भारतीय मानक

Indian Standard

IS 11273 : 2023

वस्त्रादि — 'ई' और 'ईसीआर' ग्लास फाइबर के बुने हुए रोविंग कपड़े — विशिष्टि

(दूसरा पुनरीक्षण)

Textiles — Woven Roving Fabrics of 'E' and 'ECR' Glass Fibre — Specification

(Second Revision)

ICS 59.100.10

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October 2023 **Price Group 6**

High Performance Fibres, Fibrous Structure and Textile Components of composites Sectional Committee, TXD 40

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the High Performance Fibres, Fibrous Structure and Textile Components of composites Sectional Committee had been approved by the Textiles Division Council.

This standard covers woven roving fabrics of 'E' and 'ECR' glass fibres intended for use as reinforcement with polyester, phenolic, vinyl ester and epoxide resin systems.

These woven roving fabrics are made by single end roving as prescribed in IS 11320 : 2023 'Textiles — Glass fibre rovings for the reinforcement of polyester, phenolic, vinyl ester and of epoxide resin systems — Specification (*second revision*)'. They generally have plain weave and find applications in providing additional reinforcement to various fibre reinforced, plastic equipments like chemical tanks, vessels, boats and ballistic resistant products. The glass loading achieved with these woven rovings vary in the range of 40 percent to 65 percent by weight.

Directions for ordering glass fibre rovings are given in Annex G. It is strongly recommended that the intended final use of the woven rovings should be fully discussed with the suppliers before ordering and the terms for ordering given under Annex G shall be carefully looked into while using the specification.

This standard was originally published in 1985 and was subsequently revised in 1992. This revision has been made in the light of experience gained since its publication and to incorporate the following major changes:

a) Title of the standard has been modified;
b) Scope clause has been modified;
c) Method of tests for determination of moisture content and determination of loss on ignition have been incorporated;
d) Packing and marking clause has been modified;
e) Sampling and criteria for conformity has been modified; and
f) References to Indian standards have been updated.

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

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

Indian Standard

TEXTILES — WOVEN ROVING FABRICS OF 'E' AND 'ECR' GLASS FIBRE — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes requirements for woven roving fabrics made from 'E' and 'ECR' glass intended for the reinforcement of polyester, phenolic, vinyl ester and epoxide resin systems.

2 REFERENCES

The standards given below 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 edition of these standards:

IS No.	*Title*
IS 1998 : 1962	Methods of test for thermosetting synthetic resin bounded laminated sheets
IS 2828 : 2019/ ISO 472 : 2013	Plastics — Vocabulary (*second revision*)
IS 4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)
IS 6746 : 1994	Unsaturated polyester resin systems — Specification (*first revision*)
IS 11320 : 2023	Textiles — Glass fibre rovings for the reinforcement of Polyester, phenolic, vinyl ester and of epoxide thermoset resin systems — Specification (*second revision*)
IS 17312 : 2019/ ISO 4603 : 1993	Textile Glass — Woven Fabrics — Determination of Thickness

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2828 and following definitions shall apply.

3.1 Type of Glass

Standard covers following two types of glass fibre.

3.1.1 *'E' Glass* — A type of glass which does not contain more than 1 percent by mass of alkali (calculated as Na2O) which is commonly referred to as 'low alkali' glass.

3.1.2 *'ECR' Glass* — A modified version of 'E' Glass, which is boron free. 'ECR' Glass gives better corrosion resistance than 'E' Glass for most acids.

3.2 Filament — A single glass fibre as drawn.

3.3 Strand — A plurality of filaments bonded with size.

3.4 Roving — Collection of parallel strands wound on mandrel without intentional twists.

NOTE — By reason of the method of manufacture, the strands usually contain a small amount of twist not exceeding four turns per metre.

3.5 Size — Materials applied to the strand during manufacture to facilitate processing and use.

3.6 Tex — Mass in g per kilometre length.

4 REQUIREMENTS

4.1 The fabrics shall be manufactured from single end rovings conforming to IS 11320.

4.2 The fabrics shall be uniformly woven. selvedges, where incorporated, shall be made substantially straight and even, and shall have approximately the same tension as the remainder of the fabric.

4.3 Width

The width of the fabrics at any point shall not exceed the specified width by more than 1.5 percent or 25 mm whichever is less. For fabrics without conventional selvedges the width shall be measured to the outermost warp ends.

4.4 Defects and Impurities

The fabrics shall be reasonably free from defects. It shall be uniform in colour and shall not be streaked or stained. It shall be free from oil and grease spots and other contamination and shall be free from permanent creases, wrinkles and distortions.

4.5 Fabric

The fabric shall comply with the requirements given in Table 1.

4.6 Laminate

A laminate prepared from the fabric shall meet the additional requirements set out in Table 2.

Table 1 Requirements of Woven Roving Fabrics

(*Clause* 4.5)

Sl No.	Characteristics	Requirements Fabrics Type							Tolerance	Methods of Test, Ref to Annex of this Standard
		A	B	C	D	E	F	G		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	Mass per unit area, g/m^2	200	280	360	570	610	800	860	± 10 percent	A
ii)	Yarn per 100 mm:									B
	a) Warp	67.0	47.3	61.0	22.0	27.5	17.7	16.5	± 5 percent	
	a) Weft	67.0	43.3	55.2	22.0	23.6	15.0	16.0	-do-	
iii)	Nominal linear density or roving tex:									C
	a) Warp	150	300	300	1280	1 200	2 400	2 560	± 10 percent	
	b) Weft	150	300	300	640 × 2	1 200	2 400	1 280 × 2	-do-	
iv)	Thickness (approx) in mm	0.20	0.25	0.30	0.60	0.60	0.80	0.90	—	IS 17312
v)	Moisture content, percent by mass, *Max*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	—	D
vi)	Loss on ignition, percent by mass	As agreed between the purchaser and the supplier							± 20 percent from the nominal value stated or ± 0.2 from the nominal values stated	E

NOTES

1 The fabrics are of a plain weave construction.

2 Specifications on the above lines may be arrived at for other type of woven rovings as mutually agreed to between the purchaser and the supplier.

Table 2 Requirements for Laminate

(*Clause* 4.6)

Sl No.	Characteristics	Requirements Fabrics Type							Methods of test, Ref to Annex of this Standard
		A	B	C	D	E	F	G	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Minimum cross breaking strength, MPa:								F
	a) Warp direction	220	210	180	195	210	250	250	
	b) Weft direction	220	195	160	185	200	240	240	
ii)	Number of plies of fabric to produce laminate thickness of approximately								—
	a) 3 mm	13	9	7	5	5	—	—	
	c) 6 mm	—	—	—	—	—	6	6	

4.7 Keeping Properties

Unless otherwise agreed to, the roving fabrics, shall comply with the requirements of this standard for a period of not less than one year, when stored at a temperature not exceeding 27 ºC and a relative humidity not exceeding 65 percent.

5 PACKING AND MARKING

5.1 Packing

5.1.1 The fabrics shall be rolled evenly and squarely on tubes of sufficient length and strength to produce a firm package which shall prevent collapsing or telescoping during transit, storage and handling. Both ends of the roll shall be suitably protected to prevent damage to the edges of cloth. Each roll shall be individually wrapped in polyethylene film and rolls of fabrics shall be securely packed in parcels or boxes in such a way as to protect them from soiling/damage of fabric from external elements such as air, water and sunlight. Multiple rolls can be bunched together and packed on pallets using environment friendly packaging wrap and strapping cords.

5.1.2 The weight of individual rolls shall be made uniform and standardised to the extent possible.

5.2 Marking

Each roll shall be clearly marked with the following:

a) The manufacturers name or trade mark if any;

b) The fabrics designation (mass per unit area, g/m^2) as mentioned in Table 1; and

c) Month and year of manufacture.

NOTE — Additional information such as resin compatibility can be provided as agreed between supplier and customer as part of test certificate.

5.3 BIS Certification Marking

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

6 SAMPLING AND CRITERIA FOR CONFORMITY

6.1 Sampling

6.1.1 *Lot*

All the rolls in a single consignment of the material of the same designation and from a single batch of manufacture shall constitute a lot.

6.1.2 Samples shall be tested for each lot separately for ascertaining the conformity of the material to the requirements of the specification.

6.1.3 The number of rolls to be chosen from the lot shall depend on the size of the lot and shall be in accordance with Table 3.

Table 3 Scale of Sampling

(*Clause* 6.1.3)

Sl No.	Lot Size	Number of Rolls to be Chosen	
		Mass per Unit Area and Yarns per 100 mm	Linear Density of Rovings
(1)	(2)	(3)	(4)
i)	2 to 15	2	2
ii)	16 to 25	3	2
iii)	26 to 50	5	3
iv)	51 and above	7	5

6.1.4 These rolls shall be selected at random from the lot. In order to ensure the randomness or selection, procedures given in IS 4905 may be followed.

6.2 Number of Tests and Criteria for Conformity

6.2.1 Minimum two number of specimens shall be taken from each of the rolls selected according to **6.1.3**, the required number of test samples for testing different characteristics shall be prepared.

6.2.2 Each of the rolls obtained from a lot shall be examined for visual defects (**4.2** and **4.4**); mass per unit area and yarns per 100 mm and if found satisfactory, further tests as specified shall be carried out.

6.2.3 For cross breaking strength, one roll shall be selected irrespective of the size of the lot. It may be selected from those rolls which have been passed according to **6.2.2**. The required number of specimens shall be cut from this roll and tested for this requirement according to the procedure given in Annex F.

6.2.4 For moisture content and LOI determination, one roll shall be selected irrespective of the size of the lot. It may be selected from those rolls which have been passed according to **6.2.2**. The required number of specimens shall be cut from this roll and tested for this requirement according to the procedure given in Annex D and Annex E.

6.2.5 The lot shall be declared as conforming to the requirements of the specification if there is no failure according to **6.2.2**, **6.2.3** and **6.2.4**.

ANNEX A

[*Table* 1, *Sl No*. (i)]

DETERMINATION OF THE MASS PER UNIT AREA OF WOVEN ROVING FABRICS

A-1 TEST SPECIMENS

A-1.1 Cut a sample of sufficient length to provide three test specimens from the full width of the roll. Cut the specimen with the aid of a template 400 mm ± 1 mm × 250 mm ± 1 mm. One specimen shall be cut from the right hand side of the fabrics and more than 25 mm from the selvedge, one specimen from the centre and one from the left hand side of the fabrics and more than 25 mm from the selvedge, these specimens shall be cut from fabric free from any applied tension and the longer side shall be parallel to the length of the roll.

A-2 CONDITIONING

A-2.1 Condition the test samples or test specimens for not less than 6 hours in an atmosphere having a relative humidity of 65 percent ± 2 percent and a temperature of 27 °C ± 2 °C.

A-3 PROCEDURE

A-3.1 Determine the mass of each specimen to the nearest 0.5 g by means of a suitable sensitive balance.

A-4 CALCULATION

A-4.1 Determine the mass per unit area in g/m^2 as follows:

$$\text{Mass per unit area} = M \times 10$$

where

M = the mean mass of the three specimens.

ANNEX B

[*Table* 1, *Sl No*. (ii)]

DETERMINATION OF THE AVERAGE NUMBER OF WARP AND WEFT YARNS PER 100 MM

B-1 PROCEDURE

B-1.1 Lay the fabrics smoothly and without tension on a horizontal surface with the rovings to be counted running vertically. Place the counting Glass for suitable steel rule on the fabric so that the left hand edge of the aperture of the counting glass or reference mark on the steel rule is coincident with the right hand edge of a roving. Count a whole number of rovings across a length of not less than 100 mm of fabrics. Consider this as one determination. Move the counting glass or steel rule to another position so that none of the rovings in the previous test is included and repeat above procedure four more times.

B-1.1.1 Calculate the mean of the five readings and express it as the number of warp or weft per 100 millimetres.

ANNEX C

[*Table* 1, *Sl No*. (iii)]

DETERMINATION OF ROVING TEX

C-1 PROCEDURE

C-1.1 Maintain a length of roving under sufficient tension to ensure that it is straight, cut off the length as per the table given below, measured with an accuracy of ±1 percent. Weigh the cut length to the nearest 5 mg, and report this mass in grams as the roving tex.

The length of the samples should be as given in the table below:

Sl No.	*Nominal Linear Density, Tt (tex)*	*Length of Specimen (m)*
(1)	(2)	(3)
i)	Tt < 25	500
ii)	25 < Tt < 45	200
iii)	45 < Tt < 280	100
iv)	280 < Tt < 650	50
v)	650 < Tt < 2 000	10
vi)	2 000 < Tt	5

ANNEX D

[*Table* 1, *Sl No*. (v)]

DETERMINATION OF MOISTURE CONTENT

D-1 PROCEDURE

D-1.1 Cut three specimens of mat, each of approximately the same mass between 5 g and 10 g from the roll of mat to be tested. Cut one specimen from each side and from the centre at the open end of the mat. Weigh to the nearest 5 mg, the collective mass of the three specimens (mass A). Dry the specimens in a forced oven at 105 °C ± 3 °C for one hour. Allow them to cool in a desiccator and record the collective mass to the nearest 5 mg (mass B).

D-2 CALCULATION

D-2.1 Moisture content, percent by mass = $\frac{A-B}{A} \times 100$

where

A = original mass of the specimens; and

B = mass of the oven-dried specimens.

NOTE — The dried specimens shall be used for the determination of the loss on ignition.

ANNEX E

[*Table* 1, *Sl No*. (vi)]

DETERMINATION OF LOSS ON IGNITION

E-1 PROCEDURE

E-1.1 Heat the dried specimens (mass B) from the determination of moisture content (Annex D) in a suitable container in a muffle furnace for not less than 20 min at a temperature of 625 °C ± 20 °C. After removal from the muffle furnace cool the specimens in a desiccator to room temperature and reweigh. Record the collective mass to the nearest 5 mg (mass C).

E-2 CALCULATION

E-2.1 Loss on ignition, percent by mass = $\frac{B-C}{B} \times 100$

where

B = mass of the oven-dried specimens; and

C = mass of the specimens after ignition.

ANNEX F

[*Table* 2, *Sl No*. (i)]

DETERMINATION OF CROSS BREAKING STRENGTH OF LAMINATE

F-1 TEST SPECIMENS

F-1.1 Cut the requisite number of pieces of roving fabric each approximately 400 mm × 250 mm with the longer sides of the specimens parallel to the warp direction of the woven roving.

F-1.1.1 The approximate number of plies for each fabric designation given in Table 2 gives a laminate of approximately 3 mm thickness for fabric type A, B, C, D, and E and approximately 6 mm thickness for fabrics type F and G.

F-1.1.2 Dry the pieces in a ventilated oven for 1 hour at 105 °C ± 2 ºC, remove from the oven, allow to cool, and use within an hour of removal. Impregnate the pieces with resin conforming to IS 6746 to give a final glass content of 45 percent to 55 percent of the total mass, the criterion for thorough impregnation being that the wet lay-up shall be uniformly translucent. Both impregnation and building up of the laminate shall be done at a temperature 27 °C ± 2 °C. A suitable method is as follows:

Calculate the mass of resin necessary to give the required resin/glass ratio from the mass of fabric to be used. Formulate a quantity of resin, in excess of this, according to the resin manufacturer's instructions. Cover a polished metal or glass plate of suitable size with a sheet of regenerated cellulose film or polyethylene terephthalate film of suitable thickness. Spread approximately the correct proportion of the catalysed resin uniformly on the film. Work one piece of fabric into the resin, using some suitable device, until it is fully impregnated. Care shall be taken that all obvious air inclusions are eliminated by the operation. Repeat this procedure with alternate layers of resin and fabric until the build-up is complete. Super-impose each piece of fabric on its predecessor, so that the longer sides are parallel. When impregnation of all the fabric is complete, the laminate shall be consolidated into a parallel faced composite by covering with a sheet of film and a second flat plate, taking care that no air bubbles are entrapped beneath this film. A positive pressure shall be maintained until the resin has cured, and the film left adhering to both laminate surfaces until after post curing. Cure the laminate in accordance with the resin manufacturer's instructions and post cure for 2 hours at 100 °C ± 5 ºC. Cool it to room temperature whilst still under pressure, and trim approximately 20 mm from all edges. The laminate shall be reasonably free from visible voids and other defects.

F-2 PROCEDURE

F-2.1 Cut ten rectangular strips not less than 140 mm long and 25 mm wide, five with the longer sides parallel to the warp direction and five parallel to the weft direction of the original fabric. Determine the cross-breaking strengths of these strips in accordance with **6.4** of IS 1998 as soon as convenient after cutting. The rate of movement of the loading member shall be in the range of 10 mm per minute to 15 mm per minute.

F-2.2 Report the mean cross-breaking strength of the five specimens in each direction. Also determine the resin content of the test specimen.

ANNEX G

(*Foreword*)

DIRECTION FOR ORDERING

G-1 RECOMMENDATIONS FOR ORDERING OF NON- STANDARD FABRICS

G-1.1 Fabrics of construction other than those listed in Table 1 may be supplied by agreement between the manufacturer and the purchaser. In such cases, purchaser shall provide the following information or requirements to the manufacturer:

a) Number of warp yarns per 100 mm;

b) Number of weft yarns per 100 mm;

c) Roving tex of warp;

d) Roving tex of weft;

e) Mass per unit area of woven roving fabric g/m^2;

f) The type of weave;

g) The type of resin with which it is going to be used;

h) Type of selvedge, namely, open or closed; and

j) Width of the roll.

ANNEX H

(*Foreword*)

COMMITTEE COMPOSITION

High Performance Fibres, Fibrous Structure and Textile Components of composites Sectional Committee, TXD 40

Organization	*Representative(s)*
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This Indian Standard has been developed from Doc No.: TXD 40 (22321).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi