भारतीय मानक **IS 1948 : 2024**

Indian Standard

(*Superseding IS 1949 : 1961*)

एल्यूमिनियम फ्रेमयुक्त दरवाज़े, खिड़कियाँ और स्लाइडर्स — विशिष्टि

(पहला पुनरीक्षण)

Aluminium Framed Doors, Windows and Sliders — Specification

(First Revision)

ICS 91.060.50

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

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Doors, Windows and Shutters Sectional Committee, CED 11

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Doors, Windows and Shutters Sectional Committee had been approved by the Civil Engineering Division Council.

This standard was first published in 1961. This revision has been brought out due to availability of different materials along with the advancement in the technology in the manufacturing of framed doors, windows and sliders, nowadays a lot of options are available in the market and supersedes IS 1949 : 1961. One of the options is aluminium framed doors, widows and sliders. The advantage with framed doors, windows and sliders, are good aesthetic, acoustics, more view area, etc. However, over and above the looks and aesthetics, it is also very much important that these framed doors, windows and sliders should meet the desired performance for the purpose they have been installed in buildings. The performance parameters include air infiltration/exfiltration, water tightness, operating force, durability, mass, corrosion, thermal, acoustic, impact resistance, mechanical strength, etc.

For the awareness in terms of the performance and to meet the desired quality for the same in framed doors, windows and sliders, standardization is required. Considering the above, standards have been formulated; one is the product specification for aluminium framed doors, windows and sliders specifying the raw material requirements as well as final performance requirements; and the other standard IS 18648 is for classification based on product type, different performances, etc, of the framed doors, windows and sliders and performance tests based on the classifications.

This standard contributes to the United Nations Sustainable Development Goal 9: Industry, innovation and infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

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

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

ALUMINIUM FRAMED DOORS, WINDOWS AND SLIDERS — SPECIFICATION

(*First Revision*)

1 SCOPE

1.1 This standard specifies the requirements for materials, performance requirement of whole units and tests of doors, windows and sliders made from aluminium alloy including constituent materials and glazing. The doors, windows and sliders may be non-insulated or thermally insulated based upon the application.

1.2 This standard does not apply to:

a) Windows and doors subject to regulations on smoke leakage and resistance to fire;

b) Curtain walls;

c) Industrial, commercial and garage doors;

d) Revolving doors;

e) Internal partitions including internal windows, doors and sliders; and

f) Bullet and blast resistance windows, doors and sliders.

2 REFERENCES

The standards listed in Annex A contain provisions which though reference in the 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 agreement based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMINOLGY

For the purpose of this standard, the definitions given in IS 18648 shall apply.

4 TYPES, HANDING AND CLASSIFICATION

The types, handing and classification of aluminium framed doors, windows and sliders shall as per IS 18648.

5 MATERIALS AND CONSTRUCTION

5.1 Aluminium Extrusions and Flashing

Extruded aluminium alloy used for structural framing members, shall be fabricated from the most appropriate grade of alloy complying with IS 733, IS 738 or equivalent or better (in terms of mechanical properties given in the standards for aluminium alloy) and being made with homogenized billets to ensure uniform property all across the profile. The chemical composition and mechanical properties of the aluminium profile used in the manufacture of the aluminium doors, windows and sliders shall be traceable and produced as and when requested. The thickness of the aluminium sections can vary but it shall meet the design, structural, performance, safety and durability requirements. Where two profiles are connected, the thickness of the receiving profile wall, locally, shall be a minimum of 3 mm or engage 2 complete threads of the fastener/screw or shall be secured using a rivet nut/nutsert with the exceptions of the fastener/screw secured into a screw port in the receiving profile. Where hardware is secured to a profile, the thickness of the receiving profile wall, locally, shall be a minimum of 3 mm or engage 2 complete threads of the fastener/screw or shall be secured using a rivet nut/nutsert with the exceptions when the hardware is primarily secured using grooves in the profile and the fastener/screw is only used to locate the hardware.

Such extrusions in framing members and trims shall be from 64430-H30, 63400-H9, 65032-H20 extruded aluminium grade alloys as per IS 733, IS 738 or equivalent or better (in terms of mechanical properties given in the standards for aluminium alloy (*see* Table 23 of IS 8147 for international equivalent grades) . Where T5 is to be used in shaped structures, supporting structural calculations particularly the stress criteria shall be ensured. When T4 grade is used for the purpose of curved openings or windows, post bending, the profile should be aged in the oven to reach T6 or equivalent temper. Extrusion alloy 63400-H9, 65320-H20 are commonly used for higher

strength usage in brackets. All aluminium alloys used as extruded rods/bars, tubes and profiles shall be compliant with IS 733/IS 738. Flashing around the doors and windows to be made of aluminium sheet alloy as per IS 737 or equivalent or better (in terms of mechanical properties given in the standards for aluminium alloy).

NOTE — For temper designations (*see* IS 5052).

Visible profile distortions post surface finishing when viewed from a distance of 3 m shall be accepted. Any distortion beyond this distance, acceptance to be mutually agreed with stakeholder.

5.2 Finishes

5.2.1 The aluminium system may be finished by one of the following:

a) Anodizing as per IS 1868;

b) Liquid organic coating; and

c) Powder coating as per IS 13871.

5.2.2 Protective tape with an adhesive that does not leave stains upon removal and lasts a minimum of 3 months shall be applied at ambient temperature of 27 °C ± 2 °C and a relative humidity of 65 percent ± 5 percent. The thickness of the protective tape shall be minimum 40 microns.

5.3 Glass

Different type of glass and glazing products used in doors, windows and sliders shall be as per the following Indian Standards:

a) Float glass (annealed glass) conforming to IS 14900;

b) Safety glass (laminated and toughened glass) conforming to IS 2553 (Part 1);

c) Heat strengthened glass conforming to IS 16982;

d) Insulated glazing unit (IGU) conforming to IS 17346; and

e) Silvered glass mirror conforming to IS 3438.

NOTE — For guidance related to selection of glass, refer IS 16231 (Parts 1 to 4).

5.4 Hardware and Fixing

All metal straps, clips, brackets, screws, nuts, bolts, washers and other fixings and all metal components of hardware shall be manufactured from one of the following:

a) Anodized/powder coated aluminium alloy;

b) Zinc die casting;

c) Leaded brass;

d) Cast leaded gunmetal;

e) Austenitic steel; and

f) Any metal which has been treated for corrosion protection such that there shall be no corrosion of the metal visible to normal or corrected vision when subjected to 240 h exposure in a neutral salt spray test as per IS 9844.

For coastal areas, where the hardware is used at a distance of less than 1 km from the seashore, 480 h exposure is to be used. Where windows are located in all other regions and exposed to the external atmosphere/environment, 240 h corrosion class shall be used.

All windows, doors and slider component fastening to be of minimum austenitic steel Grade 304 as per IS 6911.

5.5 Locking Points

For doors and sliders when the height is greater than 2.4 m and the wind load is greater than 2 000 Pa, multipoint locking shall be used.

For casement windows with height or width per sash, more than 1 m with multi point lock shall be used, unless proven with tests.

5.6 Human Life Safety Especially for Children

5.6.1 *Window Restrictor for Children*

For projected top hung window, parallel opening window, vertical sliding hung window and pivot window (except when used as an access door), the window restrictor shall be located such that the clear opening shall not exceed 125 mm (for human life safety especially for children). When a force of 250 N is applied in opening condition to any part of the sash a sphere of 125 mm shall not pass through any part of the opening. Key releasable window restrictor can be used for the purpose of cleaning/maintenance. The side hung opening shall be restricted to be used low rise buildings [20 m *see* IS 875 (Part 3)]. For buildings above 20 m height, projected top hung or parallel opening with an opening restriction of 125 mm shall be used.

NOTES

1 For fire access panels/window, the local authority regulations will be applied and same will supersede the above.

2 The above requirement of window restrictor for children is mandatory for residential apartments and optional for commercial establishment. However, it is recommended to limit the opening to 125 mm for commercial establishments as well especially for high rise buildings.

5.6.2 *Anti-Fallout* — shall be applicable as per the following:

a) For all open out windows in buildings up to 20 storey height (< 70 m) anti fall out secondary safety device is optional.

b) For all open out windows in buildings more than 20 storey height (> 70 m) anti fall out secondary safety device is mandatory.

5.6.3 In the case of a fall out due to the sash getting completely disengaged from the hinges/stay arms/ restrictors, the anti-fallout device shall be capable of withstanding the self-weight of the sash. The drop height for the test shall be between 100 mm.

5.7 Reinforcement

The reinforcement if used, may be of mild steel with corrosion resistance coating, stainless steel or extruded aluminium. The reinforcement shall be installed so that it shall not move or rattle when the window is in use. The reinforcement shall be provided in a closed or sealed chamber.

The thickness of the reinforcement shall be such that the windows meet the performance requirements as per IS 18648 and as per wind load calculated in accordance with IS 875 (Part 3). Design of the reinforcement shall be as per structural requirements of allowable deflection and stress.

In case of mild steel is used as reinforcement, it shall conform to any grade of IS 1079 or IS 513 (Part 1) or IS 513 (Part 2) and shall be galvanized with a zinc of minimum grade of coating of 120 g/m^2 of IS 277 for internal usage. For external usage of reinforcement (ex-couplers), it shall be hot dip galvanized with coating thickness of 100 microns to 120 microns, alternatively cold galvanizing with zinc of minimum grade of coating of 275 g/m^2 of IS 277. The minimum wall thickness of mild steel reinforcement shall be 1.5 mm. When the steel is powder coated, dielectric separator is not needed. However, powder coated steel reinforcement is recommended for use only in internal environments.

While selection on material of the reinforcement, in addition to structural properties, care shall be taken to choose an appropriate metal closer to aluminium in the galvanic series. In the sash this is not possible, depending upon the material used, suitable dielectric separator shall be used to overcome the bimetallic effect.

For all reinforcement in coastal regions and adjacent to industrial zones, reinforcement material shall be either aluminium (dielectric separator not required) or hot dip/cold galvanized mild steel as per IS 1079 or IS 513 (Part 1) or IS 513 (Part 2) or stainless steel Grade 304/316/316L as per IS 6911 with dielectric separator.

For all reinforcement in non-coastal regions (except adjacent to industrial zones) in addition to the reinforcement options available for coastal conditions, powder coated mild steel reinforcement (dielectric separator not required) or wet paint coated mild steel reinforcement with mandatory dielectric separator.

Reinforcement shall have minimum space of 0.5 mm all around the perimeter between the reinforcement and the aluminium profile cavity. This space is also used by the dielectric separator. In the event the reinforcement is smaller than the cavity, adequate blocking at every 250 mm shall be provided.

Tolerance for reinforcement straightness shall not be more than 1 mm in any 600 mm length.

5.8 Safety in Construction of Windows, Doors and Sliders

a) For all open out windows in buildings up to 20 storey height (< 70 m) anti-fallout secondary safety device — Optional;

b) For all open out windows in buildings more than 20 storey height (> 70 m) anti-fallout secondary safety device — Mandatory;

c) For all sliders to be installed in buildings more than 20 storey height (> 70 m), it is recommended to have symmetrical interlock; and

d) For wind loads beyond 3 000 Pa, only inward operable windows and doors and sliders shall be used.

NOTE — During high winds, storms, cyclones, all operable units have to be kept in closed condition and fastened.

5.9 Sealants

Structural sealant is used in structurally bonded projected top hung/side hung sashes and window/door/slider bonding of glass to frame either continuous or discontinuous.

The following test shall be carried out at the time of application for structural sealants:

a) Butterfly test for two component sealants as per IS 17346;

b) Snap time test for two component sealants as per IS 17346;

c) Peel adhesion test as per IS 17346;

d) Deglazing test as per Table 1; and

e) Peel adhesion and compatibility test as per Table 1.

NOTE — Deglazing test is not applicable for doors and windows with gasket based sealing.

5.9.1 *Structural Bite Calculation for Wind Load*

Minimum structural bite (mm)

$$= \frac{\text{Glass short span dim (mm)} \times \text{windload (kPa)} \times 0.5}{140\ \text{kPa}}$$

where

Glass short span dimension (SSD) is the shorter of the two dimensions of the rectangular glass panel, for example, on a 1.5 m by 2.5 m glass panel, the SSD is 1.5 m;

140 kPa — maximum allowable sealant design load for live load; and

Refer IS 875 (Part 3) for wind load.

5.9.2 *Structural Bite Calculation for Dead Load*

Minimum bite (m)

$$= \frac{\text{Weight of glass in kg} \times 9.81}{[2 \times \text{height (m)} + 2 \times \text{width (m)}] \times \text{allowable design stress N/m}^2 \text{ for DL}}$$

NOTES

1 The max allowable design stress for dead load is 703 kg/m^2 (6.894 kN/m^2).

2 If the horizontal frame members will not be supporting the glass or will deflect under the dead load of the glass, consider only 2 × height (m) in the denominator of the calculation above.

5.10 Glazing Gasket

Material for glazing gaskets and weather stripping shall be of EPDM or equivalent like silicone, rubber, vulcanized or thermoplastic material having the following properties in Table 2.

NOTE — It is recommended that for EPDM gaskets, EPDM content in the compound shall be minimum 20 percent and carbon content shall be minimum 30 percent and measured with suitable testing methodology as per agreement between the manufacturer and the purchaser.

5.10.1 *EPDM Extrusion Curing*

a) Peroxide cured — salt bath line; and

b) Sulphur cured — microwave line.

5.10.2 *Dimensional Tolerances*

The tolerances to be applied shall be as per agreement between the manufacturer and purchaser/specifier from the classes of tolerance described below, for which the standard tolerances are given in Table 3:

a) E1 — High quality;

b) E2 — Good quality; and

c) E3 — Non-critical.

NOTE — In any extruded cross-section, the dimensions of only two of the three variables (that is, inside dimensions, outside dimensions and wall thickness) may be considered as tolerance to control the dimensions of the cross-section.

Table 1 Requirements for Structural Sealant [Single(S), Multi Component (M) and Neutral Cure]

(*Clause* 5.9)

Sl No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Durometer hardness, Shore A, after 7 days at room temperature (*see* Note 1)	30 to 60	IS 3400 (Part 2/ Sec 4)/ ISO 48-4
ii)	Heat aging (*see* Note 2)		Annex C
	Weight loss, percent, *Max*	10 percent	
	Cracking	None	
	Chalking	None	
iii)	Slump (*Max*) (*see* Note 1)		Annex B
	Vertical, mm	4.8	

Table 1 (*Continued*)

Sl No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
iv)	Ultimate tensile stress-strain from dumbbell specimen (*Min*) (*see* Note 1)		IS 3400 (Part 1)/ ISO 37
	Tensile strength after 7 days curing at room temperature, N/mm^2	1.4	
	Percent elongation	300 percent	
v)	Ultimate tensile strength (minimum required), N/mm^2 (*see* Note 2), for conditions as mentioned below:		Annex D
	27 °C ± 2 °C and 65 percent ± 10 percent RH (for 1 h)	0.6	
	88 °C (190 °F) (for 1 h)	0.6	
	− 29 °C (− 20 °F) (for 1 h)	0.6	
	Water immersion (for 7 days)	0.6	
	A minimum of 5 000 h weathering	0.6	
vi)	Tear strength, die B (*Min*) (conditioned for 7 day at room temperature) (*see* Note 2)	5 N/mm	IS 3400 (Part 12)/ ISO 34-1
vii)	Butterfly test for multi component (*see* Note 1)	Uniform colour (no white streaks)	IS 17346
viii)	Snap time for multi component, minutes (*see* Note 1)	20 to 60	IS 17346
ix)	Tack free time, *Max* for single component (*see* Note 1)	No transfer in 3 h	Annex E
	Application Quality Test for Sealant		
x)	Peel adhesion for single and multi-component (*see* Note 1)	100 percent cohesive failure, with minimum 5.25 N/mm	IS 17346
xi)	Deglazing test (*see* Note 1)	a) First deglaze — 1 unit out of first 10 units manufactured (1/10) b) Second deglazing — 1 unit out of next 40 units manufactured (2/50) c) Third deglazing — 1 unit out of next units manufactured (3/100) d) Remaining — 1 unit of every 100 units manufactured 1) Minimum structural bite should be achieved in sealant joint at more than 95 percent of the perimeter. In case of the remaining 5 percent the minimum structural bite should be achieved 95 percent of the requirement. All the deglazed panel shall have 100 percent cohesive failure.	Annex F

Table 1 (*Concluded*)

Sl No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
xii)	Shelf life, *Min*	12 months from date of manufacture subject to storage conditions. Temperature < 30 ºC, 50 percent ± 10 percent RH	NA
xiii)	Minimum curing time before transportation	24 h for 2 part sealant and 24 h per mm of bite depth for single part sealant	NA
xiv)	Compatibility test (*see* Note 2 and 4)	No discoloration, no loss of adhesion	IS 17346

NOTES

1 Lot/batch acceptance test: Testing done at regular interval from the produced lot/batch.

2 Type test (Type test are the test, done once in 3 years due to the intensity and duration of the testing, when ingredients and method of manufacturing remains the same).

3 Weather sealants are used to seal the gap between the installed window, door and slider and the substrate, on-site. Selection of external sealants from manufacturers reports shall have minimum characteristics of resistance to UV, movement capability requirements and resistance to weathering, as per mutual agreement between the manufacturer and the purchaser.

4 To be tested for every batch of accessories such as gaskets, setting blocks, spacer tape and backer rod.

Table 2 Properties of Glazing Gaskets

(*Clause* 5.10)

Sl No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	IRHD/Shore hardness A	60 to 80 Shore A	IS 3400 (Part 2/Sec 4)/ ISO 48-4
ii)	Compression set percent (*see* Note)		
	a) High at (100 ± 1) °C for (24 + 0/-2 h)	≤ 35 percent	IS 3400 (Part 10/Sec 1)/ ISO 815-1
	b) Low at (- 25 ± 2) °C for (24 + 0/-2 h)	≤ 85 percent	IS 3400 (Part 10/Sec 2)/ ISO 815-2
iii)	Ozone resistance (50 pphm for 96 $h\frac{+0}{-2}$ h at 40 °C ± 2 °C)	No visible cracks	IS 3400 (Part 20)/ ISO 1431-1
iv)	Ageing test (for 168 $h\frac{+0}{-2}$ at 100 °C ± 1 °C)		IS 3400 (Part 4)/ ISO 48-4
	Co-efficient of deterioration of hardness change *Max* (Shore A)	+ 15/- 5	
	Tensile strength change, *Max*	- 25 percent of initial value	
	Elongation at break change, *Max*	- 50 percent of initial value	
v)	Minimum tensile strength	7.5 MPa	IS 3400 (Part 1)/ ISO 37
vi)	Minimum elongation	200 percent	IS 3400 (Part 1)/ ISO 37

Table 3 Tolerances on Cross-Sectional Dimensions of Unsupported Extrusions

(*Clause* 5.10.2)

Sl No.	Nominal Dimension, mm		Class E1 ±	Class E2 ±	Class E3 ±
	Above	Up to and Including			
(1)	(2)	(3)	(4)	(5)	(6)
i)	0	1.5	0.15	0.25	0.40
ii)	1.5	2.5	0.20	0.35	0.50
iii)	2.5	4.0	0.25	0.40	0.70
iv)	4.0	6.3	0.35	0.50	0.80
v)	6.3	10.0	0.40	0.70	1.00
vi)	10	16	0.50	0.80	1.30
vii)	16	25	0.70	1.00	1.60
viii)	25	40	0.80	1.30	2.0
ix)	40	63	1.00	1.60	2.50
x)	63	100	1.30	2.00	3.20

5.11 Setting Blocks

The number and location of setting blocks shall be as shown in Fig 1. Setting blocks shall be:

a) Positioned at quarter points or not less than 30 mm from the corner;

b) Minimum width of each setting block shall be not less than the glass thickness; and

c) If a glazing bridge is used, then the thickness of the glazing bridge can be added to the thickness of the setting block to achieve the minimum gap of 6 mm between the edge of glass and the framing member.

Setting blocks shall be located to equally support all panes of glass, and shall be fixed to prevent displacement during installation and service. The minimum length of each setting block (or two blocks side by side) shall be 25 mm in length for every square metre of glass area, or minimum length of 50 mm whichever is maximum. Setting block material shall be of PVC or silicone compatible EPDM or silicone, with a Shore A hardness of 80 to 90. Setting blocks shall be of resilient, load-bearing and material that is compatible with all other glazing materials conforming to available standards (if any) that may come into contact with the blocks.

For example, for a 3.0 m^2 glass area, 3.0 mm × 25 mm = 75 mm long, that is, 75 mm is the length of each setting block.

NOTES

1 Setting block width and location should not restrict water drainage.

2 Shaped setting block or glazing bridge is commonly used to achieve a flat surface for the glazing.

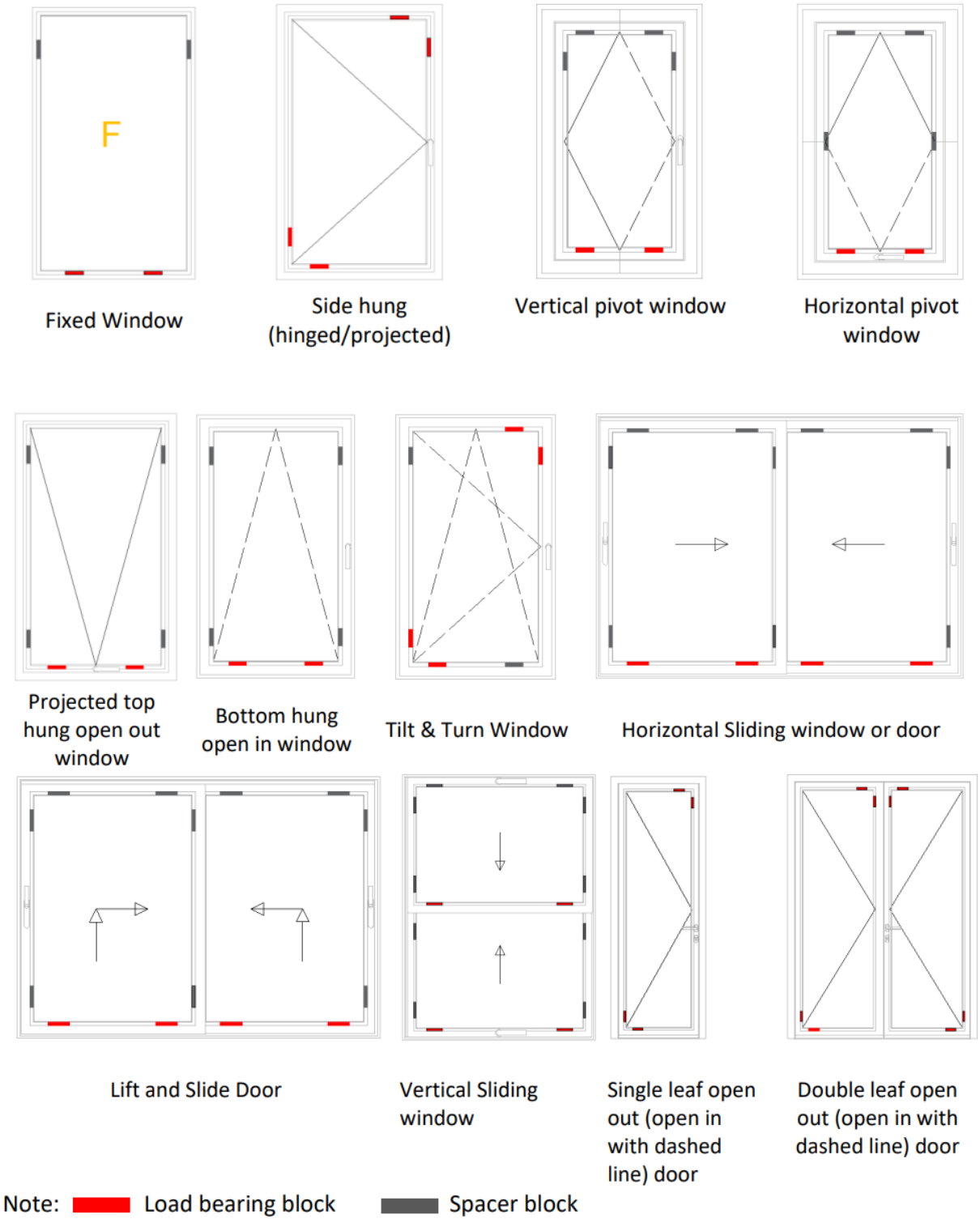


FIG. 1 NUMBER AND POSITION OF SETTING AND LOCATION/GLAZING BLOCK

5.12 Location of Glazing Blocks

The number and position of location blocks shall be as shown in Fig 1.

Location blocks shall be;

a) of minimum of 25 mm in length;

b) at least as wide as the glass thickness;

c) positively located to prevent displacement in service; and

d) sufficiently resilient to accommodate movement within the frame, without imposing stress on the glass, and of resilient material.

NOTES

1 Location blocks are used between the edges of the glass and the frame to prevent movement of the glass within the frame by thermal expansion or when the window or door is opened or closed. They are required to prevent the weight of the glass from causing the frame to become out of square.

2 Material similar to setting block can be used.

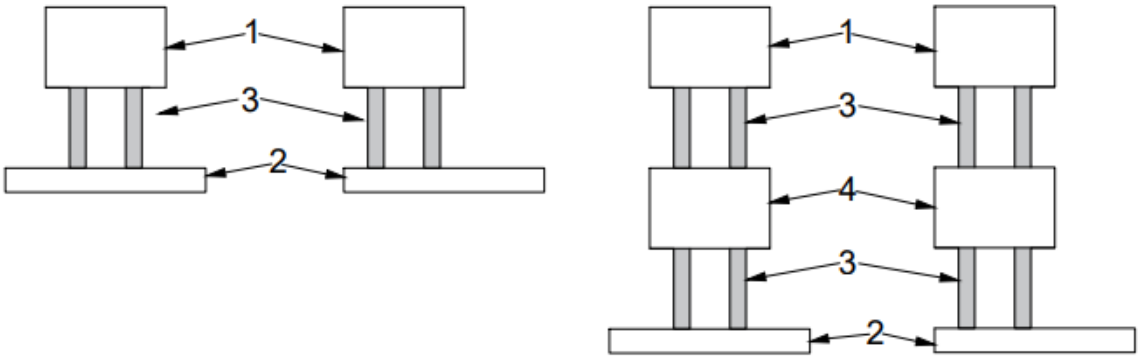
5.13 Thermal Barrier Profile

The insulation material used in thermal break profiles (*see* Fig. 2) is typically a low-conductivity material, such as polyamide, polyetherimide, polyurethane, mineral-filled polymers or equivalent. The chemical composition and mechanical properties of the thermal barrier profile used, shall be traceable and produced as and when requested.

NOTE — The insulation material when combined with the aluminium profile shall be capable of load transmission. Refer Annex G for calculation of effective momentum of inertia of thermal barrier profiles.

The individual aluminium shells can be surface treated like a typical aluminium extrusion and then rolled with the insulation material to form a thermal barrier profile. Alternatively mill-finish aluminium profile can be rolled and then surface-treated following the recommendations of the insulation material manufacturer, especially with respect to oven-temperatures. In both cases, post rolling, the thermal barrier profile needs to comply with the shear and effective moment of inertia. For method of calculation for effective moment of inertia of the composite profile, refer Annex G.

The thermal barrier profile is generally one among the below geometric types:



Key

1 Inner shell
2 Outer shell
3 Insulation material
4 Middle shell

FIG. 2 TYPICAL EXAMPLES OF TYPES OF BARRIER PROFILES

5.13.1 *Shear Strength*

When tested as per Annex H, the shear strength of the thermal barrier profiles shall not be less than 24 N/mm. The deformation at maximum loading shall not be greater than 2 mm.

5.13.2 *Thermal Properties*

The manufacturer shall provide the thermal values (U value) of the thermal barrier profile and the same shall be traceable and produced as and when requested. Validation of the physical sample for its thermal values, shall be done as per IS 17910 (Part 1)/ISO 12567-1. Thermal simulation shall be in accordance with **6.1.10** of IS 18648.

5.14 Drainage and Ventilation

Ventilation and drainage holes and slots shall be provided in the frames, sash, transom or mullions in order to permit the escape of entrapped water, moisture or hot air from the system.

A minimum of 2 no. of slots of size 5 mm × 20 mm shall be provided at every 600 mm. The holes and slots shall offset between the inner and outer walls by 25 mm so as to prevent any back flow.

5.15 Joinery

Most common joinery for the profiles is of 2 types 45° mitre joint and 90° square cut joint (*see* Fig 3).

The mitre joint uses an aluminium extruded/cast/ composite/galvanized steel corner cleat to reinforce the corner joint. The corner cleat is secured to the profile using crimping or with nails or by screws. The mitre joint is also sealed using a silicon or small gap sealant or two component epoxy.

The square cut joint is either an L or a T joint and is secured using screws fixed into screw ports or T cleats. This joint shall also be sealed with sealant to prevent air and water leakages. Both the mitre joint and T joint shall be designed to withstand forces that would be applicable on the joints.

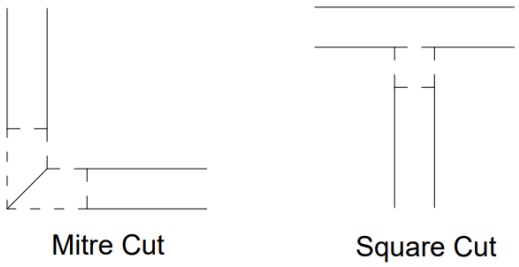


FIG. 3 TYPES OF JOINERIES

6 DIMENSIONS AND TOLERANCES

The width and height of the door, window and slider shall be measured from outer frame to outer frame of the outer faces as shown in Fig. 4. The dimensions shown in Fig. 4 are only indicative for the purpose of example.

For fabrication and assembly of doors, windows and sliders, the tolerances shall be as follows:

a) For linear dimensions: ± 2 mm;

b) For squareness (diagonal): + 3 mm; and

c) For flatness: + 0.5 mm per 300 mm length.

NOTE — For installation tolerances, (*see* IS 18648).

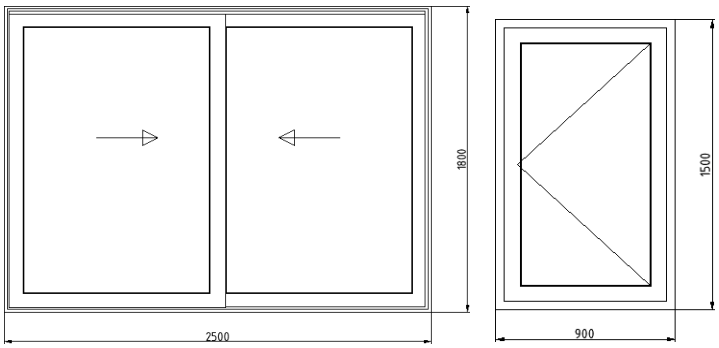


FIG. 4 SYMBOLIC REPRESENTATION OF MEASURING DIMENSIONS

7 TESTS AND REQUIREMENTS

The following tests shall be carried out on the aluminium framed doors, windows and sliders.

7.1 Product Basic Classification

Refer **6.1**, Table 1A of IS 18648.

7.2 Product Performance Classification

Refer **6.1**, Table 1B of IS 18648.

7.3 Optional Product Performance Classification

Refer **6.1**, Table 1C in addition to Table 1B of IS 18648.

8 LOT, SAMPLING AND CRITERIA OF CONFORMITY

8.1 Lot Definition

Windows, doors and sliders with same designation and designed for same load application, manufactured with raw materials having similar properties shall constitute as a lot.

8.2 Sampling

Random sampling to be taken from every lot. Unless otherwise specified, the number of samples shall be agreed between the manufacturer and the purchaser.

8.3 Criteria of Conformity

Sample selected as mentioned above shall meet the requirements mentioned in the standard. In case of non-conformity, post rectification, testing as mutually agreed between the manufacturer and the purchaser/specifier/regulator may be conducted until conformity is achieved.

9 PACKAGING

All doors, windows and sliders shall be dispatched with the opening parts suitable secured to preserve alignment when fixing and glazing. All hardware shall be dispatched separately. Coupled windows, doors and sliders shall be dispatched uncoupled.

10 MARKING

10.1 Each door, window and slider shall be legibly marked in a position which is not visible when the opening light is closed, with the following:

a) Name of manufacturer or his authorized trade-mark or brand name;

b) The value for each parameter mentioned in the classification; and

c) Date of manufacture or batch number.

10.2 BIS Certification Marking

The product(s) shall be marked with Standard Mark as per the conformity assessment schemes governed by the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations made thereunder. The details of conditions for the licence may be obtained from the Bureau of Indian Standards.

IS 1948 : 2024

ANNEX A

(*Clause 2*)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 277 : 2018	Galvanized steel strips and sheets (plain and corrugated) — Specification (*seventh revision*)
IS 513 (Part 1) : 2016	Cold reduced carbon steel sheet and strip: Part 1 Cold forming and drawing purpose (*sixth revision*)
IS 733 : 1983	Specification for wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purposes) (*third revision*)
IS 738 : 1994	Wrought aluminium and its alloys — Drawn tube for general engineering purposes — Specification (*third revision*)
IS 875 (Part 3) : 2015	Design loads (other than earthquake) for buildings and structures — Code of practice: Part 3 Wind loads (*third revision*)
IS 1079 : 2017	Hot rolled carbon steel sheet, plate and strip — Specification (*seventh revision*)
IS 1868 : 1996	Anodic coatings on aluminium and its alloys — Specification (*third revision*)
IS 2553 (Part 1) : 2018	Safety glass — Specification: Part 1 Architectural, building and general uses (*fourth revision*)
IS 3400	Methods of test for vulcanized rubber or thermoplastic:
(Part 1) : 2021/ ISO 37 : 2017	Tensile stress-strain properties (*fourth revision*)
(Part 2/Sec 2) : 2023/ISO 48-2 : 2018	Determination of hardness Section 2 Hardness between 10 IRHD and 100 IRHD (*fifth revision*)
(Part 4) : 2012/ ISO 188 : 2011	Accelerated ageing and heat resistance (*third revision*)
(Part 10/Sec 1) : 2022/ISO 815-1 : 2019	Compression set, Section 1 At ambient or elevated temperatures (*third revision*)
(Part 12) : 2022/ ISO 34-1 : 2015	Tear strength — Trouser, angle and crescent test piece (*first revision*)
(Part 20) : 2018/ ISO 1431-1 : 2012	Resistance to ozone cracking — Static strain test (*second revision*)
(Part 23/Sec 2) : 2018/ISO 7619-2 : 2010	Rubber — Determination of indentation hardness by means of pocket hardness meters, Section 2 IRHD pocket meter method (*first revision*)
IS 3438 : 2023	Silvered glass mirrors for general purposes — Specification (*third revision*)
IS 5052 : 1993	Aluminium and its alloys-temper designations (*first revision*)
IS 6911 : 2017	Stainless steel plate, sheet and strip — Specification (*second revision*)
IS 8147 : 1976	Code of practice for use of aluminium alloys in structures
IS 9844 : 1981	Methods of testing corrosion resistance of electroplated and anodized aluminium coatings by neutral salt spray test
IS 13871 : 2021	Powder coatings — Specification (*first revision*)

IS No.	*Title*
IS 14900 : 2018	Transparent float glass Specification (*first revision*)
IS 16231	Use of glass in buildings — Code of practice:
(Part 1) : 2019	General methodology for selection (*first revision*)
(Part 2) : 2019	Energy and light (*first revision*)
(Part 3) : 2019	Fire and loading (*first revision*)
(Part 4) : 2019	Safety related to human impact (*first revision*)
IS 16978	Glass in building — Forced-entry security glazing:
(Part 1) : 2022/ ISO 16936-1 : 2020	Test and classification by repetitive ball drop (*first revision*)
(Part 2) : 2018/ ISO 16936-2 : 2005	Test and classification by repetitive impact of a hammer and axe at room temperature
(Part 3) : 2018/ ISO 16936-3 : 2005	Test and classification by manual attack
(Part 4) : 2018/ ISO 16936-4 : 2005	Test and classification by pendulum impact under thermally and fire stressed conditions
IS 16982 : 2018	Heat strengthened glass — Specification
IS 17346 : 2020	Insulating glazing unit — Specification
IS 18648 : 2024	Classification and performance requirements for doors windows and sliders — Specification

ANNEX B

(*Table 1*)

TEST METHOD FOR SLUMP OF SEALANTS

B-1 GENERAL

This test method covers a laboratory procedure for the determination of degree of slump of a sealant when used in a vertical joint in a structure.

B-2 TYPES

The scope of the methodology described below is applicable for both single-and multi-component chemically curing sealants for use in building construction.

B-3 SIGNIFICANCE AND USE

Excessive sealant slump or sag in a vertical joint may cause improper bead shape or inadequate sealant thickness in the completed joint. Slump measurements, as described in this test method, serve to evaluate only this application characteristic; they do not predict the performance capability of the sealant after installation.

B-4 APPARATUS REQUIRED

a) Jig as per the drawing (*see* Fig. 5);

b) Plastic/metal scrapper; and

c) Timer.

B-5 PROCEDURE

B-5.1 Sampling

Take test specimens from a unopened container and mix thoroughly before using, if required for homogeneity.

B-5.2 Cleaning

Clean the jig with methyl ethyl ketone or similar solvent.

B-5.3 Conditioning

Condition both the test jig and the sealant to be tested for at least 5 h at 27 °C ± 2 °C.

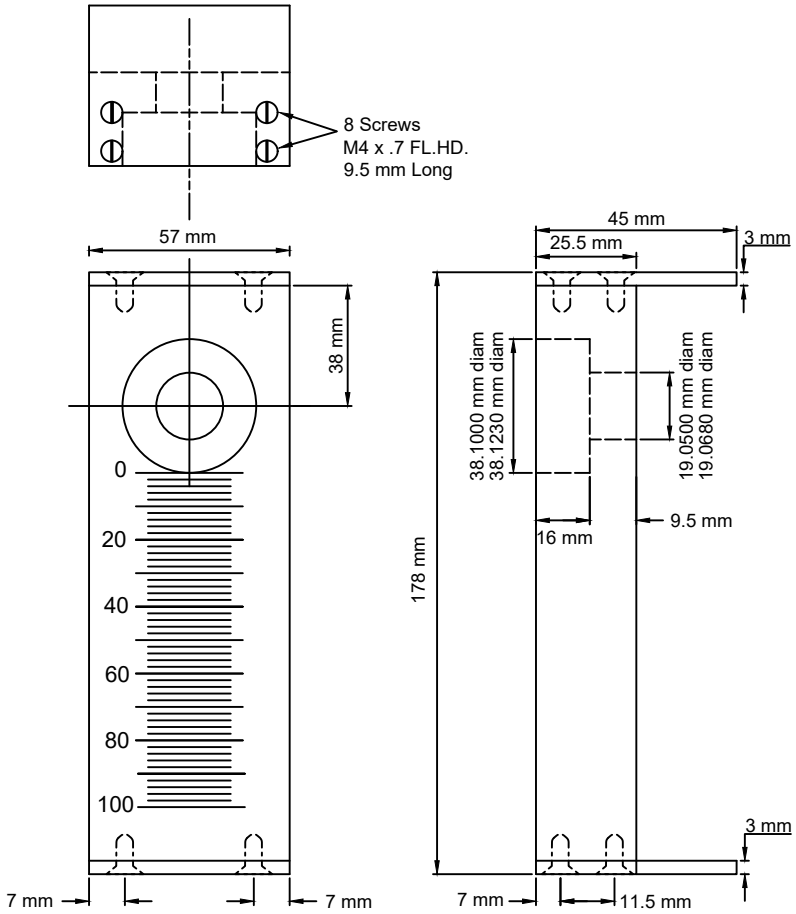
B-5.4 Procedure

Thoroughly clean the test jig with the solvent; then place it on a level table with the front face upward and the plunger depressed to the limit of its travel.

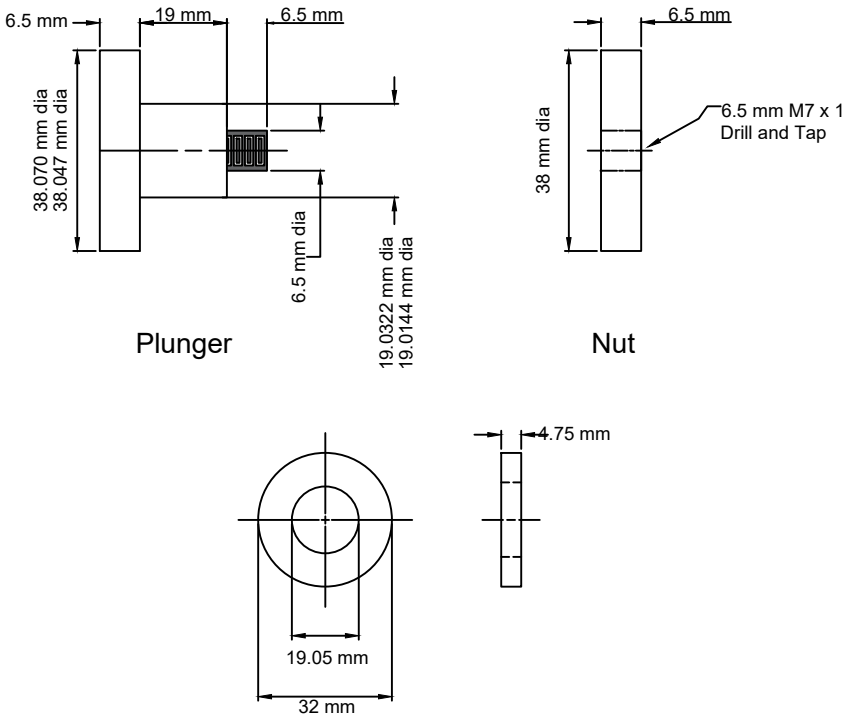
Place the mixed, conditioned sealant in the jig cavity. Level the sealant flush with the surface of the block, using one gentle upward stroke of the plastic scraper held at a 45° angle. Avoid forming air pockets in the sealant, especially near the surface of the plunger. Carefully clean the area around the cavity with the plastic scraper and a cloth. The loading operation should be completed within 2 min and with minimum amount of working of the sample.

Immediately set the jig in a vertical position and advance the plunger to the limit of its forward travel and start the timer. Allow the jig to stand undisturbed for 3 h (*see* Note). The sample will have flowed down the face of the jig. Record the point of furthest advance using graduated scale.

NOTE — If the material cures on exposure, the test may be stopped when the skin-over time has been exceeded by 5 min.



Flow Test Jig



Washer
(Aluminum or Brass)

FIG. 5 FLOW TEST JIG

ANNEX C

(*Table 1*)

TEST METHOD FOR EFFECTS OF HEAT AGING ON WEIGHT LOSS, CRACKING, AND CHALKING OF ELASTOMERIC SEALANTS AFTER CURE

C-1 GENERAL

This test method covers a laboratory procedure for determining the effects of heat aging on weight loss, cracking and chalking of elastomeric joint sealants (single and multi-component) for use in building construction.

C-2 SUMMARY OF TEST METHOD

Sealant is spread on three aluminium panels and the net weight of sealant on each panel is determined. After the three sealant specimens are allowed to cure for 28 days at standard conditions, two specimens are then heat-aged for 21 days in a forced-draft oven, maintained at 70 °C ± 2 °C. The percentage weight lost during the heat aging period is then determined and examination is made for presence of cracks and chalking.

C-3 SIGNIFICANCE AND USE

Weight loss from a sealant after application in a building joint can be detrimental to long term sealant durability. A sealant's service life will be shortened if it contains components, critical to its durability, that are volatilized by high environmental temperatures. Also, development of cracks and chalking lessens a sealant's service life. The test described herein measures weight loss, cracking, and chalking (*see* Fig. 6). The amount of weight lost during the heat aging period and any cracking or chalking helps predict premature sealant failure. However, a sealant developing no cracks or chalking, or low weight loss in this test, does not necessarily ensure good durability.

C-4 APPARATUS REQUIRED

a) Forced-draft oven, controlled at 70 °C ± 2 °C;

b) Balance, sensitive to 0.01 g;

c) Rectangular brass or TFE-fluorocarbon frame, with inside dimensions 130 mm by 40 mm by 3.2 mm;

d) Aluminium panels, three, each 152 mm × 80 mm × 0.6 mm to 1.6;

e) Straight edge, metal or plastic, about 152 mm long;

f) Thin knife blade; and

g) Spatula, steel, about 152 mm long.

C-5 PROCEDURE

Unless otherwise specified, standard test conditions shall be used.

C-5.1 Test of Multicomponent Sealants

C-5.1.1 Condition at least 400 g of base compound and appropriate amount of curing agent in closed containers for at least 24 h at standard conditions; then mix thoroughly together for 5 min. Weigh each of the three aluminium panels to the nearest 0.01 g. Centre the brass frame on an aluminium panel. Fill the frame with the mixed compound and strike it off flat with the straightedge. Run a thin-bladed knife along the inside of the frame to separate it from the sealant and immediately lift the frame from the sealant (Note 1). Prepare two more specimens the same way.

NOTE — In the case of self-levelling sealants, do not lift the brass frame until the sealant is sufficiently set that it will retain its rectangular shape.

C-5.1.2 Cure the three specimens for 28 days at standard conditions. At the end of the 28 day cure period weigh each specimen to the nearest 0.01 g.

C-5.1.3 Place two of the three specimens in the forced-draft oven at 70 °C ± 2 °C for 21 days, leaving the third (control) specimen at standard conditions for the same period. At the end of the 21 day heat-aging period, remove the specimens from the oven and allow them to cool for 1 h at standard conditions. Then weigh each specimen to the nearest 0.01 g and calculate the percent weight loss during heat aging as follows:

$$percent\ WL_{ha} = \frac{(W_2 - W_3)}{(W_2 - W_1)} \times 100$$

where

WL_{ha} = weight loss from cured sealant during heat aging;
W_1 = weight of aluminium panel;
W_2 = weight of panel and sealant after the 28 day cure period; and
W_3 = weight of panel and sealant after 21 day heat-aging period.

C-5.2 Test of Single-Component Sealants

Follow the same procedure as specified in C-5.1.1 to C-5.1.3, eliminating curing agent and the mixing necessary for multicomponent sealants.

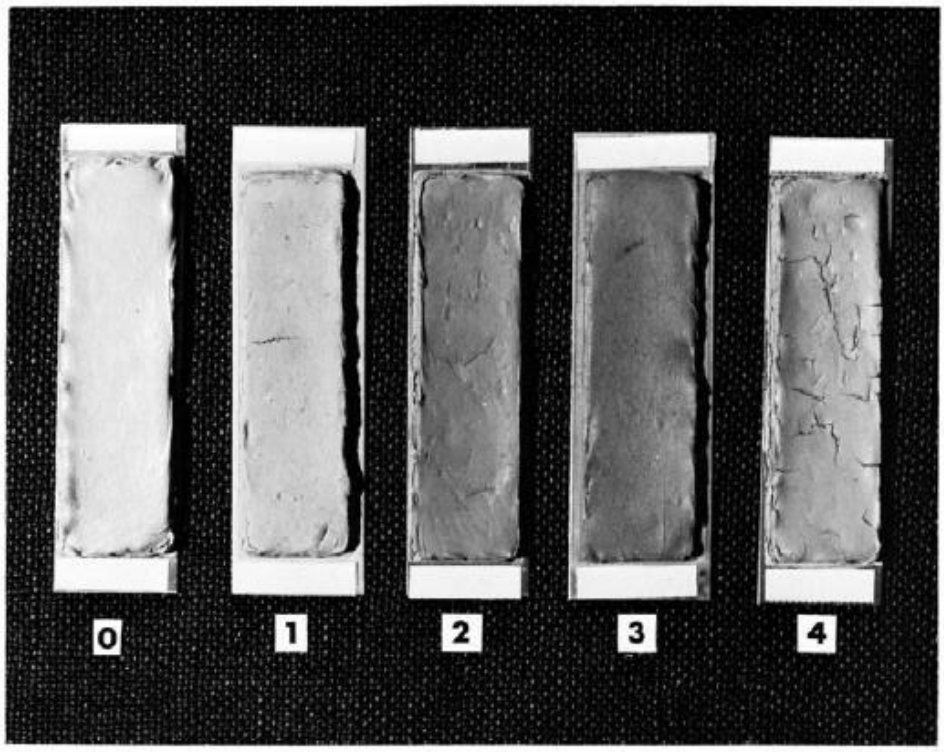


FIG. 6 EXAMPLES OF CRACKING OBTAINABLE IN THIS TEST; NUMBER 0 IN THIS FIGURE REPRESENT NO CREAKING

ANNEX D

(*Table 1*)

TEST METHOD FOR DETERMINING TENSILE ADHESION PROPERTIES OF STRUCTURAL SEALANTS AFTER EXPOSURE TO (TEMPERATURE, WATER AND WEATHERING)

D-1 GENERAL

This test method covers a laboratory procedure for quantitatively measuring the tensile adhesion properties of structural sealants, hereinafter referred to as the 'sealant'.

D-2 SIGNIFICANCE AND USE

D-2.1 Frequently, glass or other glazing or panel materials are structurally adhered with a sealant to a metal framing system. The sealants used for these applications are designed to provide a structural link between the glazing or panel and the framing system.

D-2.2 Although this test method is conducted at one prescribed environmental condition, other environmental conditions and duration cycles can be employed.

D-3 APPARATUS AND MATERIALS

D-3.1 Tensile Testing Machine — capable of producing a tensile load on the specimen at the rate of 50.8 mm/min ± 5.1 mm/min.

D-3.2 Fixed Member

A fixe or essentially stationary member carrying one grip.

D-3.3 Movable Member

A movable member carrying a second grip.

D-3.4 Grips

The grips should be suitable to firmly grasp the test fixture that holds the test specimen and should be designed to eliminate eccentric specimen loading. Specimen loading should be perpendicular to the substrate/sealant inter-faces. For alignment purposes, each grip shall have a swivel or universal joint at the end nearest to the specimen.

D-3.5 Grip Fixture

A fixture capable of being held by the grips and furnishing a tensile force to the sealant specimen.

D-3.6 Spatulas — for use in applying sealant

D-3.7 Caulking Gun — for extruding sealant from cartridges when applicable

D-3.8 Substrate Panels — two substrates of the same finish are required for each test specimen

D-3.9 Spacer

One-piece spacer made from polytetrafluorethylene (PTFE) or a suitable rigid material shall be used to which the test sealant will not bond.

D-3.10 Substrate Cleaning Materials — primer (if needed)

NOTES

1 This test method is based on identical substrates of 6.3 mm × 25.4 mm × 76.2 mm clear float glass. Other substrates may be tested; however, consideration needs to be given to maintaining adequate rigidity of the substrates during testing.

2 The precision and bias statement is based on glass substrates with a recommended cleaning solution of a 50 to 50 ratio isopropanol.

D-4 TEST SPECIMEN

D-4.1 Assembly

D-4.1.1 Prior to assembly, wipe the substrates with a clean, dry, lint-free cloth, then thoroughly clean with a solution appropriate for the substrate material. Prior to evaporation of the cleaning solution, wipe the substrates dry with a clean, lint-free cloth.

D-4.1.2 Apply recommended primer, if required. Then, construct the test specimen assemblies by forming a sealant cavity 12.7 mm × 12.7 mm × 50.8 mm between two substrate panels (*see* Fig. 7) with the aid of appropriate spacers.

D-4.2 Preparation of Test Assemblies

D-4.2.1 Prepare a set of five test specimen assemblies for each sealant and substrate combination being tested (*see* Fig. 7).

NOTE — Five test specimen assemblies should be prepared for each additional environmental condition being evaluated.

D-4.2.2 Fill each set of five assemblies with the sealant being tested. Immediately tool the sealant surface to ensure complete filling and wetting of the substrate surfaces. Take special care to strike off the sealant flus with the substrate.

D-4.3 Labelling

Each of the five specimens of each set should be individually identified.

D-5 CONDITIONING

Cure the specimens for 21 days at standard conditions. Any deviations from the curing conditions must be listed in the report. Remove all spacer sections from the specimens. If desired, spacers may be removed prior to the end of the 21 day cure. If removed early, note this in the report.

D-6 PROCEDURE

D-6.1 Pull all specimens on the tensile test machine at standard conditions at a rate of 50.8 mm per min. If an analog chart recording device is being used, the chart speed shall be a minimum of 127 mm per minute (508 mm per minute is preferred) to allow for a more accurate reading of force at specific elongations. Measure and record to the nearest 0.8 mm the actual minimum length (Dimension A) and minimum width (Dimension B), in millimetres as shown in (Fig. 7, Fig. 8 and Fig. 9). Record the tensile load, C, (*see* Note), Newton at 10 percent, 25 percent, 50 percent, and 100 percent strain, and percent strain at peak load. Measure and record percent cohesive failure along with test anomalies such as substrate breakage.

NOTE — If the substrate breaks, disregard the value at which it breaks. Other values obtained prior to breakage are acceptable.

D-6.2 Observations

Observe the specimens and record any obvious air bubbles trapped in the sealant during the preparation of test specimens.

D-7 CALCULATION

Calculate actual sealant minimum contact area, D, in square millimetres as follows:

$$D = A \times B$$

where

A = sealant length, Dimension A (Fig. 7, Fig. 8 and Fig. 9); and

B = sealant bite, Dimension B (Fig. 7, Fig. 8 and Fig. 9).

Calculate tensile stress as follows:

$$T = \frac{C}{D}$$

where

T = tensile strength, MPa (psi); and
C = tensile load, N (lb).

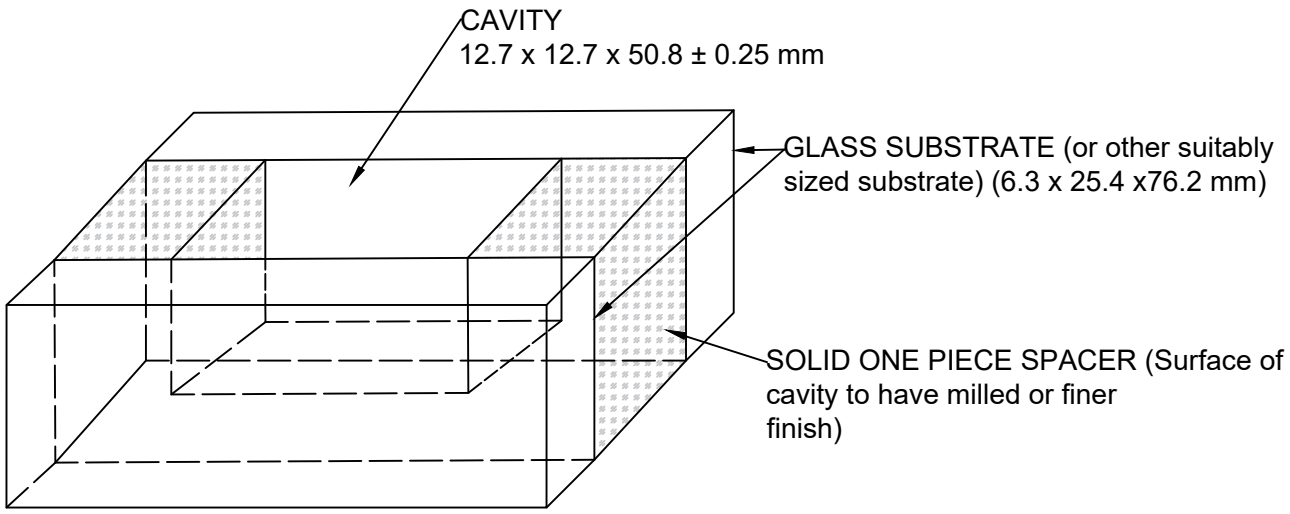


FIG. 7 GLASS SUBSTRATE AND SPACER ASSEMBLED TO FORM A SEALANT CAVITY (TAPE OR CLAMP SUBSTRATES TOGETHER PRIOR TO INJECTING THE SEALANT)

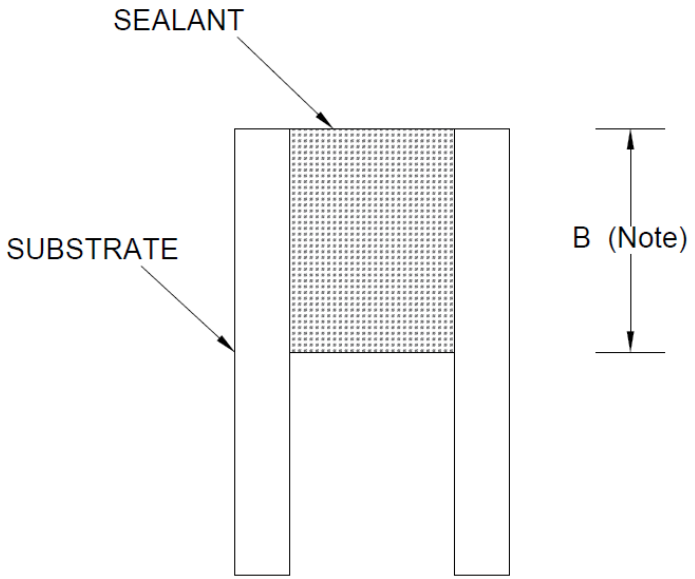


FIG. 8 SIDE VIEW OF TEST SPECIMEN WITH SPACER REMOVED

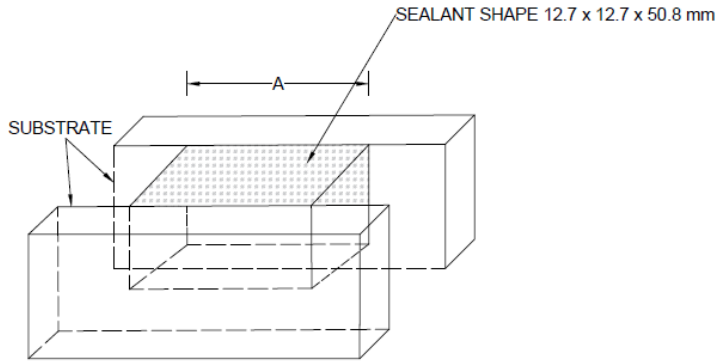


FIG. 9 END VIEW OF TEST SPECIMEN WITH SPACER REMOVED

Prepare, a total of 25 specimens for testing, except that the distance between substrates will be 9.5 mm. Cure all specimens for 21 days at standard conditions. Condition and test the specimens as described below in a tensile testing machine, with a pull rate of 12.7 mm/min. and determine the average ultimate tensile value for each group of five specimens prepared as described below.

D-8 CONDITION AND TESTING

Test five specimens at standard conditions after the initial curing period.

a) Condition five specimens for 1 h at 88 °C ± 5 °C in a forced air oven:

   1) Test the specimens at 88 °C ± 5 °C.

b) Condition five specimens for 1 h at 27 °C ± 2 °C:

   1) Test the specimens at 27 °C ± 2 °C.

c) Condition five specimens for 1 h at - 29 °C ± 2 °C:

   1) Test the specimens at - 29 °C ± 2 °C.

d) Immerse five specimens in deionized or distilled water at standard temperature for seven days; and

   1) Test the specimens at standard conditions within 10 min after their removal from the water.

e) Expose five specimens with the bond surface facing the light source to either of the exposure conditions specified below:

   1) Fluorescent UV/condensation apparatus — Expose the specimens for a minimum of 5 000 h; and

   2) Xenon arc weathering device — Expose the specimens for a minimum of 5 000 h at the irradiance level of 0.51 W/(m^2.nm) at 340 nm. The radiant exposure is 9180 kJ/(m^2.nm) at 340 nm.

ANNEX E

(*Table 1*)

TEST METHOD FOR TACK-FREE TIME OF ELASTOMERIC SEALANTS

The test consists of lightly touching a surface of a curing sealant with a polyethylene film at regular intervals until the sealant does not attach itself to the film and the film appears clean when peeled from the surface. More specifically a strip of polyethylene film is placed on the surface of the curing sealant and a 30 g weight (preferably rectangular, with dimensions of 41 mm × 19 mm) is placed on the film. The weight is left in place for 4 s ± 2 s, then removed and the polyethylene strip is removed at a constant rate of 25.4 mm/15 s and examined for sealant attachment to the film. The length of time from when the sealant was first applied and tooled into the template until the time the sealant is no longer picked up by the film is called tack-free time.

ANNEX F

(*Table 1*)

TEST METHOD FOR DEGLAZING TEST

F-1 After removal of glass or panel, the silicone sealant is inspected for cure, mix, uniformity of fill, lack of bubbles or air entrapment and to verify sealant adhesion.

a) The weather-seal joint is first cut open and a steel wire is put into the glazed structural joint. If structural sealant can be accessed directly, then a knife or glazer can be used to cut open the sealant joint.

b) Next the un-glazed glass can be removed from the support frame.

c) The joint fill and sealant mix quality can be visually checked.

d) For incomplete joint fill, the following tolerance criteria applies:

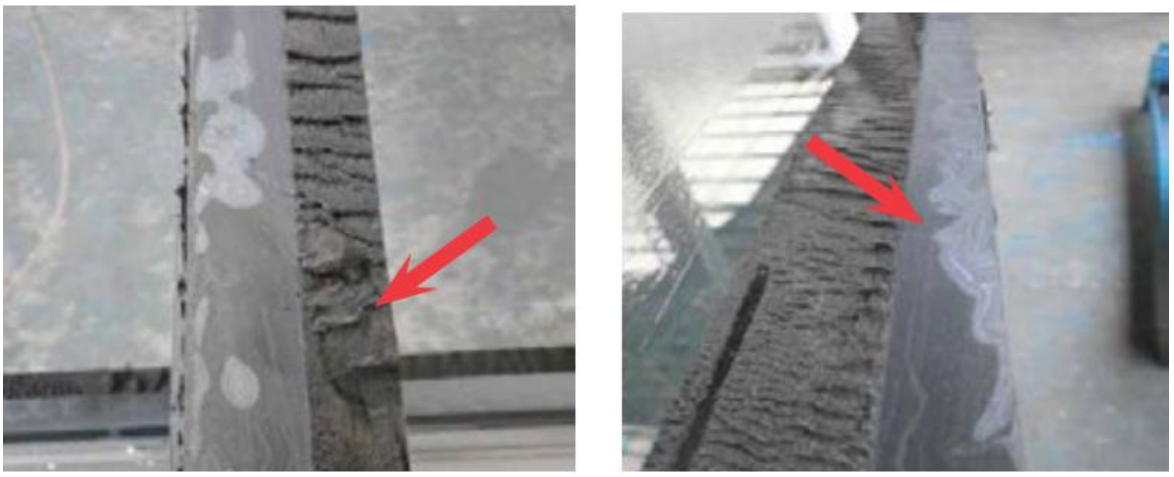
1) Coverage of minimum 95 percent of the total joint length.

2) Sealant bite shall not be less than 95 percent of the designed bite and minimum bite requirement to be calculated as per **5.9.1** and **5.9.2**.

Examples of improper adhesion are shown in Fig. 10 for reference:

INCOMPLETE JOINT FILL

COMPLETE JOINT FILL



POOR MIXING OF SEALANT- WHITE STREAKING PATTERN OBSERVED

LARGE AREA OF SEALANT LOST ADHESION ON TO THE ALUMINIUM FRAME

GOOD ADHESION WAS FOUND BETWEEN STRUCTURAL SEALANT ON TO ALUMINIUM

FIG. 10 EXAMPLES OF IMPROPER ADHESION

ANNEX G

(*Clause* 5.13)

CALCULATION OF EFFECTIVE MOMENTUM OF INERTIA OF THERMAL BARRIER PROFILES

G-1 The deflection of thermal barrier profiles is calculated by using the normal formula for the deflection, but an effective moment of inertia taking into account the elastic connection of the metal profile sections (*see* Fig. 11).

The effective moment of inertia is:

$$I_{ef} = I_s \times \frac{1 - v}{1 - v \times C}$$

where

$I_s = I_1 + I_2 + A_1 a_1^2 + A_2 a_2^2$ = rigid moment of inertia;

$v = \frac{A_1 a_1^2 + A_2 a_2^2}{I_s}$ = compound part of the rigid moment of interia; and

$C = \frac{\lambda^2}{\pi^2 + \lambda^2}$ = measure of the effect of the elastic connection.

The parameter λ depends on the geometry of the profile section, the elasticity constant c of the thermal barrier and the modulus of elasticity E of the metal (aluminium) and also on the span of the beam l.

where

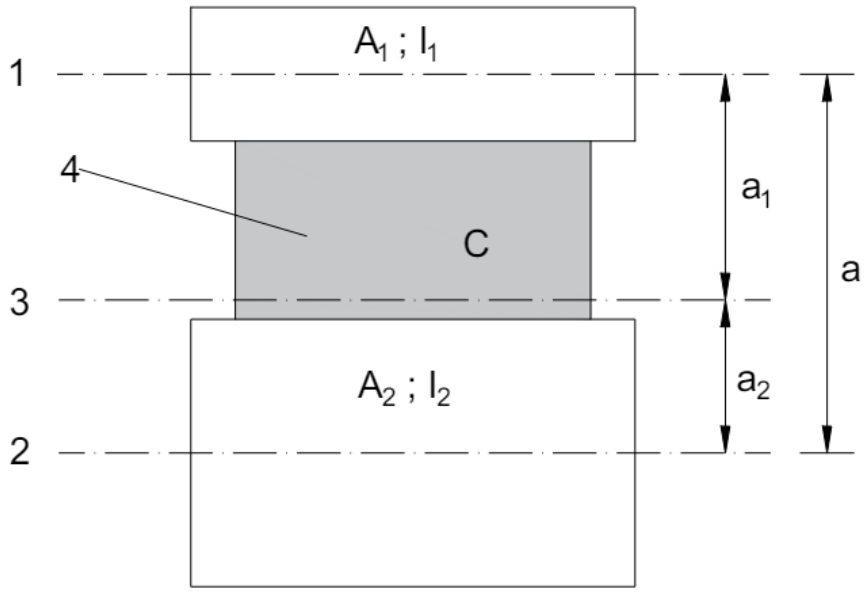
$$\lambda\,(l) = \sqrt{\frac{c \times a^2 \times l^2}{E \times I_s}} \times \frac{l}{v\,(l - v)}$$

l is span of the beam

NOTES

1 Since λ depends on the span of the beam, the effective moment of inertia is a function of the span. For large spans, the value approaches the rigid value.

2The formula for c is valid for a sinus shaped load, but it also works with high accuracy for constant or triangular shaped loads.



Key

1 Centre of mass of metal section 1 with area A_1 and moment of inertia I_1
2 Centre of mass of metal section 2 with area A_2 and moment of inertia I_2
3 Centre of mass of the composite profile
4 Thermal barrier with elasticity constant c

FIG. 11 SCHEMATIC REPRESENTATION OF PROFILE WITH THERMAL BARRIER

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ANNEX H

(*Clause* 5.13.1)

TEST METHOD FOR SHEAR STRENGTH

H-1 TEST SPECIMENS

The length of each test specimen shall be (100 ± 1) mm. In order to determine the characteristic shear strength and the elasticity constant, 10 test specimens shall be tested at the intended temperature.

If the compound connection is not continuous, the test specimens shall include a minimum of two connections, which will give the test specimen length required.

NOTE — A reduction in the length of the test specimen is permitted if it is proven that short test specimens have comparable characteristic values.

H-2 TEST PROCEDURE

In order to determine the shear strength and elasticity constant, place the test specimen in a test device as shown in Fig. 12. The test specimen shall be guided laterally. The forces shall be transmitted to the profile by a rigid support in such a way as to ensure uniform distribution of the load but without any contact with the thermal barrier material. The rigid support shall not restrain an eventual slip of the thermal barrier material.

NOTE — In case of a slender thermal barrier, problems of stability may occur. In this case, the test device should provide for the risk of buckling without affecting the shear strength.

The feed rate shall be 1 mm/min to 5 mm/min. The loads applied and the corresponding shear deformations shall be recorded up to the maximum load or at least 2 mm deformation if there is slip. The displacement shall be measured directly on the test specimen.

H-3 EVALUATION

The value of the shear strength for each test specimen shall be calculated as follows:

$$T = \frac{F_{Max}}{l}$$

where

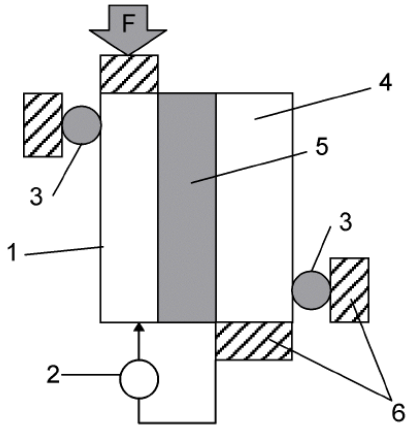
T = the shear strength (N/mm);
F_{Max} = the maximum shear load (N); and
l = the length of the test specimen (mm).

The elasticity constant c shall be obtained from the increase of the curve of deformation under load (stress-strain curve) after the beginning of the deformation. The following equation shall apply:

$$c = \frac{\Delta F}{\Delta\delta \times l}$$

where

c = the elasticity constant (N/mm²);
ΔF = the increase of the shear load (N);
$\Delta\delta$ = the corresponding displacement (mm); and
l = the length of the test specimen (mm).



Key

1 Test specimen
2 Displacement gauge
3 Guide
4 Metal profile
5 Thermal barrier
6 Rigid support

FIG. 12 TEST DEVICE FOR DETERMINING SHEAR STRENGTH AND ELASTICITY CONSTANT (SCHEMATIC)

ANNEX J

(*Foreword*)

COMMITTEE COMPOSITION

Doors, Windows and Shutters Sectional Committee, CED 11

Organization	*Representative(s)*
In Personal Capacity (*357, Bhera Enclave, Paschim Vihar, Delhi – 110087*)	SHRI R. K. KAKAR **(*Chairperson*)**
APL Apollo Tubes Limited, Ghaziabad	SHRI TAPESH GUPTA
Aluminium Association Of India, Bengaluru	DR PRADYUMNA KUMAR PRADHAN
B. G. Shirke Construction Technology Ltd, Pune	COL (RETD) SANJAY M. ADSAR SHRI Y. B. PATHAN (*Alternate*)
Bhoruka Extrusions Private Limited, Mumbai	SHRI SEIJI KUMAMOTO SHRI OM PRAKASH VERMA (*Alternate*)
Builders Association of India, Mumbai	SHRI SUDIP KUMAR DUTTA SHRI M. SATHYANARAYANAMURTHY (*Alternate*)
Central Institute of Plastics Engg & Technology, Chennai	DR ASHWINI KUMAR MOHAPATRA SHRI D. ANJANEYA SHARMA (*Alternate*)
Central Public Works Department, New Delhi	CHIEF ENGINEER (CSQ) SUPERINTENDENT ENGINEER (TAS) (*Alternate*)
CSIR – Central Building Research Institute, Roorkee	SHRI S. K. NEGI SHRI BANTI A. GEDAM (*Alternate* I) SHRI MOHD. REYAZUR RAHAMAN (*Alternate* II)
Engineers India Limited, New Delhi	SHRI SAMIR DAS SHRI ANISH KUNDU (*Alternate* I) SHRI ANISH MAHALA (*Alternate* II)
Forest Research Institute, Dehradun	SHRI VIMAL KOTHIYAL SHRI D. P. KHALI (*Alternate*)
Glazing Society of India, Chennai	SHRI G. N. GOHUL DEEPAK SHRI NAVEEN KARKI (*Alternate* I) SHRIMATI DILNA SUBRAMANIAN (*Alternate* II)
Greenlam Industries, Kolkata	SHRI SHIRISH BHATT SHRI INDER KOCHHAR (*Alternate*)
Hindalco Industries Limited, Mumbai	SHRI CHANDAN AGRAWAL SHRI SIDDHARTH SHETTY (*Alternate*)
Indian Buildings Congress, New Delhi	SHRI HITESH PAUL GUPTA
Institute of Wood Science and Technology, Bengaluru	SHRI ANAND NANDANWAR
Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	SHRIMATI RIVOO MAHENDRU SHRI KULBHUSHAN JAIN (*Alternate*)

Organization	*Representative(s)*
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National Test House, Kolkata	SHRI D. V. S. PRASAD SHRI ALOKE DE (*Alternate*)
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