROJESHWARI DAS (<i>Alternate</i>)
Directorate General of Quality Assurance (CQAT &C), Kanpur	COL D. B. KUSHWAHA SHRI PURUSHOTTAM DE (<i>Alternate</i>)
EMC Testing & Compliance LLP, Gurugram	SHRI VIVEK SHARMA SHRI SATYA RANJAN BISWAL (<i>Alternate</i>)
Global Organic Textile Standard, Thane	SHRI RAHUL BHAJEKAR SHRIMATI PRACHI GUPTA (<i>Alternate</i>)
Indian Jute Industries Research Association, Kolkata	MS ISHPITA ROY
Manjushree Spntek Pvt Ltd, Bengaluru	SHRI MADHAN R.
Northern India Textiles Research Association, Ghaziabad	DR M. S. PARMAR
Office of the Textile Commissioner, Mumbai	SHRI GAURAV GUPTA SHRI RAJESH MAHAJAN (<i>Alternate</i>)
Raymonds Ltd, Mumbai	SHRI PRABHAT PARASHER SHRI SAURAV SHEKHAR (<i>Alternate</i>)
Reliance Industries Ltd, New Delhi	SHRI M. S. VERMA SHRI MAHESH C. SHARMA (<i>Alternate</i>)
SGS, Mumbai	DR KARTHIKEYAN K. SHRIMATI MAHALAKSHMI R. (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
Sunil Industries, Mumbai	SHRI PRADEEP ROONGTA SHRI RAMESH KHANNA (<i>Alternate</i>)
Testex India Laboratories Pvt Ltd, Mumbai	SHRIMATI MEETA SHINGALA SHRI MAHESH SHARMA (<i>Alternate</i>)
Texanlab Laboratoires Pvt Ltd, Navi Mumbai	SHRI MILIND R. MARATHE SHRI VIVEK PATIL (<i>Alternate</i>)
Textile Committee, Mumbai	SHRI KARTIKEYAN DHANDA DR P. RAVICHANDRAN (<i>Alternate</i>)
The Bombay Textile Research Association, Mumbai	SHRI M. P. SATYANARAYAN SHRIMATI SAROJ VAIRAGI (<i>Alternate</i>)
The South India Textile Research Association, Coimbatore	DR PRAKASH VASUDEVAN SHRI S. SIVAKUMAR (<i>Alternate</i>)
The Synthetics & Art Silk Mills Research Association, Mumbai	SHRIMATI ASHWINI A. SUDAM SHRIMATI LEENA MHATRE (<i>Alternate</i>)
U P Textile Technology Institute, Kanpur	DR ARUN KUMAR PATRA DR SUBHANKAR MAITY (<i>Alternate</i>)
Wool Research Association, Thane	DR MIRNAL CHOUDHARI DR SWATI MAHADIK (<i>Alternate</i>)
BIS Directorate General	SHRI J. K. GUPTA, SCIENTIST 'E'/DIRECTOR AND HEAD (TEXTILES) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary
SHRI DHARMBEER
SCIENTIST 'D'/JOINT DIRECTOR
(TEXTILES), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

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 05 (23598).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

	Telephones
Central : 601/A, Konnectus Tower -1, 6 th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern : 8 th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	{ 265 9930
Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	{ 2254 1442 2254 1216
Western : 5 th Floor/MTNL CETTM, Technology Street, Hiranandani Gardens, Powai Mumbai 400076	{ 25700030 25702715

Branches : AHMEDABAD, BENGALURU, BHOPAL, BHUBANESHWAR, CHANDIGARH, CHENNAI, COIMBATORE, DEHRADUN, DELHI, FARIDABAD, GHAZIABAD, GUWAHATI, HARYANA (CHANDIGARH), HUBLI, HYDERABAD, JAIPUR, JAMMU, JAMSHEDPUR, KOCHI, KOLKATA, LUCKNOW, MADURAI, MUMBAI, NAGPUR, NOIDA, PARWANOO, PATNA, PUNE, RAIPUR, RAJKOT, SURAT, VIJAYAWADA.