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भारतीय मानक मसौदा

ताप द्वारा मजबूत सौर कांच — विशिष्टि

Draft Indian Standard

HEAT STRENGTHENED SOLAR GLASS — SPECIFICATION

ICS 81.040.20; 27.160

Glass, Glassware & Laboratoryware Sectional Committee, CHD 10

Last date for Comments: 20 September 2025

FOREWORD

(formal clauses will be added later)

Heat strengthened glass is a single piece of glass within which a permanent surface compressive stress, additionally to the basic mechanical strength, has been induced by a controlled heating and cooling process in order to give it increased resistance to mechanical and thermal stress and prescribed fracture characteristics. Heat strengthened glass is not considered as a safety glazing material, as it leads to jagged edges on breakage.

Although IS 16982: 2018 specifies the requirements for heat-strengthened glass for general and building applications, it does not fully address the unique performance demands of solar energy systems. Solar applications particularly photovoltaic modules and solar thermal collectors require glass that can endure prolonged UV exposure, high thermal cycling, mechanical loads from wind and snow, and specific optical properties to ensure energy efficiency. Recognizing these distinctions, the committee decided to formulate a dedicated standard to ensure that HS glass used in solar applications meets the stringent quality and reliability requirements essential for long-term field performance and safety in renewable energy infrastructure.

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.

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HEAT STRENGTHENED SOLAR GLASS — SPECIFICATION

1 SCOPE

This standard prescribes the requirements, sampling, and testing methods for heat strengthened solar glass intended primarily for use as a superstrate (front cover) in solar photovoltaic (PV) modules, solar thermal collectors, and other solar energy systems where a combination of enhanced mechanical strength and high solar transmittance is required.

NOTE — The glass covered under this standard is not classified as safety glazing, as it breaks into sharp-edged fragments upon failure. However, it exhibits superior resistance to thermal stress and mechanical loads compared to annealed glass. The glass may additionally be coated (e.g., anti-reflective) or textured (e.g., matte or prismatic) to improve solar efficiency. However, for the purpose of this standard, the glass shall be tested before applying anti-reflective coating.

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 listed below:

IS No.	**Title**
IS 2553 (Part 1): 2018	Safety glass — Specification Part 1 Architectural, building and general uses (*fourth revision*)
IS 5437: 2025	Rolled Glass — Patterned, Extra Clear Patterned, Wired and Wired Patterned Glass — Specification
IS 14900: 2018	Transparent Float Glass — Specification (*first revision*)
IS 16892: 2019	Heat Strengthened Glass — Specification
IS 17004: 2018	Testing Methods for Processed Glass

3 REQUIREMENTS

3.1 Raw materials

The raw glass shall conform to either IS 14900 or ‘extra clear patterned glass’ type specified in IS 5437.

3.2 Dimensional requirements

3.2.1 *Nominal thickness*

The actual thickness shall be the average of four measurements, taken to the nearest 0.01 mm, each one taken at the thickest and closest point to the centre of each side. Thickness shall be measured with micrometer or callipers, which is graduated to 0.01 mm or with a measuring instrument having an equivalent accuracy. The actual thickness, rounded to the nearest 0.1 mm shall not vary from the nominal thickness by more than the tolerances specified in Table 1.

NOTE — For patterned glass, thickness shall be measured at the crest of the design.

Table 1 Tolerances on Nominal Thickness

(*Clause* 3.2.1)

S. No.	**Nominal thickness (mm)**	**Tolerance (mm)**
(1)	**(2)**	**(3)**
(i)	< 2	± 0.1

(ii)	2	± 0.2
(iii)	2.5	± 0.2
(iv)	2.8[a]	± 0.2
(v)	3	± 0.2
(vi)	3.2	± 0.2
(vii)	3.5	± 0.2
(ix)	4	± 0.2[b]

[a] 2.8 mm thickness is applicable only for patterned glass.

[b] in case of patterned glass, ± 0.3 mm tolerance shall be considered.

3.2.2 *Dimensions (Length and Width)*

3.2.2.1 *Tolerances on final cut sizes*

The nominal dimensions, that is, width (B) and length (H) shall be as agreed to between the purchaser and the supplier. However, the deviations from these nominal dimensions shall be within the limits depending upon the thickness of the glass and nominal dimensions (H, W) as specified in the Table 2. The length and width of the glass on cut sizes shall be measured with a steel scale (tape) which is graduated to 1 mm. The measurement shall be made on adjacent two sides.

3.2.2.2 *Squareness*

Depending on the thickness and nominal dimensions (H, B), the difference between the diagonals (*see* Fig. 1) of the glass pane shall not be more than the values specified in the Table 3.

Table 2 Tolerances on Nominal Dimensions, Length (H) and Width (B)
(*Clause* 3.2.2.1)

S. No.	Nominal Dimension of Side, B or H (mm)	Tolerance on Dimensions (mm)
(1)	(2)	(3)
i)	≤ 2 000	± 1.5
ii)	> 2 000 and ≤ 3 000	± 2.0

Table 3 Deviation Limits for Difference Between Diagonals
(*Clause* 3.2.2.2)

S. No.	Nominal Dimension of Side, B or H (mm)	Difference between Diagonals (mm)
(1)	(2)	(3)
i)	≤ 2 000	≤ 3
ii)	> 2 000 and ≤ 3 000	≤ 4

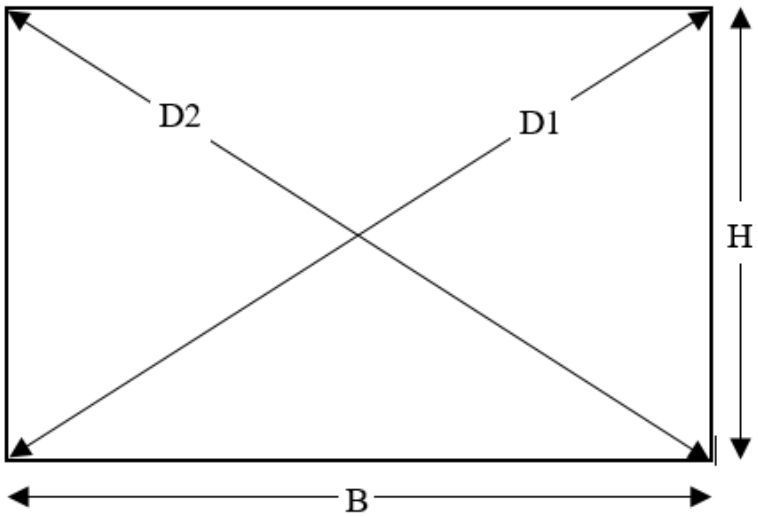

FIG. 1 DIAGONALS OF GLASS PANE

3.3 Fragmentation

It shall pass the fragmentation test when tested as per the method prescribed in 6.1.3 of IS 17004 and assessed as per 6.1.5 of IS 17004.

NOTE — As per 6.1.5 of IS 17004, 8 samples of min. 0.36 m^2 surface area are required for this test considering the two stage testing.

3.4 Compressive Stress Measurement

It shall have a surface compression between 31 and 52 MPa (4 500 and 7 500 psi) when tested as prescribed in 6.5 of IS 17004.

NOTE — As per 6.5 of IS 17004, 6 samples having dimensions minimum 360 mm x 1 100 mm are required for this test.

3.5 Mechanical Strength

When tested as per the method prescribed in 6.3 of IS 17004, the 5 percent breakage probability for heat strengthened glass, statistically evaluated with a minimum of 95 percent confidence level, shall not be less than the values specified in Table 4. The value of mechanical strength can be expressed as a statistical value associated with a particular probability of breakage and with a particular type of loading. The mechanical strength values apply to quasi-static loading over a short time, for example, wind loading.

NOTE — Samples of dimensions minimum 360 mm x 1 100 mm are required for this test.

Table 4 Minimum Values for the Mechanical Strength of Heat Strengthened Glass

(Clause 3.5*)*

Sl No.	Type of Glass	Minimum Value for Mechanical Strength, N/mm^2
(1)	(2)	(3)
i)	Float: clear / tinted / coated	70
iii)	Patterned Glass	55

3.6 Flatness

Flatness of the heat strengthened glass shall be tested as per 5.2.4 of IS 2553 (Part 1).

3.7 Fabrication in Glass

Fabrication in heat strengthened glass shall be tested as per 5.2.8 of IS 2553 (Part 1).

3.8 Light Transmission

When tested in accordance to Annex D of IS 5437, the light transmission values shall not be less than 91.5 percent in 380 nm to 1 100 nm wavelength range.

NOTE — This value is for non-AR coated glasses. For more information on AR coatings see Annex A. The recommended sample size is 600 mm x 600 mm as most equipment can handle this size. However, the concerned lab should be consulted for applicable size as per their instrument.

3.9 Solar Direct Transmittance

When tested in accordance to Annex D of IS 5437, the solar direct transmittance values shall not be less than 90.5 percent in 380 nm to 2500 nm wavelength range.

NOTE — This value is for non-AR coated glasses. For more information on AR coatings see Annex A. The recommended sample size is 600 mm x 600 mm as most equipment can handle this size. However, the concerned lab should be consulted for applicable size as per their instrument.

4 PACKING AND MARKING

4.1 Packing

Heat strengthened glass shall be packed as agreed to between the manufacturer and the purchaser.

4.1.1 The packet shall be marked with the following information:

a) Indication of the source of manufacture,

b) Nominal thickness of glass,

c) Code or batch number,

d) Month and year of manufacture, and

e) Type of glass

4.2 Marking

Each piece of heat strengthened glass shall be marked indelibly and distinctly with the following information:

a) It shall be marked with the word ‘Heat Strengthened’; and

b) Indication of the source and year of manufacture.

4.2.1 *BIS Certification Marking*

Each glass may also be marked with the standard mark.

4.2.1.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 2016 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

5 SAMPLING

Representative samples of the material shall be drawn as prescribed in Annex B.

ANNEX A

(*Informative*)

ANTIREFLECTIVE COATING - In an uncoated glass, reflection and absorption of incident light leads to a maximum achievable light transmission of approximately 91.5 percent. Anti-reflective coating may be applied on the glass surface by rolling, spraying or dipping (for example, by dipping in a metal oxide solution). It can significantly reduce reflection of incident light, thereby improving contrast and can result in a light transmission greater than 93 percent in 380 to 1 100 nm wavelength range.

ANNEX B

(*Clause* 5)

SAMPLING OF HEAT STRENGTHENED GLASS FOR SOLAR APPLICATION

B-1 SCALE OF SAMPLING

B-1.1 Lot

In a single consignment, glass of the same quality and nominal thickness and belonging to the same batch of manufacture shall constitute a lot.

B-1.2 Samples shall be tested separately from each lot for ascertaining conformity of glass to the requirements of this specification.

B-1.3 The number of glasses to be sampled from a lot for this purpose shall depend on lot size and shall be in accordance with co1 2 and 4 of Table 5. If the glasses are packed in boxes or cartons, at least 20 percent of them, subject to minimum of 2 boxes shall be selected at random and opened for taking out the samples.

B-1.4 Approximately equal number of pieces shall be selected from the middle and both the ends of each selected box or carton to give the required sample size. In order to ensure randomness of selection of the glasses from the lot, procedures given in IS 4905, may be adopted.

B-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

B-2.1 Light transmission and solar direct transmittance

B-2.1.1 Samples selected in **B-1.3** shall be examined for the requirements of light transmission, and solar direct transmittance in two stages as shown in co1 3 of Table 5. A glass sample failing to satisfy any of these requirements shall be considered as defective. If the number of defective pieces found in the sample in the first stage is less than or equal to the corresponding number given in co1 5 of Table 5, the lot shall be accepted. If it is equal to or greater than the corresponding number given in co1 6 of Table 5, the lot shall be rejected without any further testing.

B-2.1.2 If the number of defective sheets found in the sample in the first stage lies between C1 and C2, a second such sample of the size prescribed in co1 4 of Table 5 shall be taken and examined. The lot shall be considered as conforming to these requirements if the combined number of defectives in the first and second stage is less than the corresponding number C2 in second stage, given in co1 6 of Table 5; otherwise the lot shall be rejected.

B-2.2 Dimensional requirements, flatness, and fabrication in glass

The lot, which has satisfied the requirements given in **B-2.1**, shall be examined for these requirements. The sample sheets required for testing these characteristics shall be selected from those examined under **B-2.1** and found satisfactory. The sample size for these tests shall be as given in co1 7 of Table 5. The lot shall be considered to have met these requirements, if the number of defective sheets found in the sample is less than or equal to the corresponding number C3, given in co1 8 of Table 5.

B-2.3 Fragmentation, compressive stress measurement, and mechanical strength

The lot, which has satisfied the requirements given in **B-2.2**, shall be examined for these requirements. The sample sheets required for testing these characteristics shall be selected from those examined under **B-2.1** and found satisfactory. The sample size for these tests shall be as given in co1 9 of Table 3. The samples shall first be tested for compressive stress measurement, then fragmentation and then only 2 samples shall be further tested for

mechanical strength. The lot shall be considered to have met these requirements, if the number of defective sheets found in the sample is less than or equal to the corresponding number C4, given in co1 10 of Table 3.

Table 5 Scale of Sampling

(*Clauses* **B-1.3**, **B-2.1**, **B-2.2**, *and* **B-2.3**)

S. No.	**Lot**	**Light Transmission and Solar Direct Transmittance**				**Dimensional Requirements, Flatness, and Fabrication in Glass**		**Fragmentation, Compressive Stress Measurement, and Mechanical Strength**	
		Stage	**Sample Size**	**C1**	**C2**	**Sample Size**	**C3**	**Sample Size**	**C4**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	< 1 ton	First	20	0	2	20	0	10	0
ii)		Second	20	-	2	-	-	-	-
iii)	>1 ton, up to 2 tonnes	First	40	1	3	40	1	10	0
iv)		Second	40	-	4	-	-	-	-
v)	> 2 tonnes	First	60	2	4	60	1	10	0
vi)		Second	60	-	5	-	-	-	-