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BUREAU OF INDIAN STANDARDS
(NEW DELHI)

AGENDA

GEO-SYNTHETICS SECTIONAL COMMITTEE, TXD 30 **31st Meeting**

Date/Day	Time	Venue
09 August, 2024 (Friday)	1100 h	Through Video Conferencing

Chairman: Dr. A. N. Desai, SITRA Council, Coimbatore

Member Secretary: Shri Himanshu Shukla, Scientist-B, Textile Department

Item 0 WELCOME AND INTRODUCTORY REMARKS BY THE CHAIRMAN

Item 1 CONFIRMATION OF MINUTES OF LAST MEETINGS

1.1 The minutes of the 29th meeting of TXD 30 held on 28 December 2023 were circulated vide letter No. TXD 30/A2.29 dated 06 February 2024. No comments have been received.

1.1.1 The committee may **APPROVE** the minutes as circulated.

Item 2 SCOPE AND COMPOSITION OF TXD 30

2.1 The present scope and composition of TXD 30 is given in **Annex 1** (**P- 07 to 10).**

2.1.1 The committee may **REVIEW**.

2.2 Co-option requests have been received from Khator Technical Textiles Limited, Mumbai and Plastindia Foundation, Mumbai. The cooption mails and details as received are given in **Annex 2** **(P- 11 to 12)**.

2.2.1 The committee may **DELIBERATE** and **DECIDE**.

Item 3 ISSUES ARISING OUT OF THE PREVIOUS MEETING

3.1 A summary of actions on the various decisions taken during the 30th meeting is given in **Annex 3** **(P-13 to 14).**

3.1.1 The committee may **NOTE and DECIDE**.

Item 4 DRAFT STANDARDS FOR FINALIZATION

4.1 As decided by the committee in the last meeting, the following draft standard was issued in wide circulation for two months for eliciting technical comments from stake holders vide our

letter reference no.- TXD 30/25076 dated 19 March 2024 with the last date of comment on 17 April 2024.

i) Geosynthetics — Geotextiles for Drainage, Separation, Filtration, Erosion Control and Stabilization Applications — Specification [Doc. No. TXD 30 (25076)].

Draft standards as issued in wide circulation are given in **Annex 4** **(P- 15 to 37)**

Comments have been received from Shri Rajendra Ghadge, Garware Technical Fibers Ltd, Pune and Terre Armee, New Delhi and are given in **Annex 5** **(Pages- 38 to 40).**

4.1.1 The committee may **DELIBERATE** and **DECIDE.**

4.2 As decided by the committee in the last meeting, the following draft standards were issued in wide circulation for two months for eliciting technical comments from stake holders vide our letter reference no.- TXD 30/25140 dated 31 March 2024 with the last date of comment on 30 May 2024.

a) Geotextiles — Methods of Test Part 2 Determination of Resistance to the Exposure of Ultraviolet Light, Moisture and Heat (Xenon-Arc Type Apaparatus) [TXD 30 (25136)] (*first revision of* IS 13162 (Part 2) : 1991)
b) Geosynthetics — Method for Determination of Trapezoid Tearing Strength [TXD 30 (25137)] (*first revision of* IS 14293 : 1995)
c) Geosynthetics — Method for Determination of Apparent Opening Size by Dry Sieving Technique [TXD 30 (25138)] (*first revision of* IS 14294 : 1995)
d) IS 14714 Geotextiles — Determination of Abrasion Resistance [TXD 30 (25139)]
e) IS 14706/ISO 9862: 2023 Geosynthetics — Sampling and Preparation of Test Specimens [TXD 30 (25140)] (*first revision of* IS 14714 : 1999)
f) Geotextiles and Geotextile-Related Products — Determination of Water Permeability Characteristics Normal to the Plane, Without Load [TXD 30 (25141)] (IS 14324/ISO 11058: 2019)
g) Geosynthetics — Determination of Friction Characteristics Part 1: Direct Shear Test [TXD 30 (25142)] (IS 13326 Part 1/ISO 12957 Part 1: 2018)
h) IS 13162 Part 4/ISO 13433: 2006 Geosynthetics — Dynamic Perforation Test (Cone Drop Test) [TXD 30 (25143)] (IS 13326 Part 1/ISO 12957 Part 1: 2018)

Draft standards as issued in wide circulation are given in **Annex 6** **(P- 41 to 80)**. No comments were received.

4.2.1 The committee may **DECIDE.**

4.3 Draft Standard on Geotextile Tubes for Coastal and Waterways Protection

In the last meeting the comments received from the wide circulation draft of 'Geotextile Tube for Coastal and Waterways Protection' were referred to panel constituted under the convenorship of Prof. Rajagopal K. The panel meeting for discussion of the comments on the aforementioned draft was held on 19 June 2024, after detailed deliberation, the recommendation of the panel is given as follows:

i) To delete the requirement of GSM for Inner Layer (Nonwoven) of Geotube from Table 2.

ii) To add a new variety of geo-tube having maximum tensile strength of 200 kN/m in machine and cross machine directions.
iii) Substitute the existing tolerance for dimensions of geo-tube, spout/filling port and loop with '+5 percent with no negative tolerance'.
iv) Substitute the AOS (O_{95}) for AOS (O_{90}) keeping the specified values the same.
v) Requirement for grab tensile strength and trapezoidal tear strength for Inner Layer (Nonwoven) of Geo-tube will be validated by the test reports shared by Techfab India Pvt. Ltd., Mumbai.

Clause 3.3 will be rewritten as follows:

'**Fill Port** — Also called a fill spout or fill nozzle, fill ports are sleeves sewn into the top of the geotextile tube into which the discharge pipe is inserted. Ports are typically 300 mm to 450 mm in diameter and 1.0 m to 1.5 m length. Ports are spaced along the top of the tube to provide access to the contractor.

Note — Spacing between the fill ports shall usually be no closer than 5 m to accommodate sand slurry but can be as far apart as 30 m for some viscous fill materials. The end filling ports shall be 2.50 m away from the edge of the tube. Fill ports are fabricated from the same geotextile as the main tube. There must be another safety pocket outer to spout/port so that it can be kept safely inside this cover/sack after filling to avoid floating/laying in the geotextile tube.'

The revised draft incorporating the decision made under Sl. No. (i) to (iv) are in **Annex 7 (Pages- 81 to 91)**.

The test reports for the requirements mentioned at Sl. No. (v) is given in **Annex 8 (Pages- 92 to 98).**

4.3.1 The committee may **DELIBERATE** and **DECIDE.**

Item 5 INTERNATIONAL ACTIVITY

5.1 The followings standards have been published by ISO TC 221 'Geosynthetics' in recent years in the field of geosynthetics:

Sl. No.	ISO Standards	Corresponding Indian Standards	Remarks
i)	ISO 13426-2 : 2024 Geotextiles and geotextile-related products — Strength of internal structural junctions — Part 2: Geocomposites	IS 17369 (Part 2) : 2020/ ISO 13426-2 : 2005	The existing Indian standard needs to be aligned with the latest version of ISO standard.
ii)	ISO/TS 20432 : 2022 Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement	IS 17365 : 2020/ ISO TR 20432 : 2007	-do-
iii)	ISO 12958-1 : 2020 Geotextiles and geotextile-related products — Determination of water flow capacity in their plane — Part 1: Index test	IS 17179 : 2019/ ISO 12958 : 2010	-do-
iv)	ISO 12958-2 : 2020 Geotextiles and geotextile-related products — Determination of water flow capacity in		

	their plane — Part 2: Performance test		
v)	ISO 12960 : 2020 Geotextiles and geotextile-related products — Screening test methods for determining the resistance to acid and alkaline liquids	IS 17363 : 2020/ ISO TR 12960 : 1998	-do-

5.2 Following new standards have been published by ISO TC 221 'Geosynthetics' in the field of Geosynthetics:

Sl. No.	ISO Standards	Remarks
i)	ISO/TR 18228-1 : 2020 Design using geosynthetics — Part 1: General	To be adopted
ii)	ISO/TR 18228-2 : 2021 Design using geosynthetics — Part 2: Separation	To be adopted
iii)	ISO/TR 18228-3 : 2021 Design using geosynthetics — Part 3: Filtration	To be adopted
iv)	ISO/TR 18228-4 : 2022 Design using geosynthetics — Part 4: Drainage	To be adopted
v)	ISO/TR 18228-6 : 2023 Design using geosynthetics — Part 6: Protection	To be adopted
vi)	ISO/TR 18228-7 : 2021 Design using geosynthetics — Part 7: Reinforcement	To be adopted
vii)	ISO/TR 18228-9 : 2022 Design using geosynthetics — Part 9: Barriers	To be adopted
viii)	ISO/TR 18228-10 : 2024 Design using geosynthetics — Part 10: Asphalt pavements	To be adopted
ix)	ISO/TS 18198 : 2023 Determination of long-term flow of geosynthetic drains	To be adopted
x)	ISO 25619-1 : 2021 Geosynthetics — Determination of compression behaviour — Part 1: Compressive creep properties	To be adopted
xi)	ISO 22182 : 2020 Geotextiles and geotextile-related products — Determination of index abrasion resistance characteristics under wet conditions for hydraulic applications	To be adopted
xii)	ISO/TS 13434 : 2020 Geosynthetics — Guidelines for the assessment of durability	To be adopted
xiii)	ISO 13437 : 2019 Geosynthetics — Installing and retrieving samples in the field for durability assessment	To be adopted
xiv)	ISO 12956 : 2019 Geotextiles and geotextile-related products — Determination of the characteristic opening size (wet sieving)	To be adopted
xv)	ISO 25619-2 : 2015 Geosynthetics — Determination of compression behaviour — Part 2: Determination of short-term compression behaviour	To be adopted
xvi)	ISO 18325 : 2015 Geosynthetics — Test method for the determination of water discharge capacity for prefabricated vertical drains	To be adopted

Item 6 COMMENTS ON INDIAN STADNARDS

6.1 Comments have been received from SROL, Hyderabad (BIS) on the following Indian Standards:

i) IS 17483 (Part 1) : 2020 Geosynthetics — Geocells — Specification (Part 1) Load Bearing Application
ii) IS 17483 (Part 2) : 2020 Geosynthetics — Geocells — Specification (Part 2) Slope Erosion Protection Application

The comments as received from SROL, Hyderabad (BIS) are given in **Annex 9** **(P- 100 to 102).**

6.1.1 The committee may **DELIBERATE** and **DECIDE.**

6.2 Comments on IS 18309 : 2023 Geosynthetics — Prefabricated Vertical Drains for Quick Consolidation for Very Soft Plastic Soil — Specification

In the last meeting, the comments received from Tencate Geosynthetics, Gurgaon on 'IS 18309 : 2023 Geosynthetics — Prefabricated Vertical Drains for Quick Consolidation for Very Soft Plastic Soil — Specification' were referred to the panel constituted under the convenorship of Prof. Rajagopal K., Andhra University, Visakhapatnam. The panel meeting was held on 19 June 2024, the recommendation of the panel is given as follows:

To validate the following requirements from third party test report:

i) For overall drain:

a) Elongation at break % (for both varieties)
b) Roll length

ii) For filter fabric: Trapezoidal tear strength (for both varieties)

The test reports on the above requirements as received from Techfab India, Mumbai is given in **Annex 10** **(Pages- 102 to 105)**.

6.2.1 The committee may **DELIBERATE** and **DECIDE.**

7 REVIEW OF STANDARDS

7.1 As per procedure of BIS, standards which were published/reaffirmed are required to be reviewed to assess adequacy of the requirements specified. Review is carried out keeping in view the changes in technology, current industrial practices and the needs/expectations of the consumers/users so as to decide regarding further reaffirmation/ revision/withdrawal/amendment of the standards under review.

The list of standards due for review under the domain of TXD 30 are given at **Annex 11** **(P- 106 to 108).**

7.1.1 The committee may **DELIBERATE** and **DECIDE**.

Item 8 ANY OTHER BUSINESS

ANNEX 1
(*Item* 2.1)

SCOPE AND COMPOSITION OF GEO SYNTHETICS SECTIONAL COMMITTEE, TXD 30

SCOPE: a) To formulate Indian standards on terminology, testing, specifications and codes of practices for identification, handling, storage and installation, etc. of all geo-synthetic products including geo-textiles, geo-membranes, geo-grids, geo-foams, geo-composites, clay liners and other geo-synthetic related products.

b) To liaise with the work of ISO/TC 221 Geo-synthetics Technical Committee as a participating member.

Meeting(s) held	**Date & Place**
28th Meeting	17 Nov 2022 CISCO Webex
29th Meeting	20 July 2023 CISCO Webex
30th Meeting	28 Dec 2023 CISCO Webex

Sl. No	*Organization*	*Representative(s)*	*Meetings Attended/Held*			
			28th	29th	30th	*A/H*
1.	The South India Textile Research Association Council, Coimbatore	Dr A. N. Desai (***Chairman***)	1	1	1	3/3
2.	Ahmedabad Textile Industry's Research Association, Ahmedabad	Smt Deepali Plawat Shri Jigar Dave (*Alternate*)	1	1	0	2/3
3.	Andhra University, Visakhapatnam	Prof. K Rajagopal	0	0	1	1/1
4.	Best Geotechnique Pvt Ltd, Mumbai	Shri Satish Naik	1	1	1	3/3
5.	Central Coir Research Institute, Alappuzha	Dr. S. Radhakrishnan Smt Sumy Sebastian (*Alternate*)	1	1	1	3/3
6.	Central Road Research Institute, New Delhi	Dr. P. S. Prasad Dr. Pankaj Gupta (*Alternate*)	1	1	0	2/3

7.	Central Soil and Materials Research Station New Delhi	Dr R. Chitra Dr Manish Gupta (*Alternate*)	1	1	1	3/3
8.	Charankattu Coir Mfg. Co. (P) Ltd, Kerala	Shri C. R. Devraj Shri C. D. Athul Raj (*Alternate*)	1	1	1	3/3
9.	Department of Jute and Fibre Technology, Kolkata	Dr Swapan Ghosh Dr A. K. Singho (*Alternate*)	1	1	1	3/3
10.	DKTE Centre of Excellence in Nonwovens, Ichalkaranji	Dr. Shirish Kumar Vhanbatte	1	0	1	2/3
11.	Ganga Flood Control Commission, Patna	Shri M. K. Srinivas Shri Amitabh Prabhakar (*Alternate*)	1	1	0	2/3
12.	Garware Technical Fibers Ltd, Pune	Shri Tirumal Kulkarni Shri Rajendra Ghadge (*Alternate*)	1	1	1	3/3
13.	Geosynthetics Testing Services Pvt Ltd, Ahmedabad	Shri Ravikant Sharma	1	1	1	3/3
14.	ICAR- National Institute of Natural Fibre Engineering & Technology, Kolkata	Dr. Sanjoy Debnath Dr. Kartick Samanta (*Alternate)*	1	1	1	3/3
15.	Indian Geotechnical Society, New Delhi	Dr. Bappaditya Manna Dr Debayan Bhattacharya(Alternate)	0	1	0	1/3
16.	Indian Institute of Technology, Gandhinagar	Prof. Amit Prashant Dr. G V Rao (*Alternate*)	1	1	1	3/3
17.	Indian Institute of Technology, Madras	Prof. Dalli Naidu Arnepalli	1	1	0	2/3
18.	Indian Jute Industries' Research Association, Kolkata	Dr. Mahuya Ghosh Shri Palash Paul (*Alternate*)	1	1	0	2/3
19.	Indian Jute Mills Association, Kolkatta	Shri S. K. Chandra Shri J. K. Behera (*Alternate*) Shri Bhudipta Saha (YP)	1	0	1	2/3

20.	Indian Technical Textile Association, Mumbai	Dr. Anup Rakshit Smt. Ruchita Gupta (*Alternate*)	1	1	0	2/3
21.	International Geosynthetics Society, India Chapter, New Delhi	Prof. G. L Sivakumar Babu Smt. Dola Roychowdhury (*Alternate)*	1	0	0	1/3
22.	Kusumgar Corporates, Mumbai	Shri Y. K. Kusumgar Dr M. K. Talukdar (*Alternate*)	1	1	1	3/3
23.	Landmark Material Testing and Research Laboratory Pvt. Ltd, Jaipur	Dr. Anil Dixit Shri Harsh Kumar Chittora (*Alternate*)	1	1	1	3/3
24.	Macaferri Environmental Solutions Pvt Ltd, Navi Mumbai	Dr. Ratnakar Mahajan Smt Minimol Korulla (*Alternate*)	1	1	1	3/3
25.	Ministry of Road Transport & Highways, New Delhi	Nomination awaited	0	0	1	1/3
26.	National Jute Board, Kolkatta	Shri M. Dutta	1	1	1	3/3
27.	Office of The Jute Commissioner, Kolkata	Shri Soumyadipta Datta	0	0	1	1/3
28.	Office of the Textile Commissioner, Mumbai	Shri Sivakumar S Shri Sanjay Charak (*Alternate*)	0	0	1	1/3
29.	Premier Polyfilms Ltd, Ghaziabad	Shri Amitaabh Goenka Shri Praveen Kumar (*Alternate*)	1	1	1	3/3
30.	Rajadhani Institute of Engineering & Technology, Trivandrum	Dr. K. Balan	1	1	1	3/3
31.	RDSO, Lucknow	Shri Sanjay Kumar Awasthi Shri Santosh Kumar Ojha (*Alternate*)	1	1	1	3/3
32.	Reliance Industries Ltd, New Delhi	Shri V Ravikanth Shri Rajendren Subramanian	1	1	1	3/3

33.	Sahastra Engineers Pvt Ltd, Noida	Shri Vankata Mayur	0	0	1	1/3
34.	Strata Geosystems (I) Pvt Ltd, Mumbai	Shri Narendra Dalmia Shri Shahrokh Bagli (*Alternate*) Shri Suraj Vedpathak (YP)	1	1	1	3/3
35.	Techfab India, Mumbai	Shri Anant Kanoi Shri Saurabh Vyas (*Alternate*)	1	1	1	3/3
36.	The Bombay Textile Research Association, Mumbai	Dr. Sreekumar Dr. Prasanta Kumar Panda (*Alternate*)	1	1	1	3/3
37.	The Synthetics & Art Silk Mills Research, Association, Mumbai	Dr. Manisha Mathur Shrimati Ashwini Sudam (*Alternate*)	1	1	1	3/3
38.	In Personal Capacity	Shri V. N. Gore	1	0	0	1/3
39.	In Personal Capacity	Shri P. K. Choudhury	0	1	1	2/3

ANNEX 2
(*Item* 2.2)

A) CO-OPTION REQUEST FROM KHATOR TECHNICAL TEXTILES LIMITED, MUMBAI

Dear Himanshu Ji,

As discussed earlier, I would like to file in my nominations for the BIS Geosynthetic Sectional Committee TXD30.

We are one of the leading manufacturers of Nonwoven geotextiles in the country with our sales in some of the most prestigious projects in the country such as Mumbai Coastal Road, Bhuj Solar Park, Z- Morth tunnel, Mumbai- Delhi Expressway, etc. to name a few. Our company has been awarded two year back to back (2017-18, 2018-19) as the highest Exporting Geosynthetics company from India by Hon'ble Minister Shri. Nitin Gadkari himself. We have our geosynthetics sales network in more than 18 countries.
We are currently operating in many of the crucial Infrastructure projects in the country. With operations more than a decade in the Geosynthetics industry and founder and leader one of the biggest Geosynthetics Manufacturer in the country our insights about the issues faced by the Geosynthetics industry will be helpful to the committee and the formulation of various standards.

I am also a Bachelor in Textile Technology from DKTE's Ichalkaranji-with specialisation in Technical Textiles and a MBA in finance from Nirma University Ahmedabad. I have also been awarded the Outstanding Young Entrepreneur in Technical Textiles 2019 Awarded by The Hon'ble Vice President of India Shri Venkaiah Naidu and Hon'ble Minister of Textiles Smt. Smriti Irani.

I am at our disposal for any further information and look forward to being included in this prestigious committee.

THANKS & REGARDS,
AMIT KHATOR

KHATOR TECHNICAL TEXTILES

Khator Technical Textiles Limited.

Corp Off.: B-104, Varun Arcade, Opp R-Mall ,
Godhbundar Road , Thane West, Mumbai - 400610

Email ID : techtex@kttl.in **Website :**www.kttl.in

Contact : +91-22-25842600

Plant.: Survey No 166,
Plot No. 3 & 4 , Naroli,
Silvassa - 396 235
Dadra & Nagar Haveli.

B) CO-OPTION REQUEST FROM PLASTINDIA FOUNDATION, MUMBAI

PLASTINDIA FOUNDATION®

ISO 9001-2015 certified

401-B, Landmark,Opp. Cinemax, 209A Suren Road, Off Andheri - Kurla Road, Andheri (E), Mumbai - 400093, India
Tel. : +91-22-28632911-14
Website : www.plastindia.org
E-mail: plastindia@plastindia.org

NOMINATION PROFORMA

TEXTILES DEPARTMENT

Committee Name: **TXD 30: Geo Textiles and Industrial Fabrics**

Principal Member

General Interest :

Shri/Smt/Dr./Prof. : Mr. Surender Choudhary

Designation :

Name of Organization : PLASTINDIA FOUNDATION

Address in full for Correspondence (with PINCODE) : 401-B, Landmark Building, Suren Road, Off. Andheri-Kurla Road Andheri, Mumbai 400093

City : Mumbai

Telephone & Mobile No. : +91 98240 44400 Fax :

E-mail : surender@durasyntex.com / protocol@plastindia.org

Alternate Member

General Interest :

Shri/Smt/Dr./Prof. : Mr. Divyesh Goradia

Designation :

Name of Organization : PLASTINDIA FOUNDATION

Address in full for Correspondence (with PINCODE) : 401-B, Landmark Building, Suren Road, Off. Andheri-Kurla Road Andheri, Mumbai 400093

City : Mumbai

Telephone & Mobile No. : +91-9898060118

E-mail : divyesh@shaktipolyweave.co.in

PLASTINDIA FOUNDATION MUMBAI 400 093 INDIA

ANNEX 3

(*Item* 3.1)

Item No.	Decision Taken	Action Taken
2	Review of composition of TXD 30	Updated composition of TXD 30 is given in Annex 1.
4.1	**DRAFT STANDARDS/AMENDMENT FOR FINALIZATION** The comments received on the draft standard on 'Geotextile Tubes for Coastal and Waterways Protection' were referred to the panel constituted under the convenorship of Prof. K. Rajagopal, Andhra University, Visakhapatnam for discussion/deliberation and for suggesting suitable changes to be incorporated in draft standard.	Panel meeting was convened on 19 June, 2024 to discuss on the comments received on the draft standard. Coming up for discussion under Agenda Item 4**.3**.
5	**AMALGAMATION OF INDIAN STANDARDS ON GEOTEXTILES** In the last meeting, the committee decided that revised draft (amalgamating IS 16391 : 2015, IS 16392 : 2015, IS 16393 : 2015, IS 16362 : 2020 and IS 15910 : 2010) shall be issued in wide circulation for one month time period after incorporating the changes mentioned under 5.1 to the minutes, eliciting the technical comments from the stakeholders.	The draft standard was issued in wide circulation for one month time period. Coming up for discussion under Agenda Item **4.1**.
6	**COMMENTS ON PUBLISHED INDIAN STANDARDS** In the last meeting, the comments received from Tencate Geosynthetics, Gurgaon on 'IS 18309 : 2023 Geosynthetics — Prefabricated Vertical Drains for Quick Consolidation for Very Soft Plastic Soil — Specification' were referred to the panel constituted under the convenorship of Prof. K. Rajagopal, Andhra University, Visakhapatnam for discussion/deliberation and for suggesting suitable amendment/changes to be incorporated in the Indian Standard.	Panel meeting was convened on 19 June, 2024 to discuss on the comments received on the draft standard. Coming up for discussion under Agenda Item **7.2**.

7	**REVIEW OF STANDARDS** The committee decided to suitably incorporate the comments received from BTRA, Mumbai, Landmark Material Testing and Research Laboratory Private Limited, Jaipur and Geosynthetics Testing Services Pvt Ltd, Ahmedabad in the pre-2000 drafts and circulate the drafts to the committee members for 15 days time period, seeking their comments/inputs on the drafts. The committee further decided in case no comments are received, the drafts shall be issued in wide circulation for a time period of 2 months eliciting the technical comments from stakeholders.	The drafts were issued in wide circulation for two months time period after incorporating the inputs received. Coming for discussion under Agenda Item **4.2.**
9	**RESEARCH AND DEVELOPMENT ACTIVITY IN STANDARDIZATION** The committee approved the ToR for R&D project on the following subject: To study the constructional and performance requirements for jute geotextiles used in rain water erosion control in road and railway embankment and hill slopes.	The R&D project was approved by the screening committee and the project was hosted on BIS portal with the last date of submission on 31 July 2024.
10.1	**ANY OTHER BUSINESS** The committee decided that wide circulation draft on 'Coir non woven stitched composite geotextiles for erosion control applications', shall be issued in wide circulation for a time period of two months eliciting technical comments from stakeholders**.**	The draft was issued in wide circulation with the last date of comment on 19 August 2024.
10.1	**ANY OTHER BUSINESS** The committee decided to issue amendments to 'IS 17483 (Part 1):2020 Geosynthetics — Geocells — Specification (Part 1) Load Bearing Application' and IS 17483 (Part 2) : 2020 Geosynthetics — Geocells — Specification (Part 2) Slope Erosion Protection Application' addressing the issues of pocket size and confinement ratio and incorporating the changes mentioned under item 10.2 to the minutes	Amendments [A2 to IS 17483 (Part 1) and A2 to IS 17483 (Part 2)] were sent to publication.

ANNEX 4
(*Item* 4.1)

DRAFT INDIAN STANDARD ON IS 17483 (PART 2) : 2020 GEOSYNTHETICS — GEOCELLS — SPECIFICATION (PART 2) SLOPE EROSION PROTECTION APPLICATION

Doc. No: TXD 30 (25076) WC
March 2024

(Amalgamating IS 15910 : 2010, 16391 : 2015, IS 16392 : 2015, IS 16393 : 2015)

भारतीय मानक ब्युरो

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

भारतीय मानक मसौदा

भूकृत्रिम — जल निकासी, अलगाव, निस्पंदन, कटाव नियंत्रण और स्थिरीकरण अनुप्रयोगों के लिए भूवस्त्रादि — विशिष्टि

(आई एस 16362 *का दूसरा पुनरीक्षण)*

Draft Indian Standard

GEOSYNTHETICS — GEOTEXTILES FOR DRAINAGE, SEPARATION, FILTRATION, EROSION CONTROL AND STABILIZATION APPLICATIONS — SPECIFICATION

(Second Revision of IS 16362*)*

ICS 59.080.70

Geosynthetics Sectional Committee, TXD 30

Last date for receipt of comment is **17 April 2024**

FOREWORD

(*Formal clauses will be added later*)

This standard was first published in 2015. The first revision of the standard was brought out in 2020 to modify the requirement of CBR puncture strength and exclude the requirement for burst strength, pullout interaction coefficient and coefficient of direct shear.

Following standards were published on geotextiles for different applications including subgrade separation, permanent erosion control, subsurface drainage and geotextiles for highways application, the Sectional Committee responsible for the formulation of these standards has decided to amalgamate these standards in a single standard:

a) IS 15910 : 2010 'Geosynthetics for highways — Specification'
b) IS 16391 : 2015 'Geosynthetics — Geotextiles used in sub-grade separation in pavement structures – Specification'
c) IS 16392 : 2015 'Geosynthetics — Geotextiles for permanent erosion control in hard armor systems – Specification'
d) IS 16393 : 2015 'Geosynthetics — Geotextiles used in subsurface drainage application — Specification'

After the publication of this standard the above standards will stand withdrawn and relevant parts, varieties and their requirements have been covered in this standard. Additionally, two new varieties of geotextiles namely Class 1R (for application on top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment) and Class 2R (for applications and below the ballast and above the blanket layer) have been included in this standard on the recommendation of RDSO, Lucknow to extend the applicability of standard for railway applications. In formulation of this standard, considerable assistance has been derived from RDSO/2018/GE: IRS-0004 - Part-I 'Specification of Non-woven Geotextile to be Used as Separator/Filtration in Railway Formation' published by RDSO, Lucknow.

Geotextiles are mainly made from polyester (PET) or polypropylene (PP). PP is lighter than water, strong and very durable. PET is heavier than water, has excellent strength and creep properties, and is compatible with most common soil environments. Geotextiles are mainly of two types, namely, woven and non-woven geotextiles. Knitted and stitch bonded geotextiles are occasionally used in the manufacture of specialty products. Non-woven geotextiles are highly desirable for subsurface in planer drainage, and erosion control applications as well as, for road stabilization over wet moisture sensitive soils. Out of woven geotextiles, slit film fabrics geotextiles are commonly used for sediment control, that is silt fence and road stabilization applications but are poor choices for subsurface drainage and erosion control applications. Monofilament woven geotextiles have better permeability making them suitable for certain drainage and erosion control applications. High strength multifilament woven geotextiles are

primarily used in reinforcement applications. The followings are the major applications of geotextiles:

1) **Subsurface drainage:**

Effective water control is vital for structures like buildings and pavements. Traditional drainage methods using costly graded aggregates can now be replaced with geotextiles, offering a cost-effective and efficient solution. Geotextiles are being used in lieu of select grades of sand for effective dewatering to accept seepage and act as properly graded filter to prevent piping of subgrade soil because they are less expensive, provide more consistent properties and are much easier to install. These fabrics, whether non-woven or woven polypropylene or polyester, serve as permeable separators, preventing soil erosion and allowing fluid passage. Geotextiles must possess strength and durability, and their characteristics influence filter functions. Efficient edge drain systems with geotextiles have proven to extend the service life of pavements significantly, showcasing the practical benefits of this approach. The geotextile shall also have the strength and durability to survive construction and long-term conditions for the design life of the drain. Additionally, construction methods have a critical influence on geotextile drain performance.

2) Subgrade separation and Stabilization:

Geotextiles and geogrids play a pivotal role in enhancing the performance and longevity of both paved and unpaved roads. When serving as separators, geotextiles prevent fines from migrating into the base course or aggregate from penetrating the subgrade. Their soil retaining properties align with drainage and filtration requirements, ensuring efficient water control. Geosynthetics provide valuable solutions for subgrade stabilization, functioning either as separators or for lateral restraint and aggregate confinement based on subgrade California Bearing Ratio (CBR). The separator application is limited to soils which either in initially or seasonably have a CBR > 3 but < 8. For temporary roads, non-woven geotextiles or biaxial geogrids are recommended, while permanent roads with high traffic volumes benefit from geotextiles or geogrids designed for separation or reinforcement, depending on soil conditions. Geosynthetics also find utility in interlayers for distressed road surfaces, offering moisture barrier capabilities and aiding in rehabilitation efforts.

3) **Erosion Control:**

Soil banks or slopes exposed to constant concentrated flows, currents or waves cannot support vegetation and thus need to be protected from erosion by hard armor systems. These systems include fabric formed revetments, gabions, articulating concrete blocks and riprap. In a hard armor system, water can seep in or out of the bank or slope and gradually carries soil particles with it creating voids causing loss of armor support over time called piping and thus culminates in shifting, rolling or other instability in the armor system. Traditional methods involving graded sand filters can be costly and challenging, especially on steep slopes. Geotextiles offer a cost-effective solution as filter layers in hard armor systems. Their selection, either non-woven or woven, depends on the soil gradation. The primary function of geotextile in erosion control applications is filtration. Geotextile filtration properties are a function of site hydraulic conditions and the in-situ soil gradation, density, and plasticity.

For long-term durability, geotextile survivability is crucial, addressing factors like thickness, construction equipment, backfill characteristics, polymer type, and manufacturing processes.

4) **Separation/Filtration in Railway Formation:**

Geotextiles are increasingly utilized in railway track bed construction to improve performance, extend design life, and minimize maintenance. With the rise of heavy and faster trains in response to growing transportation demands, cyclic loading can cause progressive track deterioration. This is particularly evident in ballast layers, leading to excessive deformations and costly maintenance. Geotextiles address these challenges by preventing the penetration of granular particles into soft subgrades, preserving layer thickness and enhancing track longevity. For optimal performance, geotextiles must withstand concentrated stresses (tear, puncture, burst) and feature aperture sizes compatible with retained material particles. Geotextiles also serve as effective filters in preventing the transport of fines from subgrade into overlying granular layers caused by increased stress levels during train passage and pumping. To fulfill this filtration role, geotextiles must possess sufficient permeability, retention properties, and resistance to clogging, enabling water to pass through freely while retaining solid subgrade particles.

1 SCOPE

1.1 This standard specifies general and performance requirements for geotextiles made from polyolefins, polyesters or polyamides material used in:

a) subsurface drainage, subgrade separation, subgrade stabilization, erosion control applications
b) separation/filtration application in railway formation on top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment or used below the ballast and above the blanket layer

NOTES

a) This is a material purchasing specification and design review of its use for intended applications is recommended. This is not a construction or design specification. Subsurface drainage, separation, stabilization, and erosion control in hard armor systems, are site specific design issue which should be addressed by site engineer. Engineers responsible for drainage structure design or pavement and embankment design, should address the following specifics:

    1) *Subsurface drainage* — geotextile type, structure and associated details, shall be as shown on the contract drawings.
    2) *Subgrade Separation* — geotextile type, cover material thickness, pavement cross-section and associated details, shall be as shown on the contract drawings.
    3) *Subgrade Stabilization* — geotextile type, cover material thickness, pavement cross-section and associated details, shall be as shown on the contract drawings.
    4) *Erosion control* — geotextile type and thickness, slope steepness, fill thickness and associated details, shall be as shown on the contract drawings.

b) This specification is not appropriate for embankment reinforcement where stress conditions may cause global sub-grade foundation or embankment failure.
c) This standard and specification are based on the minimum requirements of the geotextile to provide drainage, filtration, tensile reinforcement, and survivability from installation stress. The physical properties listed in Table 2 and Table 3 are applicable for a minimum backfill thickness of 150 mm. However, in general, the geotextile shall be placed at the proper elevation, location and orientation as detailed on the plans and specification. Unless otherwise specified in the project specification, the contractor shall follow the construction/installation guidelines in the relevant Indian Standard.
d) Additionally, the specification includes default geotextile selection criteria related to erosion control in hard armor layer for varying severity conditions of armor layer stone weights and drop heights, with or without an aggregate bedding layer:

    1) Armour layer stone weights do not exceed 100 kg, stone drop height is less than 1 m and no aggregate bedding layer is required; and
    2) Armour layer stone weights exceed 100 kg, stone drop height is less than 1 m and the geotextile is protected by a 150 mm thick aggregate bedding layer designed to be compatible with the armor layer.

2 REFERENCES

The following standards 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 are listed in Annex A.

3 DEFINITIONS

For the purpose of this standard, the definitions given in IS 13321 (Part 1) and following definitions shall apply.

3.1 Minimum Average Roll Value (MARV) — The average value of roll minus two times the standard deviation. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing shall exceed value reported.

3.2 Sub-grade Improvement — The improvement of the bearing capacity and mitigation of deformation of the sub-grade soil by placing a geotextile immediately over a soft sub-grade soil. The goal of this application may be to reduce undercut requirements, improve construction efficiency, reduce the amount of aggregate subbase/base material required, provide a stiff working platform for pavement construction, or combination of these.

3.3 Traffic Benefit Ratio (TBR) — Also known as Traffic Improvement Factor (TIF), it is the ratio of reinforced load cycles to failure (excessive rutting) to the number of cycles that cause failure of an unreinforced road section. Thus, it compares the performance of a pavement cross-section with a geotextile-reinforced base course to a similar cross-section without geotextile reinforcement, based on the number of cycles to failure. The failure is defined as a selected depth of rut through repetitive loading applied by a passing wheel load of at least 2 041.2 kg (4 500 lbs) per single wheel or 4 082.4 kg (9 000 lbs) per dual wheel.

3.4 Erosion versus Sedimentation — Erosion occurs when soil particles are displaced due to the impact of raindrops, moving water or wind. Sedimentation occurs when eroded particles (sediments), carried by water or wind, are deposited in another location where they can cause problems. Clearly, sediments (suspended eroded particles) and sedimentation (redeposited soil particles) cause the problems commonly associated with erosion. Erosion control can prevent problems from ever starting. Sediment control can only attempt to minimize the extent of these problems.

3.5 Filtration — The long-term free flow of water from the subgrade through the geotextiles into a subsurface drain system retaining the *in-situ* soil solid particles

4 MATERIALS

4.1 The geotextiles shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties.

4.2 Polymers used in the manufacture of geotextiles, and the mechanical fasteners or threads used to join adjacent rolls, shall consist of long chain synthetic polymers, composed of at least 95 percent by weight of polyolefins (polyethylene or polypropylene), polyesters or polyamides when tested as per dissolution method in respective solvents as specified in IS 667. They shall be formed into a stable network such that the ribs, filaments or yarns retain their dimensional stability relative to each other, including selvedges. Polyolefin material shall be made resistant to ultraviolet light by adding 2-3 percent carbon black with uniform dispersion and if required a suitable UV stabilizer may be added. Recycled polyester shall not be used in the manufacture of geotextiles and only virgin polyester shall be used for manufacture of polyester containing geotextiles. The isophthalic acid content of the virgin polyester shall be nil when tested according to the method prescribed in Annex B.

5.3 Geotextiles shall be dimensionally stable and able to retain their geometry under manufacture, transport and installation. Woven slit film geotextiles (that is, geotextiles made from yarns of a flat, tape-like character) shall not be used.

6 STRENGTH AND DURABILITY REQUIREMENT FOR GEOTEXTILE USED IN SUBSURFACE DRAINAGE, SUBGRADE SEPARATION, SUBGRADE STABILIZATION, EROSION CONTROL APPLICATIONS

6.1 Geotextiles shall be of following three classes depending upon the survivability conditions:

a) *Class* 1H — For severe or harsh survivability conditions, where there is a greater potential for geo-textile damage.
b) *Class* 2H — For typical survivability conditions; this is the default classification to be used in the absence of site specific information.
c) *Class* 3H — For mild survivability conditions, where there is lower risk of geotextile damage.

6.2 The geo-textiles used for subsurface drainage, separation, stabilization and erosion control application shall meet the strength and durability requirements as given in Table 1 and specific requirements as given at **7,** based on their applications.

NOTES

1 All numeric values in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6 except Apparent Opening Size (AOS), represent MARV in the weakest principal direction. Values for AOS represent maximum average roll values.

2 The property values in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6 represent default values which provide for sufficient geotextile reinforcement and survivability under most construction conditions.

3 Average of test results from any sampled roll in a lot shall meet or exceed the minimum values specified in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6.

Table 1 Strength and Durability Requirements for Geotextile of Different Classes

(*Clauses* 6.2 *and* 9.4)

Sl No.	Property	Requirement						Method of test, Ref to
		Class 1H		Class 2H		Class 3H		
		Strain < 50%	Strain > 50%	Strain < 50%	Strain > 50%	Strain < 50%	Strain > 50%	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
a)	**Index properties**							
i)	Type of geotextile	Woven/non-woven						-
ii)	Roll length, m, *Min*	50 or 100 or as agreed						IS 1954
iii)	Roll width, m, *Min*	2.0 or 5.0 or as agreed						IS 1954
iv)	Grab strength, N, *Min*	1 400	900	1 100	700	800	500	IS 16342
v)	Sewn seam strength, N, *Min* (*see* Note 1)	1 200	810	990	630	720	450	IS 15060
vi)	Trapezoidal Tear strength, N, *Min*	500	350	400	250	300	180	IS 14293
vii)	CBR Puncture strength, N, *Min*	2 800	2 000	2 200	1 400	1 700	1 000	IS 13162 (Part 4)
viii	Burst strength, kPa, *Min*	3 500	3 500	2 700	1 300	2 100	950	IS 1966 (Part 2)
ix)	Abrasion strength (*see* Note 2)	550	400	350	-	-	-	IS 14714
b)	**Durability properties**							
i)	Resistance to installation damage, percent retained strength, SC/SW/GP (*see* Note 3), *Min*	95/93/90						IS 17420
ii)	Ultraviolet stability at 500 h, retained strength, percent of original strength, *Min*	70						IS 13162 (Part 2)

NOTES

1 The parameter shall be tested, when product is supplied with seam. Refer to IS 16344, IS 16345 and IS 16363 for stitch and overlap seam requirements based on the different geotextile applications.
2 Abrasion strength shall be tested for the geotextiles used in erosion control applications only. After abrading the geotextiles for 250 cycles, the grab strength shall be calculated by the method specified in IS 16342.
3 Resistance to installation damage (loss of load capacity or structural integrity) when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW) and crushed stone classified as poorly graded gravel (GP).
4 Class 2 geotextile may be specified for trench drain application based on field experience, laboratory testing and visual inspection of a geotextile sample removed from a field test section or when the subsurface drain depth is less than 2 m and drain aggregate is less than 30 mm.
5 In addition to the above default filtration property value of permittivity and AOS, site specific geotextile design may be performed if one or more of the following problematic soil environments is encountered: unstable or highly erodible soils such as non-cohesive silts, gap graded soils, alternating sand/silt laminated soils, dispersive clays and/or rock flour.

7 SPECIFIC REQUIREMENTS BASED ON APPLICATIONS

7.1 Subsurface Drainage Application

7.1.1 The function of sub-surface drainage refers to placing a geotextile against a soil to allow for long term passage of water into a subsurface drain system retaining the *in situ* soil. The primary function of the geotextile in subsurface drain system is filtration. Geotextile filtration properties are a function of the in-situ soil gradation, plasticity and hydraulic conditions.

7.1.2 The geo-textiles used for subsurface drainage applications shall meet the requirements as given in Table 1 and Table 2.

Table 2 Requirements of Geotextiles for Subsurface Drainage Application
(*Clauses* 7.1.2 *and* 9.4)

Sl No.	Property	Requirements			Method of test, Ref to
		Course soil	Medium soil	Fine soil	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Geo-textile class	Class 2 or Class 3			*see* Table 1
ii)	Permittivity[1)], s^{-1}, *Min*	0.5	0.2	0.1	IS 14324
iii)	AOS[2,3)], mm, *Max*	0.43	0.25	0.22[3)]	IS 14294

[1)] In addition to default permittivity value, the engineer may require geo-textile permeability and/or performance testing in problematic soil environments.
[2)] Site specific geo-textile design should be performed, if unstable or highly erodable soils such as non-cohesive silts; gap-graded soils; alternating sand/silt laminated soils; dispersive clays; and/or rock flour are encountered.
[3)] For cohesive soils with a plasticity index greater than 7, minimum average roll value shall be 0.30 mm.

NOTE — The structural integrity properties of geotextile is affected by the in-situ soil gradation. Geotextile fabric selection is determined by the presence of coarse, medium, or fine soil particles at the installation site. Soil classification into these categories is based on the percentage of particles passing through a 0.075 mm (200 mesh) sieve:

a) Course soil: *In situ* soil passing <15 percent
b) Medium soil: *In situ* soil passing 15 to 50 percent
c) Fine soil: *In situ* soil passing >50 percent

7.2 Subgrade Separation Application

7.2.1 The function of separation in this application refers to using a tensile member in the form of a geotextile between the aggregate cover material and the soft sub-grade soil with the intent of either increasing the structural support capacity of that component of the pavement structure and hence its life or reduce the initial cost. The geotextile separator may provide one or more of the following functions:

a) A filter to allow water but not soil to pass through it;
b) A separator to prevent the mixing of the soft soil and the granular material; and
c) A reinforcement layer to resist the development of rutting.

7.2.2 The separation application is appropriate for pavement structures constructed over soils with
California Bearing Ratio greater than or equal to three (CBR ≥ 3) and shear strength greater than approximately 90 kPa. It is appropriate for unsaturated sub-grade soils. The primary function of a geotextile in this application is separation.

7.2.3 The geo-textile meant for separation shall meet the requirements of Table 1 and Table 3.

Table 3 Requirements of Geotextiles for Separation Application
(*Clauses* 7.2.3 *and* 9.4)

Sl No.	Property	Requirements	Method of test, Ref to
(1)	(2)	(3)	(4)
i)	Geo-textile class	Class 2 or Class 3	*see* Table 1
ii)	Permittivity, s^{-1} , *Min*	0.02	IS 14324
iii)	AOS, mm, *Max*	0.60	IS 14294
NOTE — Permittivity of the geo-textile should be greater than that of the soil.			

7.3 Subgrade Stabilization Application

7.3.1 The function of stabilization in this application refers to using a tensile member in the form of a geotextile between the aggregate cover material and the soft subgrade soil with the intent of either increasing the structural support capacity of that component of the pavement structure and hence its life or reduce the initial cost. The geotextile may also serve to stabilize the sub-grade provided the geotextile conforms to the requirements for separation and filtration as prescribed in relevant specifications. The stabilization function of geotextile is applicable to pavement structures constructed over existing subgrade soils with a California Bearing Ratio between 1 and 3 (1 < CBR < 3), and shear strength between approximately 30 to 90 kPa. The stabilization application is appropriate for subgrade soils which are saturated due to a high ground water table or due to prolonged periods of wet weather.

7.3.2 The geo-textile for the purpose of subgrade stabilization shall meet the requirements as given in Table 1 and Table 4.

Table 4 Requirements of Geotextiles for Stabilization Application
(*Clauses* 7.3.2 *and* 9.4)

Sl No.	Property	Requirements	Method of test, Ref to
(1)	(2)	(3)	(4)
i)	Geo-textile class	Class 1 or Class 2 or Class 3	*see* Table 1
ii)	Permittivity, s^{-1} , *Min*	0.05	IS 14324
iii)	AOS, mm, *Max*	0.43	IS 14294
NOTE — Permittivity of the geo-textile should be greater than that of the soil.			

7.4 Erosion Control Requirements

7.4.1 The function of erosion control in this application refers to use of geotextile between energy absorbing armor systems and the *in situ* soil to prevent the soil loss resulting in excessive scour and to prevent hydraulic uplift pressures causing instability of the erosion control systems.

NOTE — This standard does not apply to other types of geosynthetic erosion control materials such as turf reinforcement mats.

7.4.2 The primary function the geotextile serves in erosion control applications is filtration. Geotextile filtration properties are a function of hydraulic conditions and *in situ* soil gradation.

7.4.3 The geo-textiles for soil erosion applications shall meet the requirements as given in Table 4. Average of test results from any sampled roll in a lot shall meet or exceed the minimum values specified in Table 1 and Table 5.

Table 5 Requirements of Geotextiles for Erosion Control Application
(*Clauses* 7.4.3 *and* 9.4)

Sl No.	Property	Requirements			Method of test, Ref to
		Course soil	Medium soil	Fine soil	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Geo-textile class	Class 1 or Class 2			*see* Table 1
ii)	Permittivity, s^{-1} , *Min*	0.7	0.2	0.1	IS 14324
iii)	AOS, mm, *Max*	0.43	0.25	0.22[1)]	IS 14294

1) For cohesive soils with a plasticity index greater than 7, maximum average roll value for apparent opening size for geotextile material shall be 0.3 mm.

NOTE — The structural integrity properties of geotextile is affected by the in-situ soil gradation. Geotextile fabric selection is determined by

the presence of coarse, medium, or fine soil particles at the installation site. Soil classification into these categories is based on the percentage of particles passing through a 0.075 mm (200 mesh) sieve:

a) Course soil: *In situ* soil passing <15 percent
b) Medium soil: *In situ* soil passing 15 to 50 percent
c) Fine soil: *In situ* soil passing >50 percent

8 REQUIREMENTS FOR GEOTEXTILE USED IN SEPARATION/FILTRATION APPLICATIONS IN RAILWAY FORMATION

8.1 The non-woven geotextiles to be used as separator/filtration layer (primary role as separator and secondary role as filtration) in railway application are either used on top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment or used below the ballast and above the blanket layer. The non-woven geotextile used as separator/filtration application shall be of following two types:

a) *Class* 1R — Geotextiles which are used on top of subgrade or prepared subgrade before laying blanket or anywhere within the embankment
b) *Class* 2R — Geotextiles which are used below the ballast and above the blanket layer

8.2 The non-woven geotextile used as separator/filtration application in railway formation shall meet the requirements as given in Table 6.

Table 6 Requirements of Geotextiles for Separation/Filtration Applications
(*Clauses* 8.2 *and* 9.4)

Sl No.	Property	Requirements		Method of test, Ref to
		Class 1R	Class 2R	
a)	**Index Properties**			
i)	Type of geotextile	Non-woven (needle punched and mechanically or thermally bonded type or equivalent)		-
ii)	Roll length, m, *Min*	50 or 100 or as agreed		-
iii)	Roll width, m, *Min*	5.0 or as agreed		-
iv)	Elongation at break, Percentage, *Min*	50		IS 16342
v)	Grab strength, N, *Min*	700	1 750	IS 16342
vi)	Trapezoidal tear strength, N, *Min*	250	800	IS 14293
vii)	CBR puncture strength, N, *Min*	1 800	5 800	IS 16078
b)	**Hydraulic Properties**			
i)	Apparent opening size, Micron, *Max*	85		IS 14294
ii)	Water flow rate normal to the plane,	20		IS 17179

	ltr/m^2/sec, *Min*		
c)	**Durability Properties**		
i)	Abrasion strength, percentage retained strength in breaking load, *Min*	80	IS 14714
ii)	Resistance to UV light weathering, Percentage retained strength in breaking load after 500h UV exposure, *Min*	70	IS 13162 (Part 2)
iii)	Minimum retained ultimate tensile strength (for 100 years service life), Percent	50	Annex C

9 SAMPLING AND CRITERIA FOR CONFORMITY

9.1 Lot

The quantity of the same class of geotextile manufactured from the same polymer under identical conditions and supplied to a buyer against one dispatch note shall constitute a lot.

9.2 Sampling for tests shall be done in accordance with IS 14706 from each lot. Acceptance shall be based on testing of conformance samples obtained using procedure given in IS 14706.

9.3 Testing of samples shall be performed in accordance with the methods referred to in this standard for the indicated requirement(s). The number of specimens to test shall be as specified in each test method. Product acceptance shall be determined by comparing the average test results of all the specimens within a given sample to the specified MARV.

9.4 Criteria for Conformity

The geotextile shall be tested for all the requirements as specified in Table 1 or Table 2 or Table 3 Table 4, Table 5 or Table 6 and **4.1** to **4.3** of this standard. When any individual sample fails to meet any specification requirement, that roll shall be rejected and two additional sample rolls shall be selected from the same lot. The lot shall be declared conforming to the requirements of this standard, if neither of these two additional samples fails to comply with any part of this specification, otherwise the entire quantity of rolls represented by that sample shall be rejected.

10 MARKING AND LABELLING

10.1 The geotextile material shall be marked with the following by attaching the printed labels:

a) Manufacturer’s name, initials or trade-mark;

b) Identification of the geotextile material as per manufacturer's recommendation, for example, polyester multifilament woven geotextile for erosion control;
c) Class of geotextile material, that is Class 1H, Class 2H or Class 3H, Class 1R or Class 2R;
d) Batch number, lot number and roll number;
e) Date of manufacture of geotextile material;
f) The country of origin; and
g) Any other information/instruction prescribed by the manufacturer or by the law in force.

10.2 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 thereunder, and the product(s) may be marked with the Standard Mark.

11 PACKING

The geotextile shall be packed in rolls or as per the contract or order. Each roll or package shall be
protected by wrapping it in a LDPE film of minimum thickness of 40 µ to prevent it from the adverse impact of heat and moisture, oil, grease, dirt, dust and other stains during shipment and storage prior to deployment.

12 INFORMATION AND SAMPLES TO BE SUBMITTED BY THE MANUFACTURER

The manufacturer shall submit to the purchaser the following:

a) Geotextile product sample approximately one square metre or larger;
b) Geotextile product data sheet and certification from himself or by third party certification such as the use of the Standard Mark stating that the geotextile product supplied meets the requirements of this standard; and
c) Manufacturer's installation instructions and general recommendations.

13 STORAGE AND PROTECTION

13.1 During storage, elevate the geotextile rolls off the ground and adequately protect them from the following:

a) Site construction damage;
b) Excessive precipitation;
c) Extended exposure to sunlight;
d) Aggressive chemicals;
e) Flames or temperatures in excess of 71°C;

f) Excessive mud, wet concrete, epoxy, or other deleterious materials coming in contact with and affixing to the geotextile material; and
g) Any other environmental condition that may damage the physical property values of reinforcement.

13.2 Store the geotextile material at temperatures above -20°C.

13.3 Lay the rolled materials flat or vertical on ends.

13.4 Do not leave the geotextile material directly exposed to sunlight for a period longer than the period recommended by the manufacturer.

13.5 Each geotextile roll shall be wrapped with a material that will protect it from damage due to shipment, water, sunlight and contaminants.

13.6 Keep geotextile dry until installation, and do not store directly on the ground.

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No	*Title*
IS 667 : 1981	Methods for identification of textile fibres (*first revision)*
IS 1070:2023	Reagent grade water — Specification (*fourth Revision*)
IS 1954 : 1990	Determination of length and width of woven fabrics — Methods (*second revision*)
IS 13162 (Part 2) : 1991	Geotextiles — Methods of test: Part 2 Determination of resistance to the exposure of ultraviolet light and water (xenon-arc type apparatus)
IS 13162 (Part 4) : 1992	Geotextiles — Methods of test: Part 4 Determination of puncture resistance by falling cone method
IS 14293 : 1995	Geotextiles — Method of test for trapezoid tearing strength
IS 14294 : 1995	Geotextiles — Method for determination of apparent opening size by dry sieving technique
IS 14324 : 1995	Geotextiles — Methods of test for determination of water permeability permittivity
IS 14706 : 1999	Geotextiles — Sampling and preparation of test specimens
IS 14714 : 1999	Geotextiles — Determination of abrasion resistance
IS 16078 : 2013	Geosynthetics — Static puncture test (CBR test)
IS 16344 : 2015	Geosynthetics — Guidelines for installation of geotextile for permanent erosion control in hard armor systems
IS 16345 : 2020	Geosynthetics — Guidelines for installation of geotextile used in subgrade separation in pavement structures (*first revision*)

IS 16342 : 2015	Geosynthetics — Method of test for grab breaking load and elongation of geotextiles
IS 16363 : 2015	Geosynthetics — Guidelines for installation of geotextile used in subsurface drainage application
IS 1966 (Part 2): 2022/ ISO 13938-2:2019	Textiles — Bursting properties of fabrics Part 2: Pneumatic method for determination of bursting strength and bursting distension (*third revision*)
IS 13321 (Part 1) : 2022/ ISO 10318-1:2015	Geosynthetics — (Part 1) : Terms and definitions
IS 15060 : 2018 / ISO 10321 : 2008	Geosynthetics — Tensile test for joint seams by wide-width strip method (first revision)
IS 17179 : 2019 ISO 12958 : 2010	Geotextiles and geotextile-related products — Determination of water flow capacity in their plane
IS 17360 : 2020/ ISO 13438 : 2018	Geosynthetics — Screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation
IS 17420 : 2020 ISO 10722 : 2019	Geosynthetics — Index test procedure for the evaluation of mechanical damage under repeated loading — Damage caused by granular materials (Laboratory test method)

ANNEX B

(*Clause* 4.2)

METHOD OF TEST FOR ISOPHTHALIC ACID CONTENT OF THE VIRGIN POLYESTER FIBRE

B-1 PRINCIPLE

This method is applicable to measure isophthalic acid content in polyethylene terephthalate sample. The polymer sample is digested in benzyl alcohol, depolymerized then esterified to dibenzyl isophthalate, dibenzyl terephthalate and glycol's. Isopropyl titanate is added as a depolymerization catalyst. The sample is analyzed by gas chromatography and the peak areas of the two esters are used to estimate the weight percentage dimethyl isophthalate using an internal standard.

B-2 POTENTIAL ENVIRONMENT ISSUE

B-2.1 In case of spillage, it can lead to pollution near the workplace area and environment hazard. After analysis sample is disposed as per laid down procedure.

B-2.2 Hydrogen, nitrogen and instrument air are used during analysis. The hydrogen gas has no adverse ecological effects are expected. Hydrogen does not contain any Class I or Class II ozone depleting chemicals. However, hydrogen is explosive. Gaseous nitrogen is an inert non-

flammable gas. High concentration in air may cause deficiency of oxygen with the risk of unconsciousness and death. Chloroform in high concentration in air can kill most animals in few minutes.

B-3 POTENTIAL SAFETY, OCCUPATIONAL HEALTH ISSUES

B-3.1 Proper PPE's like safety goggles, apron, surgical hand gloves to be used.

B-3.2 Glassware is to be handled with care.

B-3.3 Leak check to be carried out while handling of gas cylinder.

B-3.4 Glassware is to be handled with care.

B-3.5 Inhalation of chloroform causes dilation pupils with reduced reaction to light as well as reduced intraocculat pressure. Irritation of mucous membrane, conjunctiva. If contacted with skin and eyes cause irritation. Seek medical advice if inhaled.

B-3.6 Use leather hand gloves while handling hot apparatus and equipments.

B-4 APPARATUS

B-4.1 Gas Chromatograph (GC), with flame ionization detector.

B-4.2 Capillary Column, 60 m length and 0.53 mm ID MXT ® - 1

B-4.3 Dispensette or Pipette, 2 ml, 5 ml and 10 ml.

B-4.4 Volumetric Flask, 100 ml, 500 ml.

B-4.5 Beaker

B-4.6 Funnel

B-4.7 Flask, 50 ml

B-4.8 Heating Mental, to maintain temperature of 250°C

B-4.9 AR Grade Dimethyl Isopthalate (DMI)

B-4.10 AR Grade Benzyl Alcohol

B-4.11 AR Grade Chloroform

B-4.12 AR Grade Isopropyl Titnate

B-4.13 AR Grade Dimethyl Suburate

B-5 PREPARATION OF STANDARD SOLUTIONS

B-5.1 Stock Dibenzyl Suburate (Internal Standard) Solution

Take 1.0 ± 0.01 g of dimethyl suburate (DMS). Add 100 ml of benzyl alcohol and 6 to 7 drops of isopropyl titnate digest it for 2 h. Allow it to cool up to room temperature then make the volume to 500 ml by carefully rinsing the flask by isopropyl alcohol. Dimethyl suburate will get converted into dibenzyl suburate (DBS). Mark the stock solution as DBS per 2ml ≈ X·XXXX mg

B-5.2 Stock Dimethyl Isopthalate (DMI) Solution

Take 0.2 ± 0.01 g of dimethyl isopthalate (DMI). Add 40 ml of benzyl alcohol and 6 to 7 drops of isopropyl titnate digest it for 2 h. Allow it to cool up to room temperature then make the volume to 100 ml by carefully rinsing the flask by isopropyl alcohol. This will be converted to dibenzyl isopthalate (DBI). Mark the stock solution as DBI per 2 ml ≈ X·XXXX mg.

B-5.3 Standard Solution for Response Factor

Take 2 ml of solution prepared in **B-5.1** and 2 ml of solution prepared in **B-5.2**. Add 10 ml of chloroform.

B-5.4 2.0 Percent Standard IPA Stock Solution

Weigh out accurately 0.200 ± 0.005 g of pure DMI powder into round bottom flask, add 30 ml of benzyl alcohol and 3 drops of isopropyl titante, reflux the solution for 5 h reagent and dilute to 100 g by isopropyl alcohol, calculate actual DMI concentration by considering its purity and label the flask with actual weight taken. Consider this weight during calculation of IPA by GC.

B-5.5 2.0 Percent Standard IPA Solution for GC Injection

Take 2.0 ml IPA stock solution and add 2 ml internal standard (*see* **B-5.1**) and further add 10 ml of chloroform, same bottle to be labelled as 2.0 percent IPA Inject 1 µl in GC.

B-6 CALIBRATION FOR PERFORMANCE CHECK – TWICE /MONTH STANDARD CHIPS

B-7 ANALYTICAL PROCEDURE

Inject 1 µl of standard solution for response factor (*see* **B-5.3**) and calculate response factor. Inject 1 µl of 2 percent standard IPA solution. If value of 2.0 percent standard IPA solution is varying in the range of 0.01 percent, then there is no need for change in response factor. If there is deviation in value then rerun standard solution for response factor (*see* **B-5.3**). Weight 0.2 ± 0.02 g of chips into the round bottom flask. Add 2 ml of benzyl alcohol. Add 3 drops of isopropyl titanate. Digest the solution for 1 h. Allow it to cool up to room temperature. Add 10 ml of chloroform. Add 2 ml of internal standard solution that is solution prepared in **B-5.1** and shake vigorously. Inject 1 µl of sample solution into gas chromatograph.

B-8 CHROMATOGRAPH SETTINGS

Injector temperature	: 300 °C
Detector temperature	: 320 °C
Oven temperature	: 270 °C

Gas flow rates

Nitrogen	: 20 psig
Hydrogen	: 30 ± 10 ml/min
Air	: 300 ± 20 ml/min
Attenuation	: – 4
Range	: 1

B-9 CALCULATION

$$\text{Response factor (RF)} = \frac{A_1 \times W_2}{A_2 \times W_1}$$

where

A_1 = area of dibenzyl suburate (DBS) (internal standard) solution;
W_1 = weight of DBS in solution, in mg;
A_2 = area of DBI in standard solution; and
W_2 = weight of DBI in standard solution, in mg.

$$\text{Percent IPA} = \frac{\text{RF} \times \text{mg Internal Standard} \times \text{Area of IPA in sample} \times 100}{\text{Weight of sample, in mg} \times \text{Area of internal standard in sample}}$$

ANNEX C
(*Table* 6)

METHOD FOR DETRMINATION OF DURABILITY OF GEOTEXTILES

C-1 GENERAL
C-1.1 Service life

The provisions and assessment methods of this annex are based upon the intended use of geotextiles, and their foreseen service life in years. They are based upon the current state of the art, knowledge and experience. The service life refers to the period during which the geosynthetic retains the required properties of this annex, assuming it was properly installed, used and maintained. For a geosynthetic which satisfies the requirements of this annex the service life represents a minimum indication. The real service life, for normal conditions of use, may turn out to be considerably longer without major degradation affecting the essential requirements of the works. The indicated service life of the geosynthetic cannot be interpreted as a guarantee given by the manufacturer but should be regarded only as a tool for selecting a product suitable for the anticipated working life. The tests described in this annex do not allow the determination of reduction factors. The tests described in this annex are screening tests to show the ability of a product to serve for a certain time. The reference strength and retained strength of products investigated in this Annex C shall be determined in the same way in accordance with IS 16342.

C-1.2 Initial and Repeat Testing of Durability

C-1.2.1 A product shall be submitted to an initial testing of its durability in accordance with this annex. A product that is unchanged shall be tested again after 5 years. A product is considered unchanged if the raw material supply, the production technology and the process and stabilization of the product have not been subject to a significant process change. If a product has been subject to a significant process change, then it shall be tested in the same manner as a new product.

C-1.2.2 A significant process change is defined as any of the following:

a) a change in the chemical formulation (CAS No);

b) reduced active ingredient concentration levels of raw materials in the polymer recipe;

c) substitution of any polymer in the recipe, irrespective of any change in concentration.

C-1.2.3 After the durability tests specified in **C-2** the test specimens are subjected to tensile test given in IS 16342. The retained tensile strength is compared to the original tensile strength of reference specimens (result expressed in percentage retained strength).

C-1.2.4 The lightest product variant in a family shall be the variant selected for durability testing. If a manufacturer produces a lighter variant after the initial type testing, it is the responsibility of the manufacturer to decide whether the change is of sufficient magnitude to require the product to be tested as a new product. If the manufacturer decides the change is significant, he shall test the light variant as a new product. If the manufacturer decides this change is not significant, he can use his existing durability data to make a statement for the new product.

C-2 TESTS FOR SPECIFIC MATERIALS

C-2.1 Polyester (PET)

C-2.1.1 A non-reinforcing product consisting solely of PET shall be tested for resistance to internal hydrolysis following test given in **Annex D**.

C-2.1.2 The minimum retained strength shall be 50 percent.

C-2.2 Polypropylene (PP) and Polyethylene (PE)

C-2.2.1 A product consisting solely of PP or PE shall be tested for resistance to oxidation following IS 17360 (method A), with the following modifications:

a) The test specimen shall be stored in water (Grade 2 according to IS 1070) at 80 °C for 28 d before testing. The medium shall be changed every 7 day and moved once per day;

b) Test temperature: 100 °C;

c) Test duration: 112 d.

C-2.2.2 The minimum retained strength shall be 50 percent.

C-2.3 Polyamide (PA)

C-2.3.1 Oxidation resistance

C-2.3.1.1 A product consisting solely of PA-6 or PA-6.6 shall be tested for resistance to oxidation following IS 17360 (method B) with the following modifications:

a) The test specimen shall be stored in water (Grade 2 according to IS 1070) at 80 °C for 28 d before testing. The medium shall be changed every 7 day and moved once per day;

b) Test temperature: 100 °C;

c) Test duration: 112 d.

C-2.3.1.2 The minimum retained strength shall be 50 percent.

C-2.3.2 Hydrolysis resistance

C-2.3.2.1 A product consisting solely of PA-6 or PA-6.6 shall be tested for resistance to hydrolysis according to **Annex D**.

C-2.3.2.2 The minimum retained strength shall be 50 percent.

ANNEX D
(*Annex* C)

METHOD FOR DETERMINATION OF RESISTANCE TO HYDROLYSIS IN WATER

D-1 PRINCIPLE

The test and control specimens are immersed in hot water for specified durations and at a specified temperature. The properties of the specimens are determined after immersion. Both the machine and cross machine direction shall be tested unless otherwise agreed.

D-2 REAGENT

Water, according to IS 1070, class 3.

D-3 APPARATUS

D-3.1 Container

Container having the following properties shall be used:

a) The container shall be made of a material which is inert under the conditions of test such as stainless steel or borosilicate glass.

b) The total volume of the test specimens shall not exceed 10 percent of the free space in the container. The test specimens shall be suspended free of significant load and shall be exposed to the test medium on both sides.

c) The container shall be provided with a means of heating and controlling the temperature to (80 ± 2) °C and a separate means of recording the temperature of the solution.

NOTE — Experience has shown that some types of glass are susceptible to hydrolysis. Make sure to regularly control that no corrosion in the container is occurring.

D-3.2 Thermometer

A thermometer capable of measuring the temperature with an accuracy of ± 1 °C.

D-4 PREPARATION OF THE TEST SAMPLE

D-4.1 Size and shape

Prepare specimens to the size and shape specified in IS 16342. If the requirements of IS 16342 cannot be met due to container capacity, then the relevant components should be tested individually.

D-4.2 Number of specimens

Prepare enough specimens to provide a minimum of five test specimens and five control specimens in each test direction.

It is recommended to expose additional specimens in case an extra mechanical test is required (*see* **D-6**).

D-5 PROCEDURE

a) De-ionized water as specified in **D-2** shall always be used in the tests.

NOTE — The quality of the water used as hydrolysing agent in this test is important for the reproducibility of the test results.

b) Expose the test specimens, free of significant load, on both sides to the test medium.

c) The test temperature shall be (80 ± 2) °C and recorded at least once a day.

d) Because shrinkage may occur during the test, all specimens should be mounted in such a way that not significant pre-tension occurs during the exposure to the water.

e) The ratio between the mass of water and the mass of the test specimens shall be at least 30 : 1. Cover the specimens completely with water. Do not treat materials differing in chemical composition in the same enclosure.

f) The test duration for service life of 100 years shall be as follows:

    i) For Polyester (PET) products: 56 days
    ii) For PA-6 or PA-6.6 products: 112 days

g) The control specimens shall be exposed to the same environment for 6 hours and then removed and stored in dark at room temperature.

D-6 DETERMINATION OF CHANGES IN PROPERTIES

The test and control specimens shall be conditioned for at least 16 h at (20 ± 2) °C and (65 ± 5) percent relative humidity before evaluation of the desired properties. For type of test method refer to IS 16342.

D-7 TEST REPORT

The test report shall at least include the following information:

a) a reference to this document;
b) a description of the material;
c) the procedure and conditions used;
d) changes in maximum tensile force as defined in IS 16342;
e) date of test; and
f) any deviation from this document or other factors that may influence the result of this test.

ANNEX 5
(*Item* 4.1)

COMMENTS ON 'IS 17483 (PART 2) : 2020 GEOSYNTHETICS — GEOCELLS — SPECIFICATION (PART 2) SLOPE EROSION PROTECTION APPLICATION'

Commentator: SHRI RAJENDRA GHADGE, GARWARE TECHNICAL FIBERS LTD, PUNE

Comment:

COMMENT 'IS 17483 (PART 2) : 2020 GEOSYNTHETICS — GEOCELLS — SPECIFICATION (PART 2) SLOPE EROSION PROTECTION APPLICATION'

Item, Clause Sub-Clause No. Commented upon (Use Separate Box afresh)	**Comments**	**Specific Proposal (Draft clause to be add/amended)**	**Remarks**	**Technical References on which (2), (3), (4) are based**
(1)	**(2)**	**(3)**	**(4)**	**(5)**
4.2 of MATERIALS	**Below sentence needs to be modified**. Polyolefin material shall be made resistant to ultraviolet light by adding 2-3 percent carbon black with uniform dispersion and if required a suitable UV stabilizer may be added.	Polyolefin material shall be UV stabilized by adding suitable UV stabilizer and/or carbon black. Polyolefin material, if manufactured by using carbon black shall contain 2 percent to 3 percent of carbon black by mass with satisfactory dispersion.	Geotextiles material are mostly in natural white colour where the Carbon black content is not applicable.	-
Table 1 Strength and	v) Sewn Strength in	Note to be given as	Most of the times,	-

Durability Requirements for Geotextile of Different Classes. Sl No. v)	N to be modified with additional note or remark	*The parameter shall be tested when product is supplied with seam. Refer to IS 16344 for stitch and overlap seam requirements.*	Geotextiles supplied in roll form. Stitching is done by customer at site wherever required	
Table 1 Strength and Durability Requirements for Geotextile of Different Classes. Sl No. vii)	The reference test method IS 13162 (Part 4) to be changed for CBR Puncture Strength	Reference test method IS 16078	Given Reference Standard IS 13162 (Part 4) is for Cone drop test	IS 16078
Table 1 Strength and Durability Requirements for Geotextile of Different Classes. Sl No. vii)	The reference test method IS 1966 (Part 2) to be added with one more equivalent method	Reference test method IS 1966 (Part 1) or (Part 2)	Given Reference Standard IS 1966 (Part 2) is pneumatic method. Most commonly used method is IS 1966 (Part 1) Hydraulic method	IS 16008/IS 16513
Table 2 **Table 3** **Table 4** **Table 5** **Sl iii)**	AOS values needs to be modified	AOS values to be modified as below. Course soil 0.425 Medium soil 0.250 Fine soil 0.212	Bead size designation is in three digits	IS 14294
4.2 Material	After 4.2, sequence continued to 5.3	The sequence to be modified	Sequence error	IS 13162-WC Merged Geotextile standards
7.4.3	The geo-textiles for soil erosion applications shall meet the requirements as given in Table 4	The geo-textiles for soil erosion applications shall meet the requirements as given in Table 5	Erosion properties are given in Table 5	IS 13162-WC Merged Geotextile standards

Commentator: SHRI SOUMENDRA BANERJEE, TERRE ARMEE, NEW DELHI

Comment:

COMMENT 'IS 17483 (PART 2) : 2020 GEOSYNTHETICS — GEOCELLS — SPECIFICATION (PART 2) SLOPE EROSION PROTECTION APPLICATION'

Sr. No	Item, Caluse, Sub-Clause No. commented upon	Comments	Specific Proposal
1	Table 1 Strength and Durability Requirements for Geotextile of Different Classes Roll length 50 or 100 as agreed	the wordings should be changed	The roll length shall be 50 to 100.This is applicable for Table 1& 6
2	Table 1 Strength and Durability Requirements for Geotextile of Different Classes Roll width 2 or 5m	the wordings should be changed	the Roll width shall be 2 to 5m. This is applicable for Table 1& 6 (wastage and handling issues)
3	Table 1 Strength and Durability Requirements for Geotextile of Different Classes Sewn seam strength, N, Min (see Note 1)	Since the table refers to geotextile seam strength is not applicable	To be removed
4	Table 1 Strength and Durability Requirements for Geotextile of Different Classes. Burst strength, kPa, Min		Not relevant and hence should be removed
5	1) Subgrade separation and Stabilization:	this paragraph shall be reworded.	For temporary roads, non-woven geotextiles , biaxial geogrids and multilinear drainage geocomposite are recommended,
6	3) Erosion Control	this paragraph shall be reworded.	These systems include fabric formed revetments, gabions, articulating concrete blocks with high strength cables and riprap.

7	3) Erosion Control	this paragraph shall be reworded.	For long-term durability, geotextile survivability is crucial, addressing factors which includes Geosynthetics performance parameters

ANNEX 6
(*Items* 4.2)

DRAFTS STANDARDS FOR FINALIZATION

DRAFT FOR COMMENTS ONLY

Doc. No: TXD 30 (25136) WC
March 2024

भारतीय मानक ब्युरो

BUREAU OF INDIAN STANDARDS

भारतीय मानक मसौदा

भूवस्त्रादि — परीक्षण की पद्धतियाँ

भाग 2 परा बैंगनी प्रकाश, नमी और ऊष्मा में जीनान आर्क प्रकार के उपकरण द्वारा अनावरण का प्रतिरोध ज्ञात करना

(पहला पुनरीक्षण)

Draft Indian Standard

GEOTEXTILES — METHODS OF TEST

PART 2 DETERMINATION OF RESISTANCE TO THE EXPOSURE OF ULTRAVIOLET LIGHT, MOISTURE AND HEAT (XENON-ARC TYPE APPARATUS)

(First Revision)

ICS 59.080.70

 Last date for receipt of comment is

FOREWORD

(*Formal clauses will be added later*)

This standard was first published in 1991. The present revision has been made in the light of experience gained since last revision and to incorporate the following major changes:

1) Title of the standard has been modified;
2) Scope of the standard has been modified to include the word 'heat';
3) References to Indian Standard given in Annex A has been updated;
4) The exposure cycle given in the standard has been changed from '102 minutes of light exposure and 18 minutes of water, spray and light exposure' to '90 minutes of light and 30 minutes of light plus water spray exposure' to align the standard with the current practices;
5) Procedure of the test has been modified to specify the level of irradiance of UV light;
6) Specimen selection template has been provided for the guidance; and
7) Calculation and reporting of test result and have been modified.

In the preparation of this standard considerable assistance has been derived from 'ASTM D4355/D4355 M-21 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus' issued by the American Society for Testing and Materials, USA.

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 (first revision)'.

1 SCOPE

1.1 This standard (Part 2) prescribes a method for the determination of resistance of geotextiles to the exposure of ultraviolet light, moisture and heat.

1.2 The light and water exposure apparatus employ a xenon-arc light source.

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 subjected 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 PRINCIPLE

Specimens of geotextiles for the machine and cross directions are exposed for 0, 150, 300 and 500 hours of ultraviolet exposure in a xenon-arc apparatus. The exposure consists of 120 minute cycles consisting of 90 minutes of light only, followed by 30 minutes of water spray and light. After the exposure, the specimens are subjected to a cut strip tensile test as prescribed in IS 1969 (Part 1) or wide width strip test as prescribed in) IS 16635. The test results are compared to the test results for unexposed specimens and the deterioration which has taken place due to ultraviolet exposure is assessed. This method will enable the user to develop a degradation curve for the geotextiles being tested to determine the tendency of a geotextile to deteriorate when exposed to ultraviolet light, heat and moisture.

4 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

4.1. Condition the test specimens to moisture equilibrium from the dry side in the standard atmosphere of (65 ± 5) percent relative humidity and (27 ± 2)°C temperature *(see also* IS 6359). When the specimens have been left in such an atmosphere so that both the faces are exposed to the standard atmosphere as far as possible for 24 hours, they shall be deemed to have reached the state of moisture equilibrium.

5 PREPARATION OF TEST SPECIMENS

5.1 Take two pieces each of one square metre from each roll as selected in **9.2**, one from machine direction and the other from cross machine direction.

Note — Since the thickness of a specimen may markedly affect test results, thickness of replicate specimens shall be within ± 10 percent of the nominal dimensions. This is especially important when mechanical properties are being investigated.

5.2 Use the template illustrated in Fig. 1 to identify the potential specimens from which the actual specimens are drawn. To select these actual specimens, randomly draw 20 specimens from both the machine and cross machine directions measuring 50 mm by 150 mm from the 1 m^2 portion the test pieces obtained in **5.1.**

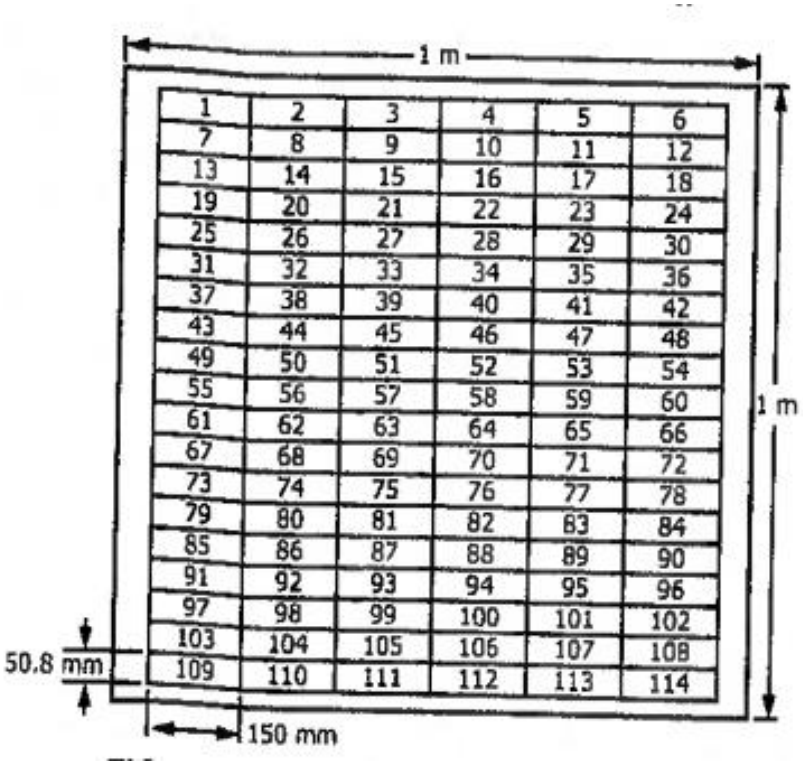


FIG. 1 SPECIMEN SELECTION TEMPLATE

5.3 Specimens from a roll shall be cut from positions evenly distributed over the full width and length of the sample, but not closer than 100 mm or one tenth of width to the selvedges, whichever is smaller.

5.4 Specimens shall not contain dirt, irregular spots, creases, holes or other visible faults.

5.5 Any two specimens shall not contain the same longitudinal or transversal position. If it is not possible, it shall be reported.

5.6 Before cutting structured geotextiles exact instructions for cutting shall be laid down, and these shall be followed with great care.

5.7 If the cutting causes fragments of geotextile to loosen influencing the test results and if this cannot be avoided, this fact shall be reported.

5.8 The specimens shall be kept free from dust, dry, kept in dark and protected against chemical and physical damage until the test is performed.

5.9 The top and bottom portion of specimen which goes inside grips should be rolled in weathering device to protect from exposure to the radiation while in weathering device to avoid jaw breaks during tensile testing.

6 APPARATUS

6.1 The working details of Xenon-arc apparatus are described in IS/ISO 105-B02.

6.1.1 The apparatus should be capable of exposing the specimens to cycles of light only, followed by light and moisture water spray and light under controlled atmospheric conditions.

6.1.2 The apparatus should be equipped with an inner and outer borosilicate filter glass as described in IS/ISO B02.

6.2 Tensile strength testing machine as described for cut strip test in IS 1969 and wide width test in IS 16635.

7 PROCEDURE

7.1 Operate the Xenon-arc apparatus as directed in IS/ISO 105-B02 to provide 120 minute cycles as follows:

90 minutes of light only at (65 ± 3)°C black panel temperature, and (50± 5) percent relative humidity, followed by 30 minutes of light and water spray.

7.1.1 Set the minimum level of irradiance at control point to achieve 0.35 $W/m^2.nm$ at 340 nm (unless otherwise specified) maintained at 0.02 $W/m^2.nm$.

7.1.2 If the UV exposure device does not equipped with irradiance control, device manufacturer's recommendation should follow to produce required irradiance. Equivalent 300 nm to 400 nm or 300 to 800 nm broadband irradiance can also use and tolerance as per instrument manufacturer specification.

7.2 Randomly assign five specimens for each direction from each laboratory sample to each of the following exposure times, zero (unexposed), 150, 300 and 500 hours. Place 30 specimens (15 for each direction) out of the total 40 test specimens in the apparatus, such that the side most likely to be exposed to the effects of ultraviolet light will be exposed in the apparatus.

7.3 Rotate specimen position in chamber accordance with procedure given in IS/ISO 105-B02.

7.4 At the end of each exposure time, remove the appropriate five specimens for each direction for tensile test using cut strip test as given in IS 1969 or wide width strip test as given in IS 16635.

7.5 Select five unexposed specimens (zero exposure time) and five exposed specimens for each exposure time interval and direction, from a laboratory sample as per the method given in IS 1969.
Test these specimens for breaking strength on a constant-rate-of-extension (CRE) or a constant rate-of-traverse (CRT) type testing machine by cut strip test, as given in IS 1969 or for wide width test as given in IS 16635. In case of controversy, the CRE method shall prevail.

NOTE —If tested on a CRT machine, the traverse speed shall be 300 ± 15 mm/ min.

8 CALCULATIONS

8.1 Calculate the average breaking strength for all exposed and unexposed (control) specimens for each direction.

8.2 Calculate the percent loss of strength from the unexposed specimens for the average results of each exposure time for each direction.

8.3 For the groups of five specimens from the unexposed specimens and the specimens exposed at various times, calculate the standard deviation and coefficient of variation for the strip tensile strength.

9 SAMPLING

9.1 A random sample shall be selected from the lot. The sample selected should be homogeneous and representative of the lot.

9.2 The number of rolls to be selected from a lot shall be in accordance with the procedure laid down in the relevant material specification or as agreed to between the buyer and the seller.

10 REPORT

The test report shall include the following information:

a) IS number of the method followed for testing;
b) Full description of the specimens and their origin;
b) The average breaking strength for unexposed (control) specimens, and exposed specimens in each direction for each of the exposure period of 150, 300 and 500 hours;
c) Graph of average breaking strength between exposure time, for each direction;
d) A listing of the percentage of strength retained for each exposure time for each direction;
e) Total exposure time alongwith the total radiant exposure (irradiance X time of exposure) at respective clock hour intervals, and the number of cycles as defined in **7.1.2**.
f) Type and Model of exposure device and light source used;
g) Type and position of black or white panel thermometer, if used;
h) Standard deviation and coefficient of variation for the strip tensile strength; and
j) If required, irradiance in $W/(m^2.nm)$, or radiant exposure in J/m^2 , at the sample plane and wavelength region in which measurements were made.

ANNEX A

(*Clause* 2)

LIST OF REFFRRED STANDARDS

IS No.	*Title*
IS 6359 : 2023	Method for conditioning of textiles
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
IS 16635 : 2017	Geosynthetics — Wide-Width Tensile Test
IS/ISO B02 :2014	Textiles — Tests for Colour Fastness Part B02 Colour Fastness to Artificial Light : Xenon Arc Fading Lamp Test

DRAFT FOR COMMENTS ONLY

Doc. No: TXD 30 (25137) WC
March 2024

भारतीय मानक ब्युरो

BUREAU OF INDIAN STANDARDS

भारतीय मानक मसौदा

भूकृत्रिम — ट्रेपेज़ोयिड विदरण बल निर्धारण की विधि

(पहला पुनरीक्षण)

Draft Indian Standard

GEOSYNTHETICS — METHOD FOR DETERMINATION OF TRAPEZOID TEARING STRENGTH

) First Revision (

ICS 59.080.70

FOREWORD

(*Formal clauses will be added later*)

This standard was first published in 1995. The present revision has been made in the light of experience gained since last revision and to incorporate the following major changes:

8) Title of the standard has been modified;
9) References to Indian Standard given in Annex A has been updated;
10) Scope of the standard has been modified to extend applicability of standard for layered fabrics, knit fabrics, and felts also;
11) Clamp size has been specified for the tensile testing machine and requirement for upper clamp has been specified additionally; and
12) Requirement of trapezoidal template has been made optional.

In the preparation of this standard assistance has been drawn from ASTM Designation: 4533-15 'Standard test method for trapezoid tear strength of geotextiles', issued by the American Society for Testing and Materials, USA.

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 (*first revision*)'.

1 SCOPE

1.1 This test method is an index test used to measure the force required to continue or propagate a tear in woven or non-woven geotextiles by the trapezoid method.

1.2 This test method is applicable to most geotextiles that include woven fabrics, nonwoven fabrics, layered fabrics, knit fabrics, and felts that are used for geotextile applications.

1.3 This test method may be used with constant-rate-of-traverse (CRT) or constant-rate-of-extension (CRE) type tension machines. However, there may be no overall correlation between the results obtained with the CRT machine and the CRE machine. Consequently, these two tension testers cannot be used interchangeably. In case of controversy, the CRE machine shall prevail.

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 TERMINOLOGY

For the purpose of this standard, definitions given in IS 13321 (Part 1) shall apply.

4 PRINCIPLE

An outline of an isosceles trapezoid is marked on a rectangular specimen cut for the determination of tearing strength (*see* Fig. l), and the non-parallel sides of the trapezoid marked on the specimen are clamped in parallel jaws of a tensile testing machine. The separation of the jaws is continuously
increased so the tear propagates across the specimen. At the same time, the force developed is recorded. The tearing strength, which is the maximum value of the tearing force, is obtained from the autographic force-extension curve (*see* Fig. 2).

5 APPARATUS

5.1 Tensile Testing Machine, of the constant-rate-of-extension (CRE) or constant-rate-of-traverse (CRT) type with autographic recorder.

5.2 Clamps, having all gripping surfaces parallel, flat, and capable of preventing slipping of the specimen during a test, and measuring 50 mm by no less than 76 mm, with the longer dimension perpendicular to the direction of application of the load.

5.3 Trapezoidal template (optional), having the dimensions as shown in Fig. 1.

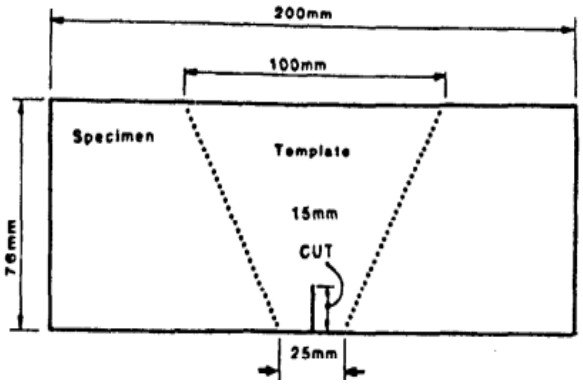
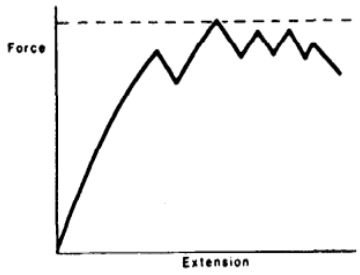
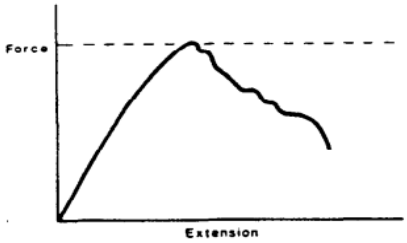


FIG.1 TRAPEZOIDALTEMPLATE FOR TRAPEZOID TEARING STRENGTH TEST



2A Fabric Exhibiting Several Maxima



2B Fabric Exhibiting Single Maximum

FIG. 2 TYPICAL TEARING FORCE-EXTENSION CURVES FOR INDIVIDUAL TEST SPICEMENS

6 PREPARATION OF TEST SPECIMEN

6.1 For woven fabrics, take the specimens to be used for the measurement of the tearing strength of machine direction yarns from different sets of machine direction yarns and the specimens to be
used for the measurement of the tearing strength of cross-machine direction yarns from different sets of cross-machine direction yarns and, when possible, from fabric woven from different bobbins. In case of non-woven fabrics take the specimens for the measurement of the machine direction tearing strength from different positions across the fabric and for the measurement of the cross-machine direction tearing strength from different positions along the length of the fabric.

6.2 Cut rectangular specimens of 76 mm × 200 mm in such a way that no specimens are taken nearer the selvedge or edge of the fabric than 1/20th of the fabric width or, 150 mm whichever is smaller. Cut the specimens to be used for the measurement of the tearing strength in the machine direction (or warp yarns), with the longer dimension parallel to the machine direction (or warp yarns). Cut the specimens to be used for the measurement of the tearing strength in the cross-machine direction (or weft yarns) with the longer dimension parallel to the cross-machine direction (or weft yarns). Mark each specimen with an isosceles trapezoid template (*see* Fig.1). Make a preliminary cut 15 mm long at the centre of the 25 mm edge, as shown in Fig. 1.

6.3 The number of specimens shall be as agreed to between the buyer and the seller subject to a minimum of 5 in each direction.

7 CONDITIONING

7.1 Bring the specimens to moisture equilibrium in the atmosphere for testing textiles as specified in IS 6359.

7.2 Specimens to be tested in the wet condition shall be immersed in water maintained at a temperature of 27 ± 2°C. The time of immersion shall be sufficient to wet out the specimens thoroughly; this is indicated by no significant change in strength or elongation following a longer period of immersion, and shall be at least 2 minutes. To obtain thorough wetting, it may be necessary and advisable to add not more than 0.05 percent of a non-ionic neutral wetting agent to the water.

8 PROCEDURE

8.1 Test the conditioned specimens in the standard atmosphere for testing as defined in IS 6359.

8.2 Test the thoroughly wet specimen in the normal machine setup within 2 minutes after removal from the water.

8.3 Set the distance between the clamps at the start of the test at 25 ± 1 mm. The upper clamp should be supported by a free swivel or universal joint which will allow the clamp to rotate in the plane of the fabric. Select the load range of the testing machine such that the maximum load occurs between 15 and 85 percent of full-scale load. Set the machine to operate at a speed of 300 ± 10 mm/min.

8.4 Secure the test specimen in the machine, clamping along the non-parallel sides of the trapezoid so that the end edges of the clamps are in line with the 25 mm long side of the trapezoid, and the cut is halfway between the clamps. Hold the short edge tight and let the remaining fabric lie in folds.

8.5 Start the machine and record the tearing force on the autographic recorder. The tearing force may not increase to a simple maximum value, but may show several maxima and minima, as shown in Fig. 2A. Record the maximum force obtained in Newtons, as illustrated in Fig. 2A and 2B.

8.6 If a fabric slips in the jaws or if 25 percent or more of the specimens break at a point within 5 mm of the edge of the jaw, then (a) the jaws may be padded; (b) the fabric may be coated under the jaw face area; or (c) the jaw face may be modified. If any of the modifications listed above are used, state the method of modification in the report.

8.7 If an individual test result deviates 25 percent or more from the average test result of a swatch, it shall be discarded and an additional specimen tested. Calculate the average excluding outlier values.

9 CALCULATION

Calculate separately the average of the maximum tearing strengths of the machine direction (or warp) specimens and the average of the maximum tearing strengths of the cross-machine direction (or weft) specimens.

10 REPORT

The report shall include the following:

a) State that the tests were performed as directed in this test method. Describe the material(s) or product(s) sampled and the method of sampling used.
b) Report the following information for each sample:

1) Average of the maximum tearing strengths in Newtons for each direction;
2) Number of specimens tested for each direction;
3) Coefficient of variation of the observed tearing strength of individual specimens, if required, and
4) Condition of the specimens (dry or wet).

ANNEX A

(Clause 2 *)*

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
6359 : 2023	Method for conditioning of textiles (*first revision*)
13321 (Part 1) : 2022	Geosynthetics Part 1: Terms and definitions

DRAFT FOR COMMENTS ONLY

Doc. No: TXD 30 (25138) WC
March 2024

भारतीय मानक ब्युरो

BUREAU OF INDIAN STANDARDS

भारतीय मानक मसौदा

भूकृत्रिम — ड्राई सिविंग तकनीक द्वारा प्रतीत छिद्र आकार निर्धारण करने की पद्धति

(पहला पुनरीक्षण)

Draft Indian Standard

GEOSYNTHETICS — METHOD FOR DETERMINATION OF APPARENT OPENING SIZE BY DRY SIEVING TECHNIQUE

) First Revision (

ICS 59.080.70

Not to be reproduced without permission of BIS or used as Standard	Last date for receipt of comment is **30 May 2024**

FOREWORD

(*Formal clauses will be added later*)

This standard was first published in 1995. The present revision has been made in the light of experience gained since last revision and to incorporate the following major changes:

13) Title of the standard has been modified;
14) References to Indian Standard given in Annex A has been updated;
15) Amendment No. 1 has been incorporated in the standard;
16) Requirement for mechanical shaker has been modified;
17) Requirement for flexible rubber template used for tracing a line on the geotextile sample has been given;
18) Procedure for preparation of test specimen has been modified; and
19) Detailed method of AOS calculation by means of plotting 'percentage passing' versus 'bead/particle size' has been specified.

In the preparation of this standard assistance has been drawn from ASTM Designation : D4751-16 'Standard test method for determining apparent opening size of a geotextile', issued by the American Society for Testing and Materials, USA.

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 (*first revision*)'.

1 SCOPE

1.1 This Indian Standard specifies method to determine apparent opening size (AOS) by dry sieving by dry- sieving glass beads or graded sand particles through a geotextile. This method is suitable for AOS 60 microns and above.

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 TERMINOLOGY

For the purpose of this standard definitions as given in IS 13321 (Part 1) shall apply.

4 PRINCIPLE

A specimen of geotextile is placed in a sieve frame and sized glass beads or graded sand particles are placed on the geotextile surface. The geotextile and frame are shaken so that the jarring motion will induce the glass beads or graded sand particles to pass through the test specimen. The procedure is repeated on the same specimen with various size glass beads or graded sand particles until its apparent opening size has been determined.

5 APPARATUS

5.1 Mechanical Sieve Shaker — A mechanical sieve shaker, if used, shall impart a vertical, or lateral and vertical, motion to the sieve, causing the particles thereon to bounce and return so as to
present different orientations to the sieving surface. The sieve shaker should be a constant frequency device utilizing a tapping arm to impart the proper motion to the glass beads.

> Note — Care should be given to the cork or rubber contact point on shakers when the vertical motion comes from an arm striking the cork or rubber. Excessive wear on cork or rubber could affect the motion imparted to the glass beads or graded sand particles, and therefore the test results.

5.2 Pan, Cover and 200 mm Diameter Sieves

5.3 Spherical Glass Beads or Graded Sand Particles, in size fractions in accordance with Table 1. It is only necessary to have on hand the glass beads or graded sand particles size fractions necessary for the range of geotextiles for which testing is anticipated. The sizing of all glass beads or graded sand particles shall be verified prior to each use by sieving on the pairs of selves shown in Table 1. Prepare at least 50 g of each size glass beads or graded sand particles to be used prior to beginning the test.

5.4 Balance, having a capacity adequate for the mass of samples anticipated and accurate to ± 0.05 g.

5.5 Static Elimination, to prevent the accumulation of static electricity when the beads arc shaken on the surface of geotextile. Commercially available devices or 'anti-static' sprays are acceptable.

5.6 Drying Oven

5.7 Pan, for Collecting Sieved Beads or Graded Sand Particles

5.8 Flexible Rubber Template, either a square shaped flexible rubber template with a 203 mm diameter hole cut in it, or a 203 mm diameter template, constructed from a durable, yet flexible material such as rubber or neoprene. This template is used to trace the 203 mm diameter circles on the geotextile fabric for mounting into the sieves described in **5.2**.

Table 1 Glass Bead or Graded Sand Particles Sizes

(*Clause* 5.3)

Sl No.	Bead or Sand Particle Size Range		Bead or Sand Particle Size Designation IS Sieve, mm
	Passing IS Sieve, mm	Retained IS Sieve, mm	
(1)	(2)	(3)	(4)
i)	2.0	1.70	1.7
ii)	1.4	1.18	1.18
iii)	1.00	0.850	0.850
iv)	0 .710	0.600	0.600
v)	0 .500	0.425	0.425
vi)	0 .355	0.300	0.300
vii)	0. 250	0.212	0.212
viii)	0 .180	0.150	0.150
ix)	0 .125	0.106	0.106
x)	0.090	0.075	0.075

6 PREPARATION OF TEST SPECIMEN

6.1 Cut five specimens from each swatch in the laboratory sample with each specimen being cut to fit the appropriate specimen holder. Cut the specimens from a single swatch spaced along a diagonal line on the swatch.

6.2 Weigh the specimens and then submerge them in distilled water for 1 hour at the standard atmosphere specified in IS 6359.

6.3 Bring the specimen to moisture equilibrium condition at ambient temperature. The drying process may be accelerated with the use of fan. The specimen shall not be dried in oven or by exposing them to elevated temperature.

7 PROCEDURE

7.1 Carryout the test at the standard atmosphere for testing textiles in such a manner that static electricity is prevented from affecting test results. If standard atmosphere cannot be maintained and static electricity is observed, any of the following methods may be used to prevent static electricity.

7.1.1 Install static eliminating devices equally spaced along the circumference of sieve and one on centre of cover, or

7.1.2 Apply commercially available 'anti-static' spray uniformly to the geotextile.

7.2 Secure the geotextile between two sieves. It is important that the geotextile be supported so that it is light, without wrinkles or bulges. The geotextile shall not be stretched or deformed such that it changes or distorts the openings in the fabric. Two systems may be used to secure the geotextile sample

7.2.1 Wedge between two sieve frames.

7.2.2 Secure with the perimeter seal device inside sieve frame.

> Note — For knitted sock geotextiles, some manipulation of the specimens may be necessary to ensure that the marked out circle is fitted to the sieve frame properly.

7.3 Prior to each use, sieve the glass beads or graded sand particles in the laboratory to verify size of beads or sand particles.

7.4 Start with the smallest diameter glass beads or graded sand particles that will be tested. Place 50 g of one size glass beads or graded sand particles on the centre of the geotextile.

7.5 Place cover and pan on sieve frame and place in shaker. Shake the sieve horizontally as well as vertically for 10 min.

7.6 Place the glass beads or graded sand particles still on the surface of the specimen in a pan and weigh. Include beads or sand particles that fall off as a result of turning the specimen over and lapping the rims of the sieves.

> NOTE — The step provides information concerning the amount of glass beads or graded sand particles trapped within the geotextile and the amount of any glass beads or graded sand particles lost during testing

7.7 Weigh the glass beads or graded sand particles that pass through the specimen, and record data on a worksheet (*see* Annex B for a sample worksheet which can be used to record the desired information).

7.8 Repeat **7.3** through **7.7** using the next larger bead size or sand particle fraction. Repeat the trial using successively larger bead size fractions until the weight of beads passing through the

specimen is 5 percent or less. Perform the trials such that the percent passing decreases from a value greater than 5 percent to a value less than or equal to 5 percent.

NOTE — All size are sieved through a single specimen of geotextile. Geotextile variability would make it difficult to obtain consistent results by sieving each size through a separate specimen

7.9 Repeat **7.2** to **7.8** for all five specimens.

8 CALCULATIONS

8.1 For each size of glass beads or graded sand particle tested with each specimen, compute to the nearest percent the glass beads or graded sand particles passing through the specimen using the following equation:

$$B = 100\ P/T$$

where

B = beads passing through specimen, percent;
P = mass of glass beads in the pan, g, and
T = total mass of glass beads used, g.

8.2 Record calculations and percent glass beads or graded sand particles passing (*see* Annex B).

8.3 Assign the AOS for each specimen as the size designation in millimetres (*see* **5.3**) of the glass beads or graded sand particles of which 5 percent or less pass. These AOS values are in millimetres, and are taken from the 'Bead or Sand Particle Size Designation' column of Table 1.

8.5 Determine the AOS for the sample by averaging the AOS values of the five specimens.

9 PLOTTING

9.1 It is often desirable due to variability among the five test specimen results to determine the AOS value by plotting the percentage of beads passing the specimen versus the bead size used for each specimen. When plotting is desirable proceed as follows:

9.1.1 For each specimen, plot the values of percent passing (ordinate) versus bead or particle size, mm (Abscissa) on semi-log graph. Draw a straight line connecting the two data points representing the bead sizes that are immediately on either side of the 5 percent passing ordinate. The particle size in millimetres (Abscissa) at the intersection of the straight line plotted and the 5 percent passing ordinate is the AOS of the specimen in millimetres, that is the theoretical bead or particle size that would result in exactly 5 percent passing of the specimen.

9.1.2 Determine the sample AOS, in millimetres, by averaging the five AOS values obtained by the graphical interpolation in **9.1.1**.

10 REPORT

Report shall include the following information:

a) IS number of the method followed for testing;
b) Glass bead or graded sand particle size range (in millimetres) used;
c) Plots of glass bead/graded sand particle size versus percentage beads/particle passing for each specimen, if required (as described in **9**);
d) The average apparent opening size (AOS = O_{95}) in millimetres;
e) When requested, AOS in terms of sieve number, that is, having nominal openings, in millimetres, next larger than or equal to the AOS, in millimetres; and
f) Deviation, if any.

ANNEX A
(Clause 2 *)*
LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
460 (Part 1) : 2020	Test Sieves — Specification Part 1 Wire Cloth Test Sieves (*Fourth Revision*)
(Part 2) : 2020	Test Sieves — Specification Part 2 Perforated Plate Test Sieves (*Fourth Revision*)
(Part 3) : 2020	Test Sieves — Specification Part 3 Methods of Examination of Apertures of Test Sieves (*Fourth Revision*)
6359 : 2023	Method for conditioning of textiles (*first revision*)
13321 (Part 1) : 2022	Geosynthetics Part 1: Terms and definitions

ANNEX B

(Clauses 7.7 *and* 8.2 *)*

SAMPLE WORKSHEET FOR DETERMINATION OF APPARENT OPENING SIZE OF GEOTEXTILE

DATE:

TEST BY:

COMP BY:

CHECK BY:

Range (mm) IS Sieve	Minimum Dia (mm)	Wt. F+G* W/Glass Beads or Sand Particles	Wt. F+G	Wt. Glass Beads or Sand Particles	% Retained	Wt. Pan +Glass Beads or Sand Particles	Wt. Pan	Wt. Passing Glass Beads or Sand Particles	Percentage Passing	Wt. F+G Before Test	Wt. F+G After Test	Wt. Retained in Geotextile	Percentage Retained in Geotextile
2.0-1.70	1.70												
1.4-1.18	1.18												
1.0-0.850	0.850												
0.710-0.60	0.600												
0.50-0.425	0.425												
0.355-0.30	0.300												
0.25-0.212	0.212												
0.18-0.15	0.150												
0.125-0.106	0.106												
0.09-0.075	0.075												
*F = Frame G = Geotextile													

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March 2024

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भारतीय मानक मसौदा

भूवस्त्रादि — अपघर्षण प्रतिरोध का निर्धारण

(पहला पुनरीक्षण)

Draft Indian Standard

GEOTEXTILES — DETERMINATION OF ABRASION RESISTANCE

(First Revision)

ICS 59.080.70

Not to be reproduced without permission of BIS or used as Standard	Last date for receipt of comment is **30 May 2024**

FOREWORD

(*Formal clauses will be added later*)

This standard was first published in 1999. The present revision has been made in the light of experience gained since last revision and to incorporate the following major changes:

1) Scope of the standard has been modified;
2) References to Indian Standard given in Annex A have been updated;
3) Terminologies given in the standard have been modified;
4) Sampling clause has been modified to specify the minimum distance from the fabric selvedge for sample cutting; and
5) Test procedure has been modified to specify lower the top plate weights used in the test.

In the preparation of this standard considerable assistance has been derived from ASTM D4886 - 23.

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 (*first revision*)’.

1 SCOPE

This test method covers determination of resistance of geotextiles to abrasion using an abrasion tester. This test method at this point has only been evaluated for geotextile – not geomembrane, grids, etc. The test method is applicable to all geotextiles and is not suitable for other geosynthetics like Geogrid, Geomembrane, Geonet etc.

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 subjected 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 TERMINOLOGY

For the purpose of this standard following definitions and the definitions given in IS 13321 (Part 1) shall apply:

3.1 Abrasion — The wearing away of any part of a material by rubbing against another surface.

3.2 Loss in Breaking Force — Percentage comparison of breaking force before and after abrasion.

4 PRINCIPLE

A test specimen, mounted on a stationary horizontal platform is rubbed by a uniaxial motion of an abradant having specified surface characteristics under controlled conditions of pressure and abrasive action. Resistance to abrasion is expressed as a percentage loss of breaking load of the original sample (control sample).

5 APPARATUS

5.1 Abrasion Tester shall have the essential parts as described in **5.1.1** to **5.1.3**.

5.1.1 *Balanced Head and Block Assembly*

The assembly shall be two parallel, smooth plates, one of which makes a reciprocating motion. The speed of the reciprocating plate shall be adjustable between 10 and 115 double strokes per minute. The stroke length shall be 25 mm. The second plate is rigidly supported by a double-lever assembly to provide free movement in a direction perpendicular to the reciprocating plate. This plate is stationary during the test and shall be well balanced so that a vertical load can be maintained by means of dead weights. Both plates are equipped with clamps at each end to hold the test sample and the abrasive medium. The clamps have adequate gripping surface to prevent slippage of the specimen or the abrading material during the test.

5.1.2 *Indicator*

Device shall be provided for indicating the number of cycles (1 cycle = 1 double stroke).

5.1.3 *Weights*

Weights shall be provided for applying a vertical load to the specimen.

6 SAMPLING

6.1 Lot Sample

For sampling of lot, the number of rolls from which samples are to be cut shall be as agreed to between the buyer and the seller. For details of sampling procedure reference may be made to IS 14706.

NOTE — Abrasion testing is not a routine quality control test for geotextiles and shall not normally be performed on every lot by the manufacturer or supplier. When testing for abrasion is performed, however, the sampling should be as described in 6.

6.2 Laboratory Sample

For laboratory sample, take a swatch extending the width of the fabric and approximately 1 m along the selvedge from each roll in the lot sample. The swatch may be taken from the end portion of a roll provided there is no evidence that it is distorted or different from other portions of the roll. In case of dispute, take a swatch that will exclude fabric from the outer wrap of the roll or the inner wrap around the core.

6.3 Test Specimens

From each swatch in the laboratory sample, prepare two sets of specimens each containing five specimens. Cut rectangular specimens (75 mm × 200 mm) ± 1 mm. Cut the set of specimens to be tested in the machine direction with the longer dimension parallel to the machine direction and set of specimens to be tested in the cross-machine direction with the longer dimension in the cross-machine direction. Take each set of specimens from a swatch along a diagonal so that they will be taken from different positions across the length and width of the swatch. No specimen shall be taken within $1/20^{th}$ of the fabric width or 150 mm from the selvedge whichever is the smaller.

7 CONDITIONING

7.1 Bring the specimens to moisture equilibrium in the atmosphere having 65 ± 5 percent relative humidity and 27 ± 2°C temperature. Equilibrium is considered to have been reached when the change in mass of the specimen in successive weighings made at intervals of not less than 2 h does not exceed 0.1 percent of the mass of the specimen. When it is not practically possible to frequently check weight to see if the sample reached moisture equilibrium or not; then a minimum 24-hour conditioning can be considered as acceptable.

7.2 Immerse the specimens to be tested in the wet condition in water maintained at a temperature of 27 ± 2°C. The time of immersion must be sufficient to wet-out the specimens thoroughly, as indicated by insignificant change in strength or elongation following a longer period of immersion, and at least 2 min. To obtain thorough wetting, a nonionic neutral wetting agent not exceeding 0.05 percent may be added to the water.

8 PROCEDURE

8.1 Test the conditioned specimen in the standard atmosphere for testing geotextiles, as described in 7.

8.2 Place the sample to be tested in the upper (stationary) plate and secure it by means of the clamp at each end of the plate. Place the abrasive medium on the lower (reciprocating) plate and secure it by means of the clamp at each

end of the plate. Use emery cloth equal to 100 grit as the abrading medium unless specified otherwise in a material specification.

NOTE — When testing nonwoven geotextiles, secure the edges of the test specimen to the stationary plate by using double-back tape or some other type adhesive. This prevents deformation (neckdown) of the specimen during the abrasion test.

8.3 Lower the top plate onto the bottom plate by releasing the support pin for the top plate and ensuring that the abrading medium and the specimen are properly aligned.

8.4 Load the top (pressure) plate with a total of 1 kg load (including weight of upper platen) unless specified otherwise. This weight must include that of the upper platen on which the geotextile is attached, in addition to the dead weight, if not compensated for.

8.5 Start the tester and operate at a speed of 30 cycles per minute unless specified otherwise.

8.6 Operate the tester at the specified speed for 250 cycles or as agreed upon in an applicable material specification or until the specimen ruptures.

NOTE — If a specimen ruptures before the specified number of cycles is reached, report that the specimen ruptured and the number of cycles completed at the time of rupture.

8.7 If the specimen or the abrading material slips or moved away in the clamps, discard the specimen and test another specimen.

8.8 Replace the abrasive medium for wear after 250 cycles (change after each specimen)

8.9 Determine the end point by the following method.

8.9.1 *Percentage Loss in Breaking Load*

Abrade the specimen for a specified number of cycles and then determine the breaking load using 50 mm ravelled-strip or cut-strip procedure given in IS 1969 with the exception of a gauge length of 100 mm and an extension rate of 300 mm /min. The abraded area of the specimen shall be placed midway between the clamps of the machine. Determine the breaking load unabraded portion of the sample under the similar conditions. Calculate the loss in breaking load and report to the nearest 1.0 percent using the following formula:

Loss in breaking load, percent = $100(A - B)/A$

where

A = breaking load before abrasion, and
B = breaking load after abrasion.

9 REPORT

The report shall include the following:

a) Average loss in breaking load, in percent, for each direction;

b) Deviation from test conditions specified in this standard;
c) Number of specimens tested from each direction; and
d) Number of specimens which ruptured, if any, before the specified number of cycles was reached and the number of cycles completed before rupture.
e) Mention if there is any deviation in specimen preparation or testing procedure other than describe in test method.

ANNEX A

(Clause 2 *)*

LIST OF REFFRRED STANDARDS

IS No.	*Title*
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
13321 (Part 1) : 2022	Geosynthetics Part 1: Terms and definitions
14706 : 1999	Geotextiles — Sampling and preparation of test specimen

GEOSYNTHETICS — SAMPLING AND PREPARATION OF TEST SPECIMENS

ICS 59.080.70

Not to be reproduced without permission of BIS or used as Standard	Last date for receipt of comment is **30 May, 2024**

NATIONAL FOREWORD

(*Formal clauses will be added later*)

This Indian Standard intended to be adopted is identical with ISO 9862:2023 'Geosynthetics Sampling and preparation of test specimens' issued by the International Organization for Standardization (ISO).

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the standard intended to be adopted, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 10320, Geosynthetics — Identification on site	IS 17421 : 2020 Geosynthetics – Identification on site	Identical

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 (*first revision*)'.

Extract of ISO 9862:2023 'Geosynthetics — Sampling and preparation of test specimens'

Foreword

This third edition cancels and replaces the second edition (ISO 9862:2005), which has been technically revised. The main changes are as follows:

— Geosynthetic products that do not come in rolls have been incorporated to this document.

A list of all parts in the ISO 9862 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Geosynthetics are produced in many different ways, partly using traditional textile procedures, partly using procedures not commonly recognized as textile procedures. Geosynthetics are defined in ISO 10318-1.

Geosynthetics are typically supplied in rolls, however, some geosynthetic products may be supplied in the form of expandable panels, folded sheets or other forms.

Whilst sampling should ensure the best possible statistical significance of the average finding and its coefficient of variation, there are practical limits to the possible distribution of samples and specimens over the entire lot and its single units supplied to a construction site.

1 Scope

This document establishes general principles for the sampling of geosynthetics delivered to construction sites, and for the preparation of test specimens from the samples.

The sampling principles are applicable to geosynthetics supplied in rolls or expandable panels.

NOTE ISO 186 can be used for products supplied in sheet form.

The specimen-preparation principles are applicable to all geosynthetics.

2 Normative references

The following referenced documents are referred to in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10320, Geosynthetics — Identification on site

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 sample
portion of material which is taken for testing
3.2 specimen
specific portion of the *sample* (3.1) upon which a laboratory test is performed

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(1)	(2)	(3)	(4)	(5)

भूवस्त्रादि और भूवस्त्रादि से संबंधित उत्पाद —
भार के बिना, सतह के प्रति जल पारगम्यता विशेषताओं का निर्धारण

Draft Indian Standard

GEOTEXTILES AND GEOTEXTILE-RELATED PRODUCTS — DETERMINATION OF WATER PERMEABILITY CHARACTERISTICS NORMAL TO THE PLANE, WITHOUT LOAD

ICS 59.080.70

Last date for receipt of comment is **30 May 2024**

NATIONAL FOREWORD

(*Formal clauses will be added later*)

This Indian Standard intended to be adopted is identical with ISO 11058 : 2019 'Geotextiles and geotextile-related products — Determination of water permeability characteristics normal to the plane, without load' issued by the International Organization for Standardization (ISO).

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the standard intended to be adopted, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 2854, Statistical interpretation of data — Techniques of estimation and tests relating to means and variances	IS 14277 : 1996 Statistical interpretation of test results —Estimation of mean, standard deviation and regression coefficient - Confidence interval	Technically equivalent
ISO 5813, Water quality — Determination of dissolved oxygen — Iodometric method	IS 3025 (Part 38) : 1989 Water and wastewater — Methods of sampling and test (Physical and Chemical): Part 38 dissolved oxygen (First Revision)	Identical
ISO 9862, Geosynthetics — Sampling and preparation of test specimens	IS 14706 : 1999 Geotextiles — Sampling and preparation of test specimens	Identical
ISO 10320, Geosynthetics —	IS 17421 : 2020 Geosynthetics —	Identical

Identification on site	Identification on site	

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 (*first revision*)'.

Extract of ISO 11058-4:2019 'Geotextiles and geotextile-related products —Determination of water permeability characteristics normal to the plane, without load'

Foreword

This third edition cancels and replaces the second edition (ISO 11058:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— editorial modifications;

— formula corrections.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

1 Scope

This document specifies two test methods for determining the water permeability characteristics of a single layer of geotextile or geotextile-related product normal to the plane:

a) The constant head method; and

b) The falling head method.

2 Normative references

The following referenced documents are referred to in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2854, Statistical interpretation of data — Techniques of estimation and tests relating to means and variances

ISO 5813, Water quality — Determination of dissolved oxygen — Iodometric method

ISO 9862, Geosynthetics — Sampling and preparation of test specimens

ISO 10320, Geosynthetics — Identification on site

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDRADS

भारतीय मानक मसौदा

भूकृत्रिम — घर्षण विशेषताओं का निर्धारण

भाग 1: प्रत्यक्ष अपरूपण परीक्षण

Draft Indian Standard

GEOSYNTHETICS — DETERMINATION OF FRICTION CHARACTERISTICS

PART 1: DIRECT SHEAR TEST

ICS 59.080.70

Last date for receipt of comment is **30 May 2024**

NATIONAL FOREWORD

(*Formal clauses will be added later*)

This Indian Standard intended to be adopted is identical with ISO 12957-1 : 2018 'Geosynthetics — Determination of friction characteristics Part 1: Direct shear test' issued by the International Organization for Standardization (ISO).

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the standard intended to be adopted, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of*

		Equivalence
ISO 9862, Geosynthetics — Sampling and preparation of test specimens	IS 14706 : 1999 Geotextiles — Sampling and preparation of test specimens	Identical

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 (*first revision*)'.

Extract of ISO 12957-1:2005 'Geosynthetics — Determination of Friction Characteristics Part 1: Direct Shear Test'

Foreword

This second edition cancels and replaces the first edition (ISO 12957-1:2005), which has been technically revised. The main changes compared to the previous edition are as follows:

— introduction of the possibility to test the shear between two geosynthetics;

— introduction of the possibility to test soil different from the standard sand.

A list of all parts in the ISO 12957 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

1 Scope

This document specifies an index test method to determine the friction characteristics of geosynthetics in contact with a standard sand as described in EN 196-1, i.e. with a specified density and moisture content, under a normal stress and at a constant rate of displacement, using a direct shear apparatus.

The same testing procedure can be used with any type of soil with the density and moisture content that are required to evaluate the performance under specific conditions or with another geosynthetic under a normal stress and at a constant rate of displacement, using a direct shear apparatus.

The procedure can also be used for testing geosynthetic barriers.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9862, *Geosynthetics — Sampling and preparation of test specimens*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 relative displacement

S

displacement of the sand, soil or other geosynthetic relative to the specimen during shearing
Note 1 to entry: Relative displacement is expressed in millimetres (mm).

3.2 normal force

N

constant vertical force applied to the specimen
Note 1 to entry: Normal force is expressed in kilonewtons (kN).

3.3 shear force

S

horizontal force measured during shearing at a constant rate of displacement
Note 1 to entry: Shear force is expressed in kilonewtons (kN).

3.4 normal stress

σ

normal force (3.2) divided by the contact area of the specimen
Note 1 to entry: Normal stress is expressed in kilopascals (kPa).

3.5 shear stress

τ

shear force (3.3) along the sand, soil or other geosynthetic /geosynthetic interface, divided by the contact area of the specimen

Note 1 to entry: Shear stress is expressed in kilopascals (kPa).

3.6 maximum shear stress

τ_{max}

maximum value of *shear stress* (3.5) developed in a shear test

Note 1 to entry: Maximum shear stress is expressed in kilopascals (kPa).

3.7 angle of friction

Φ

slope of the "best fit regression straight line", through the plot of *maximum shear stress* (3.6)

Note 1 to entry: The angle of friction is expressed in degrees (°).

Note 2 to entry: In this document, ϕ_{sg} is used to refer to the angle of friction between geosynthetic and sand, or geosynthetics and specific soil, and ϕ_{gg} is used for the angle of friction between geosynthetic and geosynthetic.

3.8 apparent cohesion

c_{sg}

calculated value of the *shear stress* (3.5) on the "best fit regression straight line" corresponding to zero *normal stress* (3.4)

Note 1 to entry: Apparent cohesion is expressed in kilopascals (kPa).

Note 2 to entry: This term is used between geosynthetic and sand, or geosynthetics and specific soil.

3.9 maximum shear stress in sand or soil alone

$\tau_{max,s}$

maximum shear stress (3.6) developed during a shear test on sand or soil alone

Note 1 to entry: Maximum shear stress in sand or soil alone is expressed in kilopascals (kPa).

3.10 maximum shear stress sand or soil/support

$\tau_{max,sup}$

maximum shear stress (3.6) developed during the shearing along the sand or soil/support interface without geosynthetic

Note 1 to entry: Maximum shear stress sand or soil/support is expressed in kilopascals (kPa).

3.11 friction ratio

$f_g(\sigma)$

ratio of the *maximum shear stress*, τ_{max} (3.6) to the *maximum shear stress in sand or soil alone*, $\tau_{max,s}$ (3.9) for the same *normal stress* (3.4)σ

3.12

apparent adhesion

a_{gg}

calculated value of the *shear stress* (3.5) on the "best fit regression straight line" corresponding to zero *normal stress* (3.4)

Note 1 to entry: Apparent adhesion is expressed in kilopascals (kPa).

Note 2 to entry: This term is used between geosynthetic and geosynthetic.

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BUREAU OF INDIAN STANDRADS

भारतीय मानक मसौदा

भूकृत्रिम — गतिशील वेध परीक्षण (शंकु पाती परीक्षण)

Draft Indian Standard

GEOSYNTHETICS — DYNAMIC PERFORATION TEST (CONE DROP TEST)

ICS 59.080.70

Last date for receipt of comment is **30 May 2024**

NATIONAL FOREWORD

(*Formal clauses will be added later*)

This Indian Standard intended to be adopted is identical with ISO 13433 : 2006 'Geosynthetics Dynamic perforation test (cone drop test)' issued by the International Organization for Standardization (ISO).

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the standard intended to be adopted, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 554, Standard atmospheres for conditioning and/or testing — Specifications	IS 6359 : 2023 Method for conditioning of textiles (*first revision*)	Identical
ISO 9862, Geosynthetics — Sampling and preparation of test specimens	IS 14706 : 1999 Geotextiles — Sampling and preparation of test specimens	Identical
ISO 10320, Geosynthetics — Identification on site	IS 17421 : 2020 Geosynthetics – Identification on site	Identical

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 (*first revision*)'.

Extract of ISO 13433-4:2006 'Geosynthetics — Dynamic perforation test (Cone drop test)

Foreword

ISO 13433 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 189, Geosynthetics in collaboration with Technical Committee ISO/TC 221, Geosynthetics, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

1 Scope

This International Standard specifies a method to determine the resistance of geosynthetics to penetration by a steel cone dropped from a fixed height.

The degree of penetration is an indication of the behaviour of the geosynthetic when sharp stones are dropped on its surface.

The method is generally applicable to geosynthetics. However, the validity of this test for some types of products should be considered carefully, as the test principle may not be applicable.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 554, Standard atmospheres for conditioning and/or testing — Specifications

ISO 9862, Geosynthetics — Sampling and preparation of test specimens

ISO 10320, Geosynthetics — Identification on site

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Hole size

diameter of the hole made by the cone in penetrating the specimen
Note 1 to entry: The hole size is measured in millimetres.

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ANNEX 7
(*Item* 4.3)

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Doc. No: TXD 30 (22876) WC
July 2023

भारतीय मानक ब्युरो

BUREAU OF INDIAN STANDARDS

भारतीय मानक मसौदा
भुकृत्रिम — तटीय और जलमार्ग संरक्षण के लिए भुवस्त्रादी नली — विशिष्टी
Draft Indian Standard

GEOSYNTHETICS — GEOTEXTILE TUBES FOR COASTAL AND WATERWAYS PROTECTION — SPECIFICATION

ICS 59.080.70

Last date for receipt of comment is **08 September 2023**

FOREWORD
(*Formal clauses will be added later*)

Geotextile tubes find wide usage in riverbank, beach protection, sludge dewatering and offshore breakwaters for coastal and waterways protection. Geotextile tubes made from polypropylene (PP) or polyester (PET) monofilament, multifilament or fibrillated woven geotextiles, has been used for protecting riverbanks and hydraulic structures from severe scouring and erosion. Geotextile tubes have also been used as revetments, breakwaters, etc., to build structural erosion protection measures. Such tubes provide stability and prevent soil and coastal erosion. Geotextile tubes technology possesses minimal impacts on fish resources and facilitates fishing activities. It facilitates the algal community to grow. The technology has been popular worldwide due to its easier installation, cost effectiveness, their technical efficiency and environmental friendliness in comparison to the conventional erosion protection work using cement concrete block, gravel, hard rock, etc.

Worldwide it has been seen that erosion protection work using geotextile tubes requires less installation and maintenance cost, light weight equipment, less space for construction work, much less transportation cost and less energy requirement. The constructing materials of Geotextile tubes are locally available and cost-effective compared to importing boulders from other sites. The Geotextile tubes are lighter in weight than the traditional materials and their manufacturing and quality control are easy as compared to the cement concrete blocks and boulders. Geotextile tubes are filled with dredged material and are generally used when sea shores or bunds adjacent to rivers are to be protected in case of an emergency.

For best performance, Geotextile tubes have to be filled to maximum volume and density with dredged material based on design. These are installed in a pattern-placed arrangement that greatly improves their overall stability and performance. Filling task can be efficiently done by using water to compact the dredged material (hydraulically filling the dredged material into a tube). Filled density and volume are important from the view point of maximizing the stability, minimizing the effects of fill liquefaction and loss of shape of the Geotextile geotubes. To ensure that the contained fill is maintained in its dense state, the geo-textile sheet shall have adequate tensile strength.

One major advantage of Geotextile tubes is that these units can be used to construct hydraulic and marine structures that require adherence to designed geometrical shape accurately. Geotextile tubes' designs feature significantly larger dimensions and use higher strength woven geotextile. Sometimes nonwoven fabrics are used as

inner lining of the tubes. The construction allows large amount of sludge and silt to be easily removed without having to constantly change or replace bags. Geotextile tubes sizes can be custom made to your required location and surface area.

This Geotextile tubes can be used for a range of hydraulic and marine applications as given below:

Harbour & Shoreline Remediation

- Submerged Breakwater
- Detached Breakwater
- Groin
- Harbor Basin Sludge Dredging
- Channel Sediment Dredging

River/Wetland Remediation

- Riverbed protection
- River channel Dredging
- Wetland Remediation

Coastal Infrastructure Protection

- Cofferdam construction
- Reclamation works

Guidelines for installation of geotextile tubes are given in Annex B for information only.

1 SCOPE

This standard specifies requirements for geotextile tubes made from polypropylene (PP) or polyester (PET) monofilament, multifilament or fibrillated woven geotextiles, used for sludge dewatering**,** coastal and waterways protection applications such as revetments, river training, construction of groynes and artificial reefs, etc., in order to minimize soil erosion and control floods.

NOTES

1 The survivability/durability of geotextile tubes depends upon water pressure, soil condition, type of contents of geotextile tubes that is sand or gravels, water *p*H and temperature etc.

2 This standard does not apply to other types of geosynthetic erosion control materials such as turf reinforcement mats.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provision 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 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 13321 (Part 1) and the following shall apply.

3.1 Minimum Average Value (MAV) — MAV is the minimum average value of geotextile tubes.

3.2 Scour Apron — An apron of geotextile designed to protect the foundation of the main geotextile tube from the undermining effects of scour. In coastal and riverbed applications, scour can occur at the base of the tube due to wave and current action. Scour aprons may be on both sides of the main tube, or on only on the water front side. Scour aprons also reduce local erosion and scour caused during the hydraulic filling process of the main tube. Scour aprons are typically anchored by a small tube at the water's edge or by sandbags attached to the apron.

3.3 Fill Port — Also called a fill spout or fill nozzle, fill ports are sleeves sewn into the top of the

geotextile tube into which the pump discharge pipe is inserted. Ports are typically 300 mm to 450 mm in diameter and 1.0 m to 1.5 m length. Ports are spaced along the top of the tube to provide access to the contractor. Spacing is usually no closer than 7.5 m to accommodate sand slurry but can be as far apart as 30 m for some viscous fill materials. Fill ports are fabricated from the same geotextile as the main tube. There must be another safety pocket outer to spout/port so that it can be kept safely inside this cover/sack after filling to avoid floating/laying in the geotextile tube.

4.1 Material of Geotextile Tubes

4.1.1 Geotextile tubes shall be made from monofilament, multifilament or fibrillated woven fabric manufactured from ultraviolet stabilized polypropylene or polyester, depending upon the end use requirements and shall conform to requirements as specified in Table 1. The geotextile tubes shall be inert to commonly encountered chemicals, resistant to rot and mildew and shall have no tear or defects which adversely affect or alter its physical properties.

4.1.2 The standard geotextile tube is made of soil tight, permeable and high strength woven geotextile sheets sewn along the edges with inlets sewn at regular intervals. If required, the tubes can be designed as inner and outer tube. The inner tube (if required) can be of nonwoven fabric that acts as a filter to retain the fine-grained material requirements and shall conform to requirements as specified in Table 2. An outer layer of high strength woven fabrics designed to contain the weight of the fill material and pumping pressure required to fill the tube to the required height.

4.1.3 All property values except elongation and apparent opening size in this standard represent minimum values. Average of test results from any sampled tube in a lot shall meet or exceed the minimum values specified in this standard. In case of elongation and apparent opening size, shall represent the maximum value.

4.2 Geotextile tubes shall be dimensionally stable and able to retain their geometry under manufacture, transport, and installation.

Table 1 Requirements of Polypropylene and Polyester Geotextile Tube

(*Clause* 4.1.1)

Sl No.	**Characteristic**	**Requirement**				**Method of Test, Ref. to**
		Type 1	Type 2	Type 3	Type 4	
A.	**Mechanical Properties:**					
i)	Polymer type	Polypropylene or Polyester				IS 667
ii)	Wide width tensile strength, kN/m, *Min*:					IS 16635
	a) Machine direction	75	125	175	250	
	b) Cross machine direction	75	125	175	250	
iii)	Elongation at designated tensile strength, percent, *Max*					IS 16635
	a) Machine direction	25	25	20	20	
	b) Cross machine direction	25	25	20	20	
iv)	Seam strength, Percent of actual fabric strength, *Min*	70	70	70	70	IS 15060
v)	Trapezoidal tear strength, kN, *Min*					IS 14293
	a) Machine direction	1.0	1.5	2.5	3.2	
	b) Cross machine direction	1.0	1.5	2.5	3.2	
vi)	CBR puncture resistance, kN, *Min*	7	10	12	20	IS 16078
B.	**Hydraulic Properties:**					
i)	Water permeability at 50 mm water head, $l/m^2/s$, *Min*	5	5	5	3	IS 14324
ii)	Apparent opening size (AOS), mm, 0_{90}, *Max*	0.30	0.25	0.25	0.20	IS 14294

iii)	UV resistance after 500 h, Retained tensile strength in machine and cross direction, Percent, *Min*	70	70	70	70	IS 13162 (Part 2)
iv)	Chemical resistance after 72 h immersion in chemicals, Retained tensile strength, Percent, *Min*	70	70	70	70	IS 16351
v)	Abrasion resistance by sliding block method, Retained tensile strength in machine and cross direction after 250 cycles, Percent	70	70	70	70	IS 14714

Table 2 Requirements of Inner Layer (Nonwoven) of Geotube

(*Clause* 4.1.2)

Sl No.	Characteristic	Requirements	Method of Test, Ref. to
i)	Material	Polypropylene or Polyester	IS 667
ii)	Mass, g/m^2 , *Min*	150	IS 14716
iii)	Ultimate tensile strength, kN/m, *Min*		IS 16635
	a) Machine direction	6.0	
	b) Cross machine direction	7.5	
iv)	Grab tensile strength, N, *Min*		IS 16342
	a) Machine direction	320	
	b) Cross machine direction	450	
v)	Trapezoidal tear strength, N, *Min*		IS 14293
	a) Machine direction	210	
	b) Cross machine direction	290	
vi)	Apparent opening size, $O_{95,}$ Micron, *Max*	250	IS 14294
vii)	Water permeability at 50 mm waterhead, l/m^2/s, *Min*	90	IS 14324
viii)	UV resistance, retained strength after 500 hrs of UV exposure, Percent , *Min*	70	IS 13162 (Part 2)

4.3 Prefabrication of Geotextile Tubes

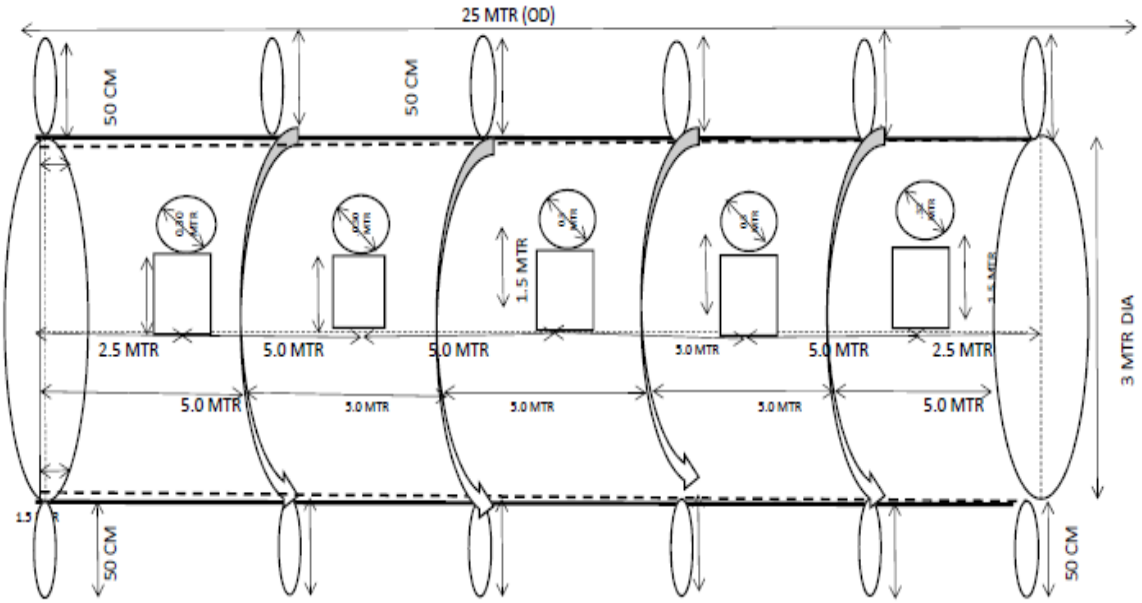
Geotubes shall be prefabricated using white or black colour UV stabilized high strength polyester or polypropylene multifilament yarn. The geotubes shall have seam with six line parallel chain stitch along the edges on the two sides with a minimum stitch density of 12 stitches/dm. Number of stitches is chosen in such a way that seam strength is achieved at least 70 percent of its original strength. The stitching yarn shall be UV resistance such that, retained tensile strength after 500 h exposure shall not be less than 50 percent of its original value.

The sewing shall be done by using a UV stabilized high strength polyester or polypropylene multifilament yarn in circumferential or longitudinal stich pattern, as the case may be of minimum linear density 2000 Denier. The distance between the two row of stitches shall be 10 mm.

Stitch on both lines of the geotextile tube shall continue beyond the tube's open mouth and end in a loose loop of thread of length 25 mm to 50 mm. The stitching shall be uniform without any loose thread or knot.

4.4 Dimensions

Geotube may be either longitudinal or circumferential in shape as shown in Fig. 1 and Fig. 2 respectively. The typical dimensions of the geotube, spout/filling port and loop is given in Table 3, Table 4 and Table 5 respectively. The geotubes may be made to other shapes and dimensions as per agreement between buyer and seller.



Tube Spec. Details
Tube Size:- 25 X3 ØMtr (OD)
Spout:- 1.50X0.30 Mtr Ø X 5 Nos. with 1 meter length tie each
Loop:-50 Cm.(Height) X12 Nos.(6+6)

FIG. 1 TYPICAL SECTION OF CIRCUMFERENTIAL GEOTEXTILE TUBE OF 25 M × 3 M DIMENSION

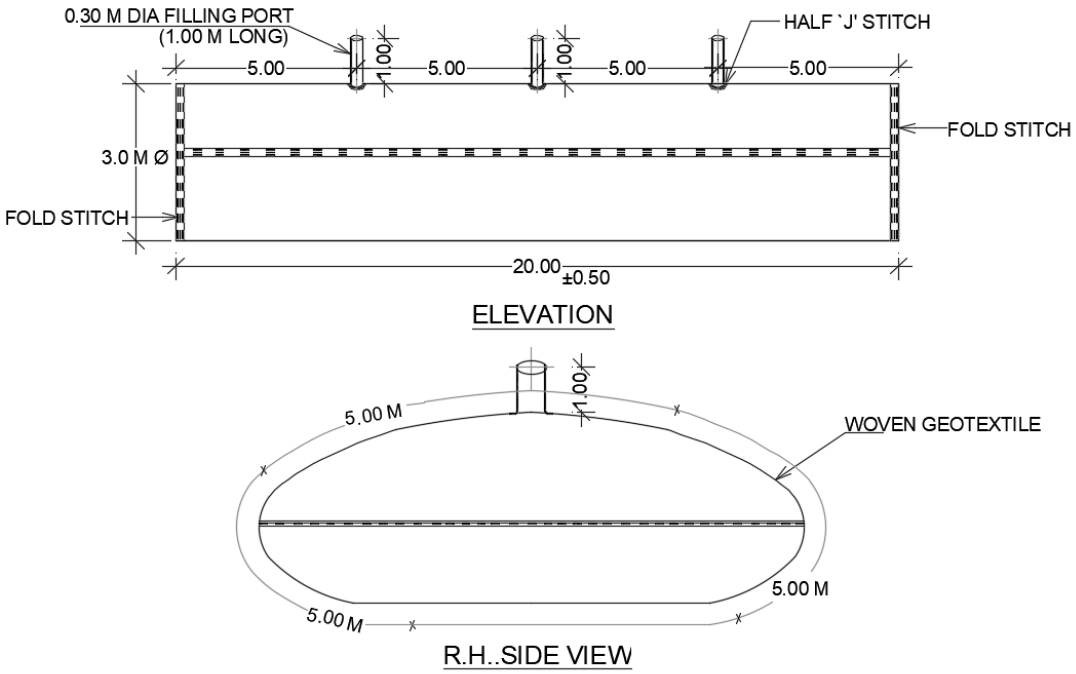


FIG.2 TYPICAL SECTION OF LONGITUDINAL GEOTUBE OF 20 M × 3 M DIAMETER

4 REQUIREMENTS

Table 3 Dimensions for Geotubes

(*Clause* 4.4)

Geotube type	*Length (m)*	*Diameter(m)*	*Tolerance on Length and Diameter, Percent*
20x2m	20.00	2.00	+3 percent with no negative tolerance
20x3m	20.00	3.00	
20x5m	20.00	5.00	
25x2m	25.00	2.00	
25x3m	25.00	3.00	
25x5m	25.00	5.00	
30x2m	30.00	2.00	
30x3m	30.00	3.00	
30x5m	30.00	5.00	

Table 4 Dimensions for Spout/filling port
(*Clause* 4.4)

Length (m)	*Diameter (m)*	*Tolerance on Length and Diameter, Percent*
1.00	0.30	+3 percent with no negative tolerance
1.00	0.35	
1.50	0.30	
1.50	0.35	

Table 5 Dimensions for Loop
(*Clause* 4.4)

Length (cm)	*Width(inch)*	*Tolerance on Length and Width, Percent*
20.00	1.00	+3 percent with no negative tolerance
20.00	2.00	
50.00	1.00	
50.00	2.00	

5 MARKING AND LABELLING

5.1 The geotextile tubes shall be marked with the following by attaching the printed labels:

a) Manufacturer’s name, initials or trade-mark;

b) Identification of the geotextile tubes material as per manufacturer's recommendation, for example, polypropylene woven geotextile tubes for coastal/ waterways protection;
c) Type of geotextile tubes/mass in g/m^2, of fabric used for manufacture of geotextile tubes;
d) Dimensions (length and width) of geotextile tubes;
e) Lot number and date of manufacture;
f) The country of origin;
g) Any other information/instruction provided by the manufacturer/required under law.

5.2 BIS Certification Marking

The geotextile tubes may also be marked with the Standard Mark.
5.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 2016 and Rules and Regulations made thereunder. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6 PACKING

Each bundle shall be labeled or tagged to provide product identification sufficient for field identification as well inventory and quality control purpose.
Bundles shall be stored in a manner which protects them from adverse impact of weather. If stored outdoors, they shall be elevated and protected with a waterproof cover. Geotextile tubes are laid flat in a HDPE tube or wrapped in a HDPE film of minimum thickness of 60 microns and tied with a HDPE/PP tape so as to remove excess air and to prevent it from the adverse impact of heat and moisture, oil, grease, dirt, dust and other stains as well as to extended ultra-violet exposure during shipment and storage prior to deployment and placement.

7 IDENTIFICATION, DELIVERY, STORAGE AND HANDLING

7.1 The finished geotextile tube and its associated scour apron shall be rolled on a stable core or accordion folded into a bundle for handling, storage and shipment. The geotextile tube and/or scour apron is to be protected by an outer wrapping or plastic bag. The manufacturer's identification label shall be clearly visible on the outer wrapping and in a manner consistent with the established policy of the manufacturer.

7.2 Geotextile tubes and scour aprons shall be labeled, shipped, stored, and handled in accordance with IS 17421 and as specified herein. Each segment of geotextile tube and scour apron shall be wrapped in an opaque layer of plastic during shipment and storage. The plastic wrapping shall be placed around the unit in the manufacturing facility and shall not be removed until deployment. Each packaged segment of geotextile tube and/or scour apron shall be labeled with the manufacturers name, geotextile type, lot numbers, roll numbers, and dimensions (length, width, gross weight). For the purposes of inventory and shipping, bar code system may be followed.

7.3 During storage, Geotextile tubes shall be elevated off the ground and adequately protected from the following:
a) Site construction damage;
b) Excessive precipitation;
c) Extended exposure to sunlight;
d) Aggressive chemicals;
e) Flames or temperatures in excess of 60°C;
f) Excessive mud, wet concrete, epoxy, or other deleterious materials coming in contact with and affixing to the geotextile material;
g) Any other environmental condition that may damage the physical property values.

7.4 The geotextile tubes shall be stored at temperatures above 10°C and below 40°C.

7.5 The geotextile tubes shall be laid flat.

7.6 The geotextile tubes shall not be directly exposed to sunlight for a period longer than the period recommended by the manufacturer.

7.7 The geotextile tubes shall be kept dry until installation, and shall not be stored directly on the ground.

8 SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Lot

The number of geotextile tubes of the same size, type and quality delivered to a buyer against one dispatch note shall constitute a lot.

8.2 The number of geotextile tubes to be selected at random shall be according to col 2 and col 3 of Table 4. To ensure the randomness of selection, IS 4905 may be followed.

8.3 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

8.3.1 The number of geotextile tubes to be selected for length, width, and mass of sand to be filled and pre-fabrication requirements shall be in accordance with col 3 of Table 4. For tensile strength, elongation, seam strength and water permeability, the number of Geotextile tubes selected shall be in accordance with col 6 of Table

NOTE — If agreed to between buyer and seller, the sampling at the consumer/user end at site shall be carried out for deciding the conformity of the lot.

8.3.2 All the geotextile tubes selected from the lot shall be tested for various requirements as per methods specified in relevant standards as specified in Table 1 and in **4.1.1**, **4.1.2**, **4.2** and **4.3**. A geotubes shall be declared defective, if it does not meet any of the requirements specified in Table 1 and in **4.1.1**, **4.1.2**, **4.2** and **4.3**. The lot shall be declared conforming to this standard, if the average of test results from sampled bags in a lot shall meet or exceed the minimum values specified in this standard against each requirement; except in case of elongation and apparent opening size where the average value of test results shall not be more than the value specified in Table 1. The lot shall also be declared as conforming to this standard, if the number of defective Geotextile tubes does not exceed the values specified in col 4 of Table 6. In addition to above the lot shall meet the requirements of marking and labelling (*see* **5.1**), packing (*see* **6**) and storage and handling (*see* **7.1** to **7.5**).

Table 6 Sample Size
(*Clauses* 8.2, 8.3, 8.3.1 and 8.3.2)

Sl No.	**Lot Size (No. of bundles of 20 Geotextile Tubes)**	**Sample Size (No. of Geotextile Tubes)**	**Permissible Number of Non-conforming Geotextile Tubes**	**Sub-Sample Size (No. of Geotextile Tubes)**	**Sub-Sub-Sample Size (No. of Geotextile Tubes)**
(1)	(2)	(3)	(4)	(5)	(6)
i)	Up to 100	5	0	2	1
ii)	101 to 200	8	1	4	2
iii)	201 to 300	13	1	5	3
iv)	301 to 500	20	2	8	4
v)	501 to 1 000	32	3	10	5
vi)	1 001 and above	50	3	10	6

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 667 : 1981	Methods for identification of textile fibres (*first revision*)
IS 13162 (Part 2) : 1991	Geotextiles — Methods of test (Part 2): Determination of resistance to exposure of ultraviolet light and water (Xenon-arc type apparatus)
IS 14293 : 1995	Geotextiles — Method of test for trapezoid tearing strength
IS 14294 : 1995	Geotextiles — Method for determination of apparent opening size by dry sieving technique
IS 14324 : 1995	Geotextiles — Methods of test for determination of water permeability — Permittivity
IS 14714 : 1999	Geotextiles — Determination of abrasion resistance
IS 14716 : 2021	Geosynthetics — Test method for the determination of mass per unit area of geotextiles and geotextile-related products
IS 16237 : 2014	Geo-synthetics — Method for determination of apparent opening size by wet sieving
IS 16342 : 2015	Geosynthetics — Method of test for grab breaking load and elongation of geotextiles
IS 16351 : 2015	Geosynthetics — Standard practice for laboratory immersion procedures for evaluating the chemical resistance of geosynthetics to liquids
IS 17421 : 2020	Geosynthetics – Identification on site
IS 4905 : 2015 / ISO 24153: 2009	Random sampling and randomization procedures (*first revision*)
IS 13321 (Part 1) : 2022 / ISO 10318-1:2015	Geosynthetics (Part 1) : Terms and definitions (*first revision*)
IS 15060 : 2018 / ISO 10321:2008	Geosynthetics — Tensile test for joint seams by wide-width strip method (first revision)
IS 16078 : 2013 / ISO 12236:2006	Geosynthetics —Static puncture test (CBR Test)
IS 16635 : 2017 / ISO 10319:2015	Geosynthetics — Wide width tensile test

ANNEX B
(*Foreword*)

GUIDELINES FOR INSTALLATION OF GEOTEXTILE TUBES

B-1 PREAMBLE

B-1.1 Geotextile tubes are made up of high-strength Polypropylene Multifilament (PPMF) or Polyester Multifilament (PETMF) woven Geotextile fabric with specially designed hydraulic properties which allow water to pass through it while entrapping the soil inside the tube. The tubes are stitched with six lines of UV stabilized high strength polyester or polypropylene multifilament stitching thread to get desired seam strength. Geotextile tubes are resistant to UV and other microbiological organisms found in soil. The geotextile tubes are usually filled by the hydraulic pumping method with soil slurry.

B-2 PRODUCT DELIVERY, STORAGE AND HANDLING

B-2.1 Geotextile tube and related components shall be delivered to the project site in a protective cover. Each geotextile tube shall be clearly labelled for easy identification.

B-2.2 No hooks, tongs or other sharp instruments etc. should be used for handling the geotextile tube. The supplied geotextile tube should not be dragged along the ground. The geotextile tube should be placed in position as recommended by the manufacturer.

B-2.3 Geotextile tube shall be stored over a platform constructed in areas where water cannot accumulate, elevated off of the ground and protected from conditions that will affect the properties or performance of the geotextile. Geotextile tubes should not be exposed to temperatures over 60°C. The duration of storage time shall not exceed the manufacturer's recommendation.

B-3 SITE PREPARATION

Location at which geotextile tubes are to be placed, shall be checked properly to confirm any obstructions, which could damage the geotextile tubes, such as roots, sharp objects, debris and any other material shall be removed. Bb,

B-4 PLACEMENT OF GEOTEXTILE TUBE

B-4.1 Lay nonwoven geotextile for scour protection covering the entire area before placing the geotextile tube.

B-4.2 No portion of the geotextile tube shall be filled until the entire tube segment has been fully anchored along the correct alignment.

B-5 INJECTION OF FILL MATERIAL

B-5.1 After the placement of the geotextile tube and scouring apron, the sand slurry shall be filled in the tube according to the approved plan of construction. The discharge line of the dredge shall be fitted with a valve to allow control of the rate of filling. The valve system shall be fitted with an internal mechanism such as a gate, butterfly valve, ball valve or pinch valve, to allow the contractor to regulate the discharge into the geotextile tube. Any excess discharge shall be directed away from the tube into a designated area.

B-5.2 Typically, the diameter of the dredge discharge pipe should be in the range of 150 mm to 250 mm to ensure the adequate filling of the geotextile tube. Injection ports are typically 300 to 350 mm in diameter and 1.0 m to 1.5 m in length. Care should be taken not to overfill or over-pressurize the "anchor tube" that is incorporated into the scour apron.

B-5.3 The dredge discharge pipe shall be free of protrusions that could tear the fill port. The dredge discharge pipe shall be supported above the fill port in a manner, which reduces stress on the fill port seams. Excessive

movement of the dredge discharge pipe during filling can result in damage to the fill port. The pump may be installed 50 to 100m far from the geotextile tube in position.

B-5.4 Geotextile tubes used in coastal and river erosion control applications are most often filled hydraulically with a slurry of sand and water. Upon filling the geotextile tube, the fill port sleeves shall be closed and attached to the geotextile tube in a manner sufficient to prevent movement of the sleeve by subsequent wave action or other disturbances. Tie the mouth of the port and place the same inside the safety pocket of the geotextile tube so that the port material/spout does not escape/float after filling.

B-5.5 The geotextile tube should not be filled up to its capacity through the filling ports at once because it may not allow the slurry to settle adequately. Therefore, the tube should be filled up to 40 percent to 50 percent of its capacity in the first step by allowing the water to drain out through the pores. In case there is any clogging at any of the ports before the tube is completely filled then water should be injected inside the port to remove the clogging allowing further space for filling.

B-5.6 The geotextile tube shall be completely filled to its design height as suggested by the engineer-in-charge and geotextile tube manufacturer.

B-6 POST INSTALLATION PRECAUTIONS

B-6.1 Immediately after installation, ensure the proper placement of geotextile tubes as per design and geometry of the site. If any abnormality is observed, correction or re-dumping shall be carried out.
B-6.2 Proper care shall be taken to avoid manual interference of civilians and animals which can cause damage to the material.

ANNEX 8
(*Item* 4.3)

INPUTS ON 'GEOTEXTILES TUBES FOR COASTAL AND WATERWAYS PROTECTION'

Inputs from: SHRI SAURABH VYAS TECH FAB (INDIA) INDUSTRIES LTD

Inputs:

TECH FAB (INDIA) INDUSTRIES LTD. (100 % EOU)

TEST CERTIFICATE

Customer : To whom so ever it may concern.

Product : PP Multifilament woven Geotextile (TFI 1950Z) &
Techgeo PR 15Test certificate No: KRQTC-GT/2425003

Date : 29.07.2024

Sr. No	Properties	Test Method	Unit	Specification	Observed Value
1	Polymer type	IS 667	-	Polypropylene	Polypropylene
2	Wide width tensile strength (MD/CD)	IS 16635	kN/m	≥ 00/200	214.5/218
3	Elongation at designated tensile strength(MD/CD)	IS 16635	%	20±5%	18/19
4	Seam strength of actual fabric strength	IS 15060	%	>70	79
5	CBR puncture resistance	IS 16078	kN	≥10.5	11.4
6	Apparent opening size (AOS)	IS 14294	mm	≤0.18	0.150
7	UV resistance after 500 h, Retained tensile strength in machine and cross direction	IS 13162 (Part 2)	%	≥80	86
8	Water permeability at 50 mm water head	IS 14324	$l/m^2/s$	≥20	24.5
9	Dynamic Perforation (Cone Drop)	EN ISO 13433	mm	≤7	6
10	Abrasion Resistance by sliding block method, Retained tensile strength in machine and cross direction after 250 cycles.	IS 14714	%	75	84
Inner Layer					
1	Material	IS 667	-	Polypropylene	Polypropylene
2	Mass	IS 14716	g/m2	≥150	164

3	Ultimate Tensile strength (MD/CD)	IS 16635	kN/m	9.0/9.0	9.1/9.6
4	Grab Tensile Strength(MD/CD)	IS 16342	N	500/500	524/545
5	Trapezoidal Tear Strength (MD/CD)	IS 14293	N	180/180	238/318
6	Apparent Opening Size	IS 14294	Micron	≤250	212
7	Water permeability at 50 mm water head	IS 14324	$l/m^2/s$	80	95
8	UV Resistance retained strength after 500 hrs of UV exposure	IS 13162 (Part 2)	%	70	78
9	Tube Length	-	mtr	25	25
10	Geotube Filled Height	-	mtr	2.5	2.5

Approved By
Prabhu Tripathy(DGM-QA)

END OF TEST REPORT (Page 1 of 1)

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The Test Results relate only to the item tested Sample condition and tested at Temp. Of 21±2 Deg.C & 65±5 % RH

Works: Survey No.60/4P, Plot No. 18, Village-Karajgam, Silvassa-396 230. (D.N.H.)
E-mail: karajgam.accounts@techfabindia.com, geocel.works@techfabindia.com,
website: www.techfabindia.com
H.O.: 712, Embassy Centre, Nariman Point, Mumbai 400021 Tel: 91-22-22876224/25,
E-mail: office@techfabindia.com\

TECH FAB (INDIA) INDUSTRIES LTD. (100 % EOU)

TEST CERTIFICATE

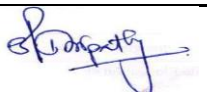
Customer : To whom so ever it may concern.

Product : Techgeo Tube TGT TFI 1400Z+
Techgeo PR 15Test certificate No: KRQTC-GT/2425001

Date : 29.07.2024

Sr. No	Properties	Test Method	Unit	Specification Type 1	Observed Value
01	Polymer type	IS 667	-	Polypropylene	Polypropylene
02	Wide width tensile strength (MD/CD)	IS 16635	kN/m	≥75/75	78.4/81.5
04	Elongation at designated tensile strength(MD/CD)	IS 16635	%	≤25	21/22
06	Seam strength of actual fabric strength	IS 15060	%	≥70	94
07	Trapezoidal tear strength (MD/CD)	IS 14293	kN	1.0	1.15
09	CBR puncture resistance	IS 16078	kN	≥7.0	8.6
10	Apparent opening size (AOS)	IS 14294	mm	≤0.30	0.25
11	UV resistance after 500 h, Retained tensile strength in machine and cross direction	IS 13162 (Part 2)	%	≥70	84
12	Water permeability at 50 mm water head	IS 14324	$l/m^2/s$	≥5.0	8.4
13	Chemical Resistance after 72 h immersion in chemicals, Retained tensile strength, Percent	IS 16351	%	≥70	87
14	Abrasion Resistance by sliding block method, Retained tensile strength in machine and cross direction after 250 cycles.	IS 14714	%	≥70	81
	Inner Layer				
1	Material	IS 667	-	Polypropylene	Polypropylene
2	Mass	IS 14716	g/m2	150	158
3	Ultimate Tensile strength (MD/CD)	IS 16635	kN/m	≥9.0/9.0	9.4/9.7

4	Grab Tensile Strength(MD/CD)	IS 16342	N	≥500/500	522/528
5	Trapezoidal Tear Strength (MD/CD)	IS 14293	N	≥180/180	240/305
6	Apparent Opening Size	IS 14294	Micron	250	212
7	Water permeability at 50 mm water head	IS 14324	$l/m^2/s$	80	95
8	UV Resistance retained strength after 500 hrs of UV exposure	IS 13162 (Part 2)	%	70	78



Approved By
Prabhu Tripathy(DGM-QA)

END OF TEST REPORT (Page 1 of 1)

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The Test Results relate only to the item tested Sample condition and tested at Temp. Of 21±2 Deg.C & 65±5 % RH

THE BOMBAY TEXTILE RESEARCH ASSOCIATION

(Approved Body of the Ministry of Textiles, Govt. of India)
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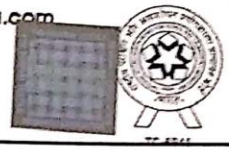
Website: www.btraindia.com

BTRA TEST LABORATORIES

TEST REPORT



Report Details : **BTL/TR/2204578/TTG/1/A/2022 dtd 16/08/2022**
ULR No. : TC694122000004578F

Customer : Techfab (India) Industries Ltd. (Daman)
Survey No. 147/ 2, 3, & 4, Opp. Dabhel Talab,
Village Dabhel, Daman-396210 (U.T.)
IN -

Total Number of Samples in Order : 1
Date of performance of test :06/08/2022
To
16/08/2022

Reference :Letter No. TFI/QC/19/2022 Dtd. 05/08/2022
Received on :06/08/2022

Despatched on :

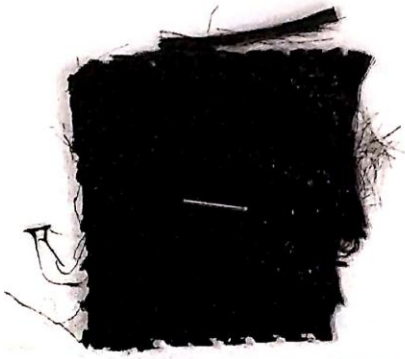
SAMPLE NO.	2204578/TTG/1
SAMPLE MARK	TECHGEOTUBE TFI1500(Z) Black 4m X 35m

Name of Work : Client Name M/s MAGELLAN MARINE SERVICES LLC

TEST RESULTS

TEST PARAMETER	RESULTS	METHOD OF TEST	STANDARD VALUE
Wide Width Tensile Strength, (kN/m)	-	ASTM D 4595-2017	
Machine Direction	104		>100
Cross Machine Direction	102		>100
Elongation at Break, (%)	-		
Elongation % @ Designated Load	23.3		<25
Machine Direction	24.7		<25
Static (CBR) Puncture Resistance, (kN)	11.1	ASTM D:6241:2014	>10.5
Water Permeability (at 100 mm WH), L/m²/ sec.	50.1	ASTM D:4491:2021	>20

*** End of the Report ***



THE BOMBAY TEXTILE RESEARCH ASSOCIATION * MUMBAI-86 * btra

R.A. Shaikh
(Authorised Signatory)

384

THE BOMBAY TEXTILE RESEARCH ASSOCIATION

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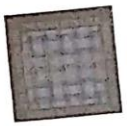
BTRA TEST LABORATORIES



TEST REPORT

Report Details : **BTL/TR/2204578/TTG/1/B/2022 dtd 16/08/2022**

ULR No. : TC694122000004578P

Customer : Techfab (India) Industries Ltd. (Daman)
Survey No. 147/ 2, 3, & 4, Opp. Dabhel Talab,
Village Dabhel, Daman-396210 (U.T.)
IN -

Total Number of Samples in Order : 1

Date of performance of test :06/08/2022
To
16/08/2022

Reference :Letter No. TFI/QC/19/2022 Dtd. 05/08/2022

Received on :06/08/2022

Despatched on :

SAMPLE NO.	2204578/TTG/1
SAMPLE MARK	TECHGEOTUBE TFI1500(Z) Black 4m X 35m

Name of Work : Client Name M/s MAGELLAN MARINE SERVICES LLC

TEST RESULTS

TEST PARAMETER	RESULTS	METHOD OF TEST	STANDARD VALUE
Seam Strength, (kN/m)	95	ASTM D:4884-2014	
Fabric Strength, (kN/m)	104	ASTM D 4595-2017	
Seam Strength Retained %,	91		>90
Apparent Opening Size, (micron)	174	ASTM D:4751:2016	<210

*** End of the Report ***

Woven Polypropylene Geotextile: Technical Data Sheet

TFI 1000 Series are the woven multifilament polypropylene woven geotextile. The geotextile are resistant to chemicals and micro-organisms normally found in soils.

TFI 1000 series geotextile are stable within pH range of 2 to 13 and are resistant to short-term to ultraviolet radiation.

PRODUCT PROPERTIES	TEST METHOD	UNIT	**TFI-1950Z), 25 X 2.5 M Fill height GEOTUBE**
MATERIAL	POLYPROPYLENE MULTIFILAMENT		**Result Value**
Polymer Composition, Structure and Physical Properties			
Polymer	Polypropylene		
Structure	Woven with multifilament yarn in both Warp and weft directions		
Mass per unit area	ASTM D 5261/ISO-9864	g/m2	≥950
MECHANICAL PROPERTIES			
Tensile Strength (MD)	ASTM D 4595/EN ISO 10319	kN/m	≥200
Tensile Strength (CD)	ASTM D 4595/EN ISO 10319	kN/m	≥200
Elongation at specified Tensile Strength MD	ASTM D 4595/EN ISO 10319	%	≤20 (±5%)
Elongation at specified Tensile Strength CD	ASTM D 4595/EN ISO 10319	%	≤20 (±5%)
Ultraviolet resistance @500 Hrs.	ASTM D 4355	%	≥80
Seam Strength	ASTM D 4884/EN ISO 10321	%	≥70
Abrasion resistance	ASTM D 4886/BAW Drum rotation	%	≥75
Dynamic Perforation (Cone Drop)	EN ISO 13433	mm	≤7
CBR Puncture Resistance	ASTM D 6241/EN ISO 12236	k N	≥10.5
HYDRAULIC PROPERTIES			
Water Flow Rate Normal to the Plane	ASTM D 4491/ EN ISO 11058	l/m^2/sec	>20

Apparent Opening Size (O95)	ASTM D 4751/ EN ISO 12956	µm	≤180
Remark.	Roll Length and Roll width may vary as per requirement		
Geotube Length		M	25
Geotube fill height		M	2.5

[1] Minimum average roll value (Minimum refers to 95 % confidence limit.) MD – Machine Direction CD – Cross Direction.

ANNEX 9

(*Item* 6.1)

COMMENTS RECEIVED FROM SROL, HYDERABAD ON 'IS 17483 (PART 1) : 2020 AND IS 17483 (PART 2)'

Commentator: SROL, BIS, HYDERABAD

Comment:

I hope you're well. I've been reviewing the QCO product standards for Geosynthetic products, and there are a few sections that I believe could benefit from a bit more clarity. Particularly, the segment the **DSC flowmeter** seems to have some points.
The DSC will utilize in four products for testing as per the following details:

S. No.	IS No.	Product	Clause	Test	Test Method	Equipment	Remarks
1	16352: 2020	Geosynthetics — High Density Polyethylene (HDPE) Geomembranes for Lining	Table 1, xii	Oxidative induction time (OIT), minutes (Standard or High pressure)	ISO 11357 (Part 6)	DSC, Flowmeter	(Standard or High pressure)
2	16352: 2020	Geosynthetics — High Density Polyethylene (HDPE) Geomembranes for Lining	Table 1, xiii	Oven ageing at 85°C, Retention of oxidative induction time (OIT) after 90 days (Standard or High pressure)	IS 7016 (Part 8), ISO 11357-6 and ASTM D 5885	DSC, Flowmeter	(Standard or High pressure)
3	16352: 2020	Geosynthetics — High Density Polyethylene (HDPE) Geomembranes for Lining	Table 2, xiii	Oxidative induction time (OIT), minutes (Standard or High pressure)	ISO 11357 (Part 6)	DSC, Flowmeter	(Standard or High pressure)
4	16352: 2020	Geosynthetics — High Density Polyethylene (HDPE) Geomembranes for Lining	Table 2, xiv	Oven ageing at 85°C, Retention of oxidative induction time (OIT) after 90 days (Standard or High pressure)	IS 7016 (Part 8), ISO 11357-6 and ASTM D 5885	DSC, Flowmeter	(Standard or High pressure)
5	17374: 2020	Geosynthetics — Reinforced HDPE	Table 1, xviii	Oxidative induction time	ISO 11357	DSC, Flowmeter	(Standard or High

		Membrane for Effluents and Chemical Resistance Lining		(OIT), minutes (Standard or High pressure)	(Part 6)		pressure)
6	17374: 2020	Geosynthetics — Reinforced HDPE Membrane for Effluents and Chemical Resistance Lining	Table 1, xix	Oven ageing at 85°C, Retention of oxidative induction time (OIT) after 90 days (Standard or High pressure)	IS 7016 (Part 8), ISO 11357-6 and ASTM D 5885	DSC, Flowmeter	(Standard or High pressure)
7	17483 (Part 1): 2020	Geosynthetics — Geocells — Specification Part 1 Load Bearing Application	Table 1, xi	Standard oxidative induction time (Standard)	ISO 11357-6	DSC, Flowmeter	Standard
8	17483 (Part 1): 2020	Geosynthetics — Geocells — Specification Part 1 Load Bearing Application	Table 1, xii	High pressure oxidative induction time (High Pressure)	ISO 11357-6	DSC, Flowmeter	High pressure
9	17483 (Part 2): 2020	Geosynthetics — Geocells — Specification Part 2 Slope Erosion Protection Application	Table 1, xi	Standard oxidative induction time (Standard)	ISO 11357-6	DSC, Flowmeter	Standard
10	17483 (Part 2): 2020	Geosynthetics — Geocells — Specification Part 2 Slope Erosion Protection Application	Table 1, xii	High pressure oxidative induction time (High Pressure)	ISO 11357-6	DSC, Flowmeter	High pressure

The above details show two types of DSC requirements: standard and high pressure. According to our market survey, the approximate cost of DSC is

1. Standard DSC 10 Lacs
2. DSC 100 lacs High Pressure 100 Lacs

Could you clarify IS 17483 (Part 1 & 2) for including both the parameters to be tested and other 2 standards either standard or high pressure OIT is given. What is the necessity for testing both parameters in one product, why not optional test? In what way it varies from usage from other products?

ANNEX 10

(*Item* 6.2)

THE BOMBAY TEXTILE RESEARCH ASSOCIATION

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Website: www.btraindia.com

BTRA TEST LABORATORIES

TEST REPORT

Report Details	BTL/TR/B2307693/TT/1/B/2024	ULR No	TC694123000007693	Date: 02.01.2024

Bureau of Indian Standards (Surat)
40, Sheetal Shopping Center, Batar Road, Green Enclave, Adajan,
Surat
Pincode:395007

Type-1

Pass

THE FOLLOWING SAMPLE(S) WAS/WERE SUBMITTED AND IDENTIFIED BY/ON BEHALF OF THE CUSTOMER AS:

Sample No	**B2307693-1**	Product Description	**SUBO/64238/20231123/AS/1 -QR CODE-100000568826**
Received on	**07-12-2023**	Total Number of Samples in Order	**2**
Testing Period	**07.12.2023 To 02.01.2024**	Reference	**SUBO/64238/20231123/AS/1 & SUBO/64238/20231123/AS/2**
Despatched on		Sample Type	**TT**
Project Name		Page	

TEST RESULTS

Sr. No.	Test Parameters- Overall drain (Type 1)	Standard	Test Result	Required Value
1	Discharge capacity at 300kPa i=1.0 straight condition (m^3/s)	IS 17179	110×10^{-6}	*Min* 90×10^{-6}
2	Discharge capacity at 300kPa i=1.0 buckled condition (m^3/s)	IS 17179	68×10^{-6}	*Min* 55×10^{-6}
3	Tensile Strength (kN)	IS 16635	2.19	*Min* 1.5
4	Elongation at 1 kN (%)	IS 16635	4.43	*Max* 5.0
5	Elongation at Break (%)	IS 16635	49.4	*Min* 40.0
6	Thickness (mm)	IS 13162 (Part 3)	4.33	*Min* 4.0
7	Width (mm)	IS 1954	99.5	100±3
8	Roll Length (m)	IS 1954	50	
9	Dimensional Stability	IS 18309 CL 6.1	Sample was Dimensionally Stable	Sample should be stable
10	Identification of material by DSC	IS 667/DSC	100% Polypropylene	Polypropylene

Prasanta K. Panda
Geotech
(Authorised Signatory)

Chandrakala Madichetty
Special Testing
(Authorised Signatory)

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BTRA TEST LABORATORIES
TEST REPORT

Report Details	BTL/TR/B2307693/TT/1/B/2024	ULR No	TC694123000007693	Date: 02.01.2024

Sr. No.	Test Parameters- Filter (Type 1)	Standard	Test Result	Required Value
1	Mass per unit area (g/m^2)	IS 14716	126	*Min* 110
3	Tensile Strength, MD (kN/m)	IS 16635	4.73	*Min* 3
4	Grab Tensile Strength, MD (N)	IS 1969 (Part 2)	389	*Min* 250
5	Grab Elongation, MD (%)	IS 1969 (Part 2)	68.5	*Min* 45
6	Index Puncture Strength (N)	IS 13162 (Part 3)	103.5	*Min* 100
7	Trapezoidal Tear Strength (N)	IS 14293	88.6	*Min* 50
8	Permeability (m/s)	IS 14324	30×10^{-6}	*Min* 5×10^{-6}
9	Pore Size (μ)	IS 14294	<75	*Max* 75

End of the Report

Prasanta K. Panda
Geotech
(Authorised Signatory)

Chandrakala Madichetty
Special Testing
(Authorised Signatory)

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BTRA TEST LABORATORIES
TEST REPORT

Report Details	BTL/TR/B2307693/TT/1/B/2024	ULR No	TC694123000007693	Date:02.01.2024

Bureau of Indian Standards (Surat)
40, Sheetal Shopping Center, Batar Road, Green Enclave, Adajan,
Surat
Pincode:395007

Type-2

THE FOLLOWING SAMPLE(S) WAS/WERE SUBMITTED AND IDENTIFIED BY/ON BEHALF OF THE CUSTOMER AS:

Sample No	B2307693-2	Product Description	SUBO/64238/20231123/AS/1 - QR CODE-100000568826
Received on	07-12-2023	Total Number of Samples in Order	2
Testing Period	07.12.2023 To 02.01.2024	Reference	SUBO/64238/20231123/AS/1 & SUBO/64238/20231123/AS/2
Despatched on		Sample Type	TT
Project Name		Page	

TEST RESULTS

Sr. No.	Test Parameters- Over all Drain (Type 2)	Standard	Test Result	Required Value
1	Discharge capacity at 300kPa i=1.0 straight condition (m^3/s)	IS 17179	105×10^{-6}	*Min* 80×10^{-6}
2	Discharge capacity at 300kPa i=1.0 buckled condition (m^3/s)	IS 17179	70×10^{-6}	*Min* 55×10^{-6}
3	Tensile Strength (kN)	IS 16635	3.68	*Min* 2.0
4	Elongation at 1 kN (%)	IS 16635	6.07	*Max* 10
5	Elongation at Break (%)	IS 16635	43.0	*Min* 40.0
6	Thickness (mm)	IS 13162 (Part 3)	4.62	*Min* 4.0
7	Width (mm)	IS 1954	100.5	100±3
8	Roll Length (m)	IS 1954	50	50
9	Dimensional Stability	IS 18309 CL 6.1	Sample was Dimensionally Stable	Sample should be Stable
10	Identification of material by DSC	IS 667/DSC	100% Polypropylene	Polypropylene

Prasanta K. Panda
Geotech
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Chandrakala Madichetty
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BTRA TEST LABORATORIES
TEST REPORT

Report Details	BTL/TR/B2307693/TT/1/B/2024	ULR No	TC694123000007693	Date: 02.01.2024

TEST RESULTS

Sr. No.	Test Parameters- Filter (Type 2)	Standard	Test Result	Required Value
1	Mass per unit area (g/m^2)	IS 14716	160.3 ✓	*Min* 120
3	Tensile Strength, MD (kN/m)	IS 16635	10.0 ✓	*Min* 6
4	Grab Tensile Strength, MD (N)	IS 1969 (Part 2)	513.0 ✓	*Min* 500
5	Grab Elongation, MD (%)	IS 1969 (Part 2)	66.5 ✓	*Min* 45
6	Index Puncture Strength (N)	IS 13162 (Part 3)	352.6 ✓	*Min* 120
7	Trapezoidal Tear Strength (N)	IS 14293	165.0 ✓	*Min* 150
8	Permeability (m/s)	IS 14324	44×10^{-6} ✓	*Min* 5×10^{-6}
9	Pore Size (μ)	IS 14294	<75 ✓	*Max* 75

End of the Report

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ANNEX 11

(*Item* 7.1)

LIST OF STANDARDS DUE FOR REVIEW

Sl. No.	IS Number	IS Title	Due Date
1	IS 13162 (Part 2) : 1991 (Reviewed In : 2024)	Geotextiles — Methods of test Part 2 Determination of resistance to exposure of ultraviolet light and water (Xenon-arc type apparatus)	December, 2024
2	IS 13162 (Part 4) : 1992 (Reviewed In : 2024)	Geotextiles — Methods of test Part 4 Determination of puncture resistance by falling cone method	December, 2024
3	IS 15869 : 2020	Textiles — Open weave coir Bhoovastra — Specification (first revision)	March, 2025
4	IS 15872 : 2009 (Reviewed In : 2019)	Application of coir geotextiles (Coir woven BHOOVASTRA) for rain water erosion control in roads, railway embankments and hill slopes — Guidelines	December, 2024
5	IS 15909 : 2020	PVC Geomembranes for Lining — Specification (Second Revision)	March, 2025
6	IS 16341 : 2015 (Reviewed In : 2019)	Geosynthetics — Standard practice for exposure and retrieval of samples to evaluate installation damage of geosynthetics	December, 2024
7	IS 16342 : 2015Reviewed In : 2019	Geosynthetics — Method of test for grab breaking load and elongation of geotextiles	December, 2024
8	IS 16343 : 2015Reviewed In : 2019	Geosynthetics — Guidelines for installation of geotexiles as pavement fabric	December, 2024
9	IS 16344 : 2015Reviewed In : 2019	Geosynthetics — Guidelines for installation of geotextile for permanent erosion control in hard armor systems	December, 2024
10	IS 16345 : 2020	Geosynthetics — Guidelines for installation of geotextile used in subgrade separation in pavement structures (first revision)	March, 2025
11	IS 16346 : 2015Reviewed In : 2019	Geosynthetics — Method of test for evaluation of stress crack resistance of polyolefin geomembranes using notched constant tensile load test	December, 2024

12	IS 16347 : 2015Reviewed In : 2019	Geosynthetics — Method of test for effects of temperature on stability of geotextile	December, 2024
13	IS 16348 : 2015Reviewed In : 2019	Geosynthetics — Method of test for index puncture resistance of geomembranes and related products	December, 2024
14	IS 16351 : 2015Reviewed In : 2019	Geosynthetics — Standard practice for laboratory immersion procedures for evaluating the chemical resistance of geosynthetics to liquids	December, 2024
15	IS 16352 : 2020	Geosynthetics — High density polyethylene (HDPE) geomembranes for lining – Specification (first revision)	March, 2025
16	IS 16355 : 2015Reviewed In : 2019	Geosynthetics — Guidelines for installation of geogrids used as soil reinforcement in mechanically stabilised earth (MSE) retaining structures	December, 2024
17	IS 16356 : 2015Reviewed In : 2019	Geosynthetics — Method of test for pore size characteristics of geotextiles by capillary flow test	December, 2024
18	IS 16363 : 2015Reviewed In : 2019	Geosynthetics — Guidelines for installation of geotextile used in subsurface drainage application	December, 2024
19	IS 16389 : 2015Reviewed In : 2019	Geosynthetics — Method of test for biological clogging of geotextile or soil/geotextile filters	December, 2024
20	IS 16392 : 2015Reviewed In : 2019	Geosynthetics — Geotextiles for permanent erosion control in hard armor systems — Specification	December, 2024
21	IS 16393 : 2015Reviewed In : 2019	Geosynthetics — Geotextiles used in subsurface drainage application — Specification	December, 2024
22	IS 16362 : 2020	Geosynthetics — Geotextiles used in subgrade stabilization in pavement structures — Specification (first revision)	March, 2025
23	IS 16391 : 2015Reviewed In : 2019	Geosynthetics - Geotextiles used in sub-grade separation in pavement structures — Specification	December, 2024
24	IS 16349 : 2015Reviewed In : 2019	Geosynthetics — Guidelines for installation of geogrids used as reinforcement of base and sub-base layers in pavement structures	December, 2024
25	IS 16474 : 2015Reviewed In : 2019	Geosynthetics — Method of test for tensile properties of geogrids by the single or multi-rib tensile method	December, 2024
26	IS 16475 :	Geosynthetics — Method of test for determination of 2	December,

	2015Reviewed In : 2019	percent secant modulus for polyethylene geomembranes	2024
27	IS 16477 : 2015Reviewed In : 2019	Geosynthetics — Method of test for determination of 2 performance strenght of geomemberanes by the wide strip tensil method	December, 2024
28	IS 16380 : 2020	Geosynthetics — Method of test for measuring pullout resistance of geosynthetics in soil (first revision)	March, 2025
29	IS 17368 : 2020	Geosynthetics — Determination of damage to geosynthetic caused during installation	March, 2025
30	IS 17371 : 2020	Geosynthetics — Geogrids for flexible pavements — Specification	March, 2025
31	IS 17372 : 2020	Geosynthetics — Polymeric strip/geostrip used as soil reinforcement in retaining structures – Specification	March, 2025
32	IS 17373 : 2020	Geosynthetics — Geogrids used in reinforced soil retaining structures — Specification	March, 2025
33	IS 17374 : 2020	Geosynthetics — Reinforced HDPE membrane for effluents and chemical resistance lining — Specification	March, 2025
34	IS 17360 : 2020	Geosynthetics — Screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation	March, 2025
35	IS 17363 : 2020	Geotextiles and geotextile-related products — Screening test method for determining the resistance to liquids	March, 2025
36	IS 17365 : 2020	Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement	March, 2025
37	IS 17369 (Part 2) : 2020	Geotextiles and geotextile-related products – Strength of internal structural junctions Part 2 Geocomposites	March, 2025
38	IS 17420 : 2020ISO 10722:2019	Geosynthetics – Index test procedure for the evaluation of mechanical damage under repeated loading – Damage caused by granular materials (Laboratory test method)	March, 2025
39	IS 17421 : 2020	Geosynthetics — Identification on site	March, 2025
40	IS 17369 (Part 1) : 2020ISO 13426-1:2019	Geotextiles and geotextile-related products — Strength of internal structural junctions Part 1 Geocells	March, 2025
41	IS 17483 (Part 1) : 2020	Geosynthetics — Geocells — Specification (Part 1) Load Bearing Application	March, 2025
42	IS 17483 (Part 2) : 2020	Geosynthetics — Geocells — Specification (Part 2) Slope Erosion Protection Application	March, 2025