भारतीय मानक

Indian Standard

IS 17953 : 2023

खिड़कियों और दरवाजों के लिए यू पी वी सी प्रोफाइल — विशिष्टि

uPVC Profiles for Windows and Doors — Specification

ICS 91.060.50; 83.140.99

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Doors, Windows and Shutters Sectional Committee, CED 11

FOREWORD

This Indian Standard 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.

Building materials industry is incorporating large options to choose from, for users including the professionals. Window and door frames is one such area where the material options covered timber, steel, aluminum, and sometimes concrete. Use of unplasticized polyvinyl chloride (uPVC) profiles in doors and windows is getting popular across the world and so in the country. uPVC profiles are made through extrusion process. The material from which the profile is produced consists substantially of unplasticized polyvinyl chloride to which additives are added to facilitate the production of sound and durable profiles of good surface finish and mechanical strength.

As there is a demand on quality of uPVC profiles in our country, standardizing the same gains prominence. This standard has been prepared considering both the raw material requirements and the final performance requirements of the uPVC profiles.

The composition of the committee responsible for the formulation of this standard is listed 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, 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

uPVC PROFILES FOR WINDOWS AND DOORS — SPECIFICATION

1 SCOPE

This standard specifies the requirements for uncoated unplasticized polyvinyl chloride (uPVC) profiles and light coloured surfaces intended to be used for fabrication of windows, doors and their framing components.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following terms and definitions shall apply.

NOTE — For editorial reasons in this standard the term 'window' is used for both windows and doors.

3.1 Definitions Relating to Profile

3.1.1 *Profile* — Continuously extruded section of uPVC used for fabrication of window.

3.1.2 *Uncoated Profile* — Profile without any surface treatment and without non uPVC coextruded layers. For example, profiles without laminated foils or painted surfaces.

3.1.3 *Main Profile* — Profile which has a load bearing function in the door and window.

NOTE — Main profiles can be outer frame, sash and transom or mullion.

3.1.4 *Auxiliary Profile* — Profile, which is not a main profile and has a reduced load bearing function within the door and window and are of supportive in function.

NOTE — Auxiliary profiles can be glazing beads, packers, Interlocks, frame extension profiles, sill profiles or decorative profiles.

3.1.5 *External Wall (of Main Profile)* — Wall of a main profile corresponding to its sight and non-sight surfaces.

3.1.6 *Surface* — Face surface of a profile that is seen from either side before installation of window, open or closed (*see* Fig. 1).

3.1.7 *Visible Surface* — Face surface of a profile that is seen from either side after installation of window, open or closed (*see* Fig. 1).

3.1.8 *Sight Visible Surface* — Face surface of a profile that is seen from either side after installation, when the window is closed (*see* Fig. 1).

3.1.9 *Non–Sight Visible Surface* — Parts of surface of profile which can be exposed to UV radiation after installation, when the window is opened (*see* Fig. 1).

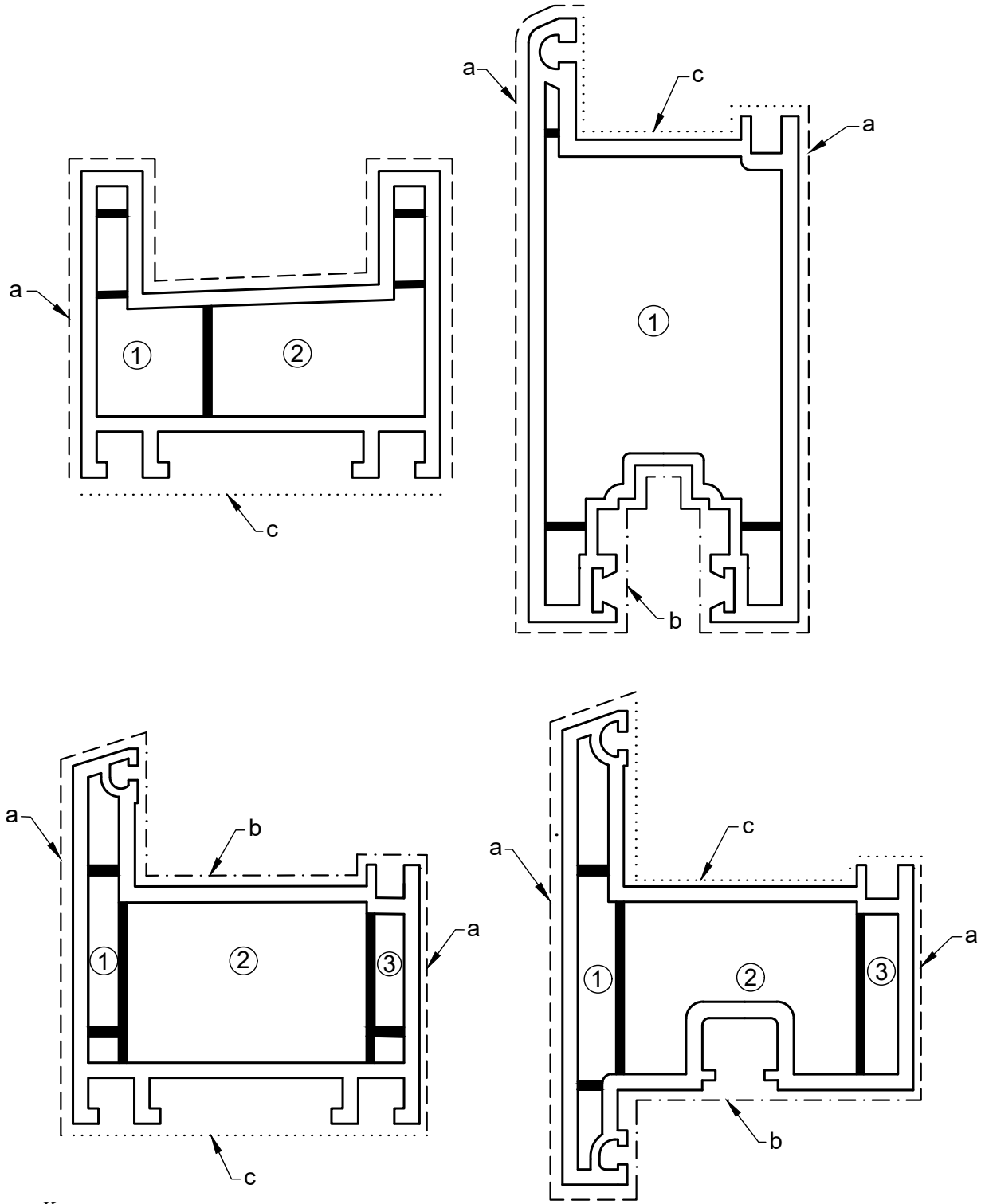
3.1.10 *Non Visible Surface* — Parts of surface of profile which cannot be exposed to UV radiation after installation of window, open or closed (*see* Fig. 1).

3.1.11 *Co-Extruded uPVC Profile* — Profile produced by two or more feedstock in different areas of its cross section using co-extrusion technology (*see* Fig. 2).

3.1.12 *Co-Extruded Gasket Profile* — Profile combining rigid and flexible elements (such as glazing bead with co-extruded rubber gasket) (*see* Fig. 2).

3.1.13 *Web* — A membrane connecting two walls of a profile (*see* Fig. 1).

3.1.14 *Chamber* — Number of vertical divisions in a profile measured from outside to inside. *See* Fig. 1 for chamber numbers (1, 2, 3).



Key

a,b,c	Surface
a,b	Sight surface
a	Sight visible surface
b	Non-sight visible surface
c	Non visible surface
▬	Web
1,2,3	Chamber

FIG. 1 SURFACE, WEB AND CHAMBER IN DIFFERENT TYPE OF PROFILES

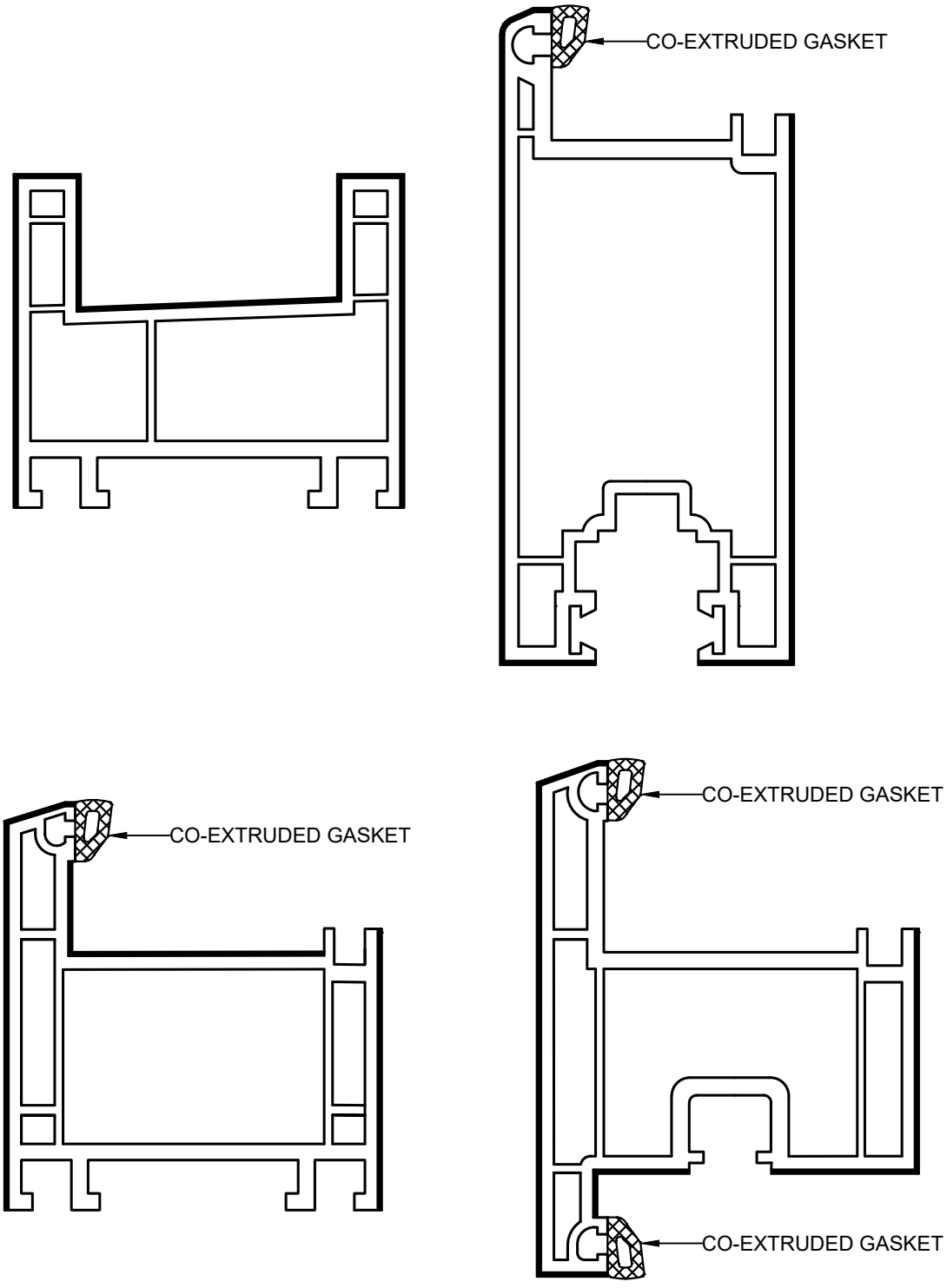


FIG. 2 EXAMPLES OF TYPICAL COEXTRUDED PROFILES

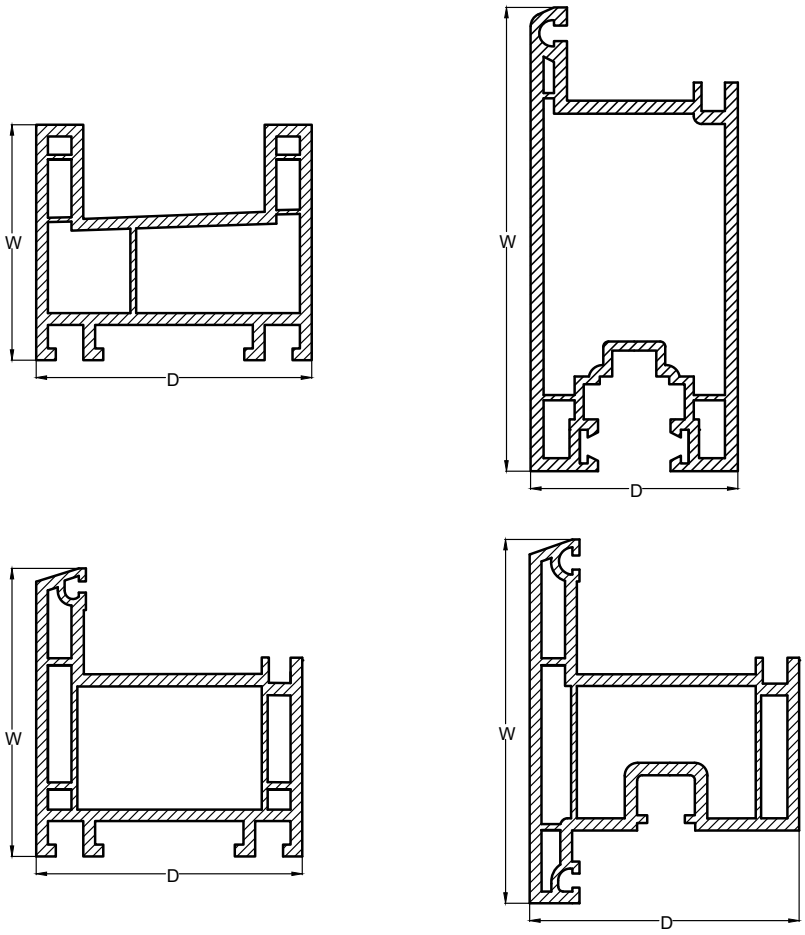


FIG. 3 GEOMETRY OF TYPICAL PROFILES

3.2 Definitions Relating to Geometry

3.2.1 *Nominal Profile Shape* — Standard shape and dimensions of the profile, as specified by the manufacturer.

3.2.2 *Depth of Profile (D)* **—** Dimension between the two faces of profile which is measured at right angles to the glazing plane, between the front and back face surfaces of a profile (*see* 'D' in Fig. 3).

3.2.3 *Overall Width of Profile (W)* — Greatest dimension, measured in the direction of the glazing plane and perpendicular to the longitudinal axis of a profile (*see* 'W' in Fig. 3).

3.2.4 *Deviation from Straightness* **—** Deviation of the longitudinal axis of the profile from the straight line in both planar and perpendicular direction. This is also known as bow.

3.2.5 *Sight Surface Flatness* **—** The quality of being level and without curved, high, or hollow parts [*see* Table 2 (iv)].

3.2.6 *Parallelism* — Flatness and straightness of the both sight visible surfaces with respect to each other [*see* Table (v)].

3.3 Definitions Relating to Materials

3.3.1 *Material* — uPVC compound in a form of granules or powder for the production of uPVC profiles intended to be used for the fabrication of a window, door and their framing component.

3.3.2 *Defined Formulation* — Formulation which is a specified composition of polymer, additives and pigments.

3.3.3 *Virgin Material* — Material of a defined formulation, which has not been subjected to use or processing other than required for its manufacture and to which no reprocessed or recyclable material has been added.

3.3.4 *Non-UV Resistant Virgin Material* — Material according to **3.3.3** but not necessarily satisfying the requirements of the resistance to weathering.

3.3.5 *Own Reprocessed Material* — Material prepared from defined formulations, free of degradation, prepared from pre-consumer uPVC profiles, including discarded/rejected/unused windows and off-cuts, from window assembling manufacturers, that will be reprocessed by the same manufacturer from which it was previously extruded.

3.3.6 *Recyclable Material (r-uPVC)* — Material prepared from defined formulations, free of degradation and contamination (for example dust, dirt, gaskets, metal or foil), prepared from pre-consumer or post-consumer uPVC profiles, regardless of where they were originally manufactured, including discarded/ rejected/ unused windows and off-cuts.

3.3.7 *Non-Recyclable Material (NRM)* — Any material which is not defined in **3.3.3** to **3.3.6** It is not permitted to use non-recyclable material.

4 TESTS DEFINITION

4.1 Type Tests on Material — Tests carried out on a new defined formulation or whenever a change is made in the defined formulation in order to establish the suitability and the performance capability of uPVC profiles or once in every 5 years for all except resistance to weathering and reduction in impact strength after weathering for which the period will be 7 years.

a) Vicat softening point;
b) Flexural modulus of elasticity;
c) Tensile impact strength;
d) Charpy impact resistance of main profile;
e) Resistance to weathering;
f) Reduction in impact strength after weathering; and
g) Density.

4.2 Acceptance Test on Material Lot — Test carried out on samples of material of defined formulation taken from a lot for the purpose of acceptance of the lot include:

a) Density.

4.3 Type Tests on Profile Lot — Tests carried out for a new profile or whenever a change is made in the design and size (including thickness) in order to establish the suitability and the performance capability of uPVC profiles or once in every 5 years:

a) Appearance;
b) Dimensions and tolerances;
c) Mass of profile;
d) Weldability;
e) Density;
f) Resistance to impact of falling mass;
g) Heat ageing at 150 °C; and
h) Heat reversion.

4.4 Acceptance Tests on Profile Lot — Tests carried out on samples of same nominal profile shape taken from a lot for the purpose of acceptance of the lot.

a) Appearance;
b) Dimensions and tolerances;
c) Mass of profile; and
d) Weldability.

4.5 Failure Load — Load at which yield occurs, or, if yield does not occur, load at which the test specimen breaks.

4.6 Defect — The visual appearance of blisters, cavities or cracks on any of the surfaces (inner or outer) of the profile and of any delamination in the cross section.

5 REQUIREMENTS

5.1 Raw Material Requirements

The material from which the profile is produced shall consist substantially of unplasticized polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the profile and the production of sound and durable profile of good surface finish and mechanical strength under conditions of use. None of these additives shall be used separately or together in quantities sufficient to constitute organoleptic or microbial growth hazard, and materially to impair the fabrication or welding properties, and to impair its chemical and physical or mechanical properties (in particular long-term mechanical strength and impact strength) as defined in this standard. Additives containing compounds based on lead (Pb) or cadmium (Cd) shall not be used except that recycled uPVC window profile material containing these elements may be used provided it is contained within the inner layer of coextruded profile (*see* **5.1.3**). The additives to be used shall be selected from IS 10148 and shall be uniformly dispersed.

5.1.1 *UV Resistant Virgin Material*

The UV resistant virgin material shall comply with the requirements given in Annex B and **5.10**.

5.1.2 *Non-UV Resistant Virgin Material*

It is permitted to use non-UV resistant virgin material when the coextruded visible surfaces of the profile are made from a UV resistant virgin material or an own reprocessed material. The non-UV resistant virgin material shall comply with the requirements given in Annex B.

5.1.3 *Own Reprocessed, Recyclable Materials and Non-UV Resistant Virgin Materials*

If the material used is not a UV resistant virgin material according to **5.1.1**, the requirements of this standard apply together with the following:

a) The use of own reprocessed, recycled, non UV resistant and NRM materials shall conform to Table 1;

b) Recyclable materials (r-uPVC) may be used after any necessary re-stabilization and/or addition of additives (for example, modifiers, pigments, lubricants) for the core of a profile, where any visible surfaces of the window are completely covered by co-extrusion with a virgin material or an own reprocessed material;

c) For sight visible surfaces, the minimum value of thickness of the coextruded surface layer shall be 0.5 mm;

d) For non-sight visible surfaces, the minimum thickness of the coextruded surface layer shall be 0.2 mm; and

e) No requirement for minimum thickness of the coextruded surface layer at the bottom of grooves with an open width less than equal to 5 mm.

5.2 Appearance of uPVC Profile

The colour of the profile shall be the same and uniform on all visible surfaces, when viewed in accordance with **6.1**. uPVC profiles with the colorimetric co-ordinates measured on the visible surfaces, shall be as follows (*see* **6.5** and **G-4.3**):

a) $L^* \geq 82$ (chromaticity co-ordinate $Y \geq 60$)

b) $-2.5 \leq a^* \leq 5$

c) $-5 \leq b^* \leq 15$

The surfaces of the profiles shall be smooth and free from pitting, impurities, cavities and other surface defects when viewed in accordance with **6.1**. The edges of the profiles shall be clean and burr-free. Further arrangements with respect to appearance, such as tolerances on the colour shade, shall be as agreed to between the manufacturer and the purchaser.

NOTE — Extrusion lines, caused by the process shall be permissible, unless these are visually intrusive.

5.3 Dimensions and Tolerances

5.3.1 *Nominal* Shape *of uPVC Profile*

The cross section, perpendicular to longitudinal axis, shall conform to the nominal profile shape. Nominal shape shall be declared by the manufacturer. The tolerance of the outside dimensions of the profile (*see* Fig. 3) with respect to the nominal profile shape shall be in accordance with Table 2. The dimensions shall be determined in accordance with **6.2**.

Table 1 Permitted Use of Own Reprocessed, Recyclable (r-uPVC), Non-recyclable (NRM) and Non-UV Resistant Virgin Material

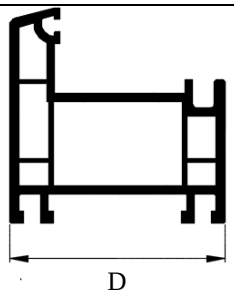
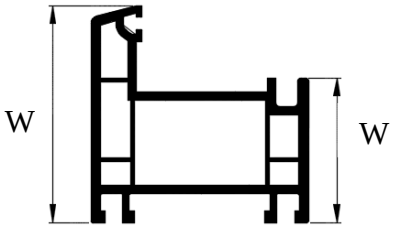
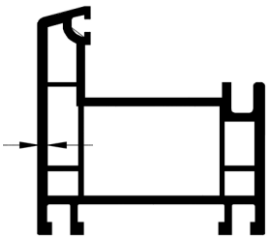
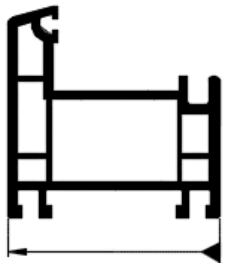
[*Clause* 5.1.3 a)]

Sl No.	Application	Material			
		Own reprocessed material	Non UV-resistant virgin material	r-uPVC	NRM
(1)	(2)	(3)	(4)	(5)	(6)
i)	Monoextrusion or co-extrusion of a layer of any visible surface	Yes	No	No	No
ii)	Non-visible surface and material covered by co-extrusion	Yes	Yes	Yes	No

5.3.2 *Wall Thickness of Main Profiles*

The wall thickness of sight visible surfaces, when measured in accordance with **6.2**, shall be within the specified tolerance. The manufacturer shall also declare the minimum value for the co-extrusion layer (if applicable) of the sight visible surface and non-sight visible surface.

Table 2 Tolerances on Dimensions
(*Clause* 5.3.1 *and* 3.2.5)

Sl No.	Dimension	Tolerance	Typical Illustration
(1)	(2)	(3)	(4)
i)	Depth (D)		
	a) Less than or equal to 80 mm	± 0.3 mm	
	b) More than 80 mm	± 0.5 mm	
ii)	Width (W)	± 0.5 mm	
iii)	Sight visible surface wall thickness, *Max*	- 10 %	
iv)	Sight visible surface flatness, *Max*	0.3 mm	
v)	Parallelism, *Max*	0.5 mm	

5.3.3 *Tolerances on other Dimensions*

The other dimensions of main profile and of auxiliary profile and their tolerances shall be as declared by the manufacturer or mutual agreement between the manufacturer and the purchaser.

5.3.4 *Straightness*

The deviation from straightness, when measured in accordance with **6.2** shall not be more than 1 mm for a length of 1 m for main profiles. The deviation from straightness for auxiliary profiles shall be as declared by the manufacturer.

5.4 Mass of Profile

The mass of profiles, when measured in accordance with **6.3** shall not be less than 95 percent of the nominal mass per meter length declared by the manufacturer.

5.5 Heat Reversion

When tested in accordance with Annex C, for each test specimen the heat reversion of the two opposite sight visible surfaces shall meet the following requirements:

a) Main profiles ≤ 2.0 percent; for each test specimen, the difference of the values of the heat reversion, between these sight visible surfaces ≤ 0.4 percent; and
b) Auxiliary profiles ≤ 3.0 percent.

5.6 Resistance to Impact of Falling Mass

When tested in accordance with Annex D, no more than one test specimen shall show rupture in the tested external sight visible surface. For co-extruded uPVC profiles, delamination of co-extruded layer shall be considered as a failure. This test shall be conducted on main profiles only.

5.7 Heat Ageing

When tested in accordance with Annex E, the profiles shall not show defects such as blisters, cavities, cracks and surface peel offs on any of the surfaces. For co-extruded uPVC profiles, delamination of co-extruded layer shall be considered as a failure.

5.8 Weldability

For determination of the weldability of profiles, welded corners and T joints shall be tested in accordance with the method given in Annex F. The sample subjected to the weld test shall not be finished by grooving or knifing, except for the outside edge of 90° angle, which shall be cleaned to permit the sample to sit fully onto the support.

5.8.1 *Tensile Bending Test*

The mean failure stress σ_t, calculated for maximum load of each corner, shall not be less than 25 N/mm^2 and each individual value shall be ≥ 20 N/mm^2. If the depth or the overall width of the profile is ≥ 80 mm, the mean failure stress, σ_t, calculated for the maximum load of each corner, shall be ≥ 20 N/mm^2 and each individual value shall be ≥ 16 N/mm^2.

5.8.2 *Compression Bending Test*

The mean failure stress σ_c, calculated for maximum load of each corner, shall not be less than 35 N/mm^2 and each individual value shall be ≥ 28 N/mm^2. If the depth or the overall width of the profile is ≥ 80 mm, the mean failure stress, σ_c, calculated for the maximum load of each corner, shall be ≥ 28 N/mm^2 and each individual value shall be ≥ 24 N/mm^2.

5.9 Charpy Impact Resistance of Main Profile

When tested in accordance with IS 13360 (Part 5/Sec 5) by using method designation 'ISO 179-1/1fA', the average charpy impact strength of the profile shall conform to Table 3 for each profile according to specimen sight visible surface wall thickness. The test specimen shall be conditioned at 27 °C ± 5 °C for at least 16 h. In deviation to IS 13360 (Part 5/Sec 5) and weathering test, no conditions for humidity are required. The test specimen shall be taken from the sight visible surface of a main profile such that the longitudinal direction of the test specimen and profile are the same. The test specimen shall have a length of 50 mm ± 1 mm, a width of 6 mm ± 0.2 mm and a thickness equal to the wall thickness of the profile. The residual width between the notches shall be 3 mm ± 0.1 mm. The support shall have a span of $40\ ^{+0.5}_{-0}$ mm.

Table 3 Charpy Impact Strength Threshold
(*Clauses* 5.9 *and* 5.10.3)

Sl No.	Sight Visible Surface Thickness	Charpy Impact Strength Before Artificial Weathering	Charpy Impact Strength After Artificial Weathering	Maximum Impact of Reduction After Artificial Weathering
	mm	kJ/m^2	kJ/m^2	%
(1)	(2)	(3)	(4)	(5)
i)	≥ 2.8	≥ 55	≥ 33	40
ii)	≥ 2.5	≥ 60	≥ 42	30
iii)	< 2.5	≥ 65	≥ 52	20

5.10 Resistance to Weathering

5.10.1 *Exposure Procedure*

When tested in accordance with Annex G, the test specimens shall be taken from sight visible surfaces of the profiles and shall be exposed for a time period representing five years of outdoor weathering in the climate with annual total solar radiant exposure on horizontal surface of 8 GJ/m^2. For the determination of the solar radiant exposure doses and exposure duration, a calculation method is given in **5.10.2**

NOTE — For quality estimation purposes, the colour fastness results for time period 3 000 h exposure may be referred for faster analysis. Values of ΔE* and Δb* shall not be more than 50 percent of the values given in **5.10.4.**

5.10.2 *Calculation Method for the Determination of the Solar Radiant Exposure Doses and Exposure Duration.*

5.10.2.1 For the purpose of this calculation the amount of solar radiant exposure is estimated at 8 GJ/m^2/year (*see* **5.10.1**).

5.10.2.2 In order to compare value mentioned **5.10.2.1** with the usual practice in artificial weathering, the part falling in the ultraviolet and visible regions between 300 nm to 800 nm, is considered, which is about 60 percent of the total solar radiation energy. A further correction factor of 67 percent is applied to allow for the fact, that not all this radiation is acting at higher summer temperatures and so will be less damaging to the effected surfaces. The radiation doses for the wavelength range between 300 nm to 800 nm are given in Table 4.

Table 4 Radiant Exposures for the Wavelength Range 300 nm to 800 nm

(*Clause* 5.10.2.2)

Sl No.	Years	Radiant Exposure GJ/m^2
(1)	(2)	(3)
i)	2 year's equivalent	6.4
ii)	5 year's equivalent	16

5.10.2.3 For an artificial weathering device having a time-averaged irradiance I = 550 W/m^2, in the range 300 nm to 800 nm the exposure times are given in Table 5.

Table 5 Exposure Times for the Wavelength Range 300 nm to 800 nm
(*Clause* 5.10.2.3)

Sl No.	Years	Exposure Time h
(1)	(2)	(3)
i)	1 year equivalent	1 600
ii)	2 year's equivalent	3 300
iii)	5 year's equivalent	8 000

NOTE — This calculation method represents only approximate means of estimation. However, it does put the requirements on a logical basis bearing in mind that natural weathering itself is a variable phenomenon depending on location, aspect, shading, etc.

The exposure times are calculated as example. The actual exposure times shall be calculated with the real values of the used equipment to achieve the required radiant exposure in GJ/m².

5.10.3 *Impact Strength after Artificial Weathering of Main Profiles*

After an exposure in accordance with **5.10.1**, the charpy impact strength shall not be below the thresholds given in Table 3 as per the profile specimen thickness.

NOTE — The test of impact strength after artificial weathering is a test for evaluation of quality of the material (formulation), not for the profile.

5.10.4 *Colour Fastness*

After an exposure in accordance with **5.10.1**, the change in colour, evaluated in accordance with Annex G, between the unexposed and exposed test specimens, expressed as ΔE^* shall be ≤ 5 and Δb^* shall be ≤ 3.

NOTE — The visual change in colour shall be determined using the methods specified in IS/ISO 105-A02.

5.11 Density

When determined in accordance with IS 13360 (Part 3/Sec 10), the density of the profile shall be between 1.40 g/cm^3 and 1.50 g/cm^3.

6 TEST METHODS

6.1 Determination of Appearance

The appearance is determined by viewing by normal or corrected vision at distance of 1 m, at 45° north sky light perpendicular to the surface as specified in IS/ISO 105-A01, clauses **14** and **15**, or with an equivalent artificial source of light.

6.2 Determination of Dimensions

6.2.1 *Measuring Devices*

The measuring devices for the determination of the external dimensions and the wall thickness shall be capable of measuring upto 0.02 mm, for flatness shall be capable of measuring upto 0.01 mm and for the deviation from the straightness shall be capable of measuring upto 0.05 mm.

6.2.2 *Test Specimen*

For the determination of the deviation from straightness, the length of the profile to be tested shall be 1 000 mm ± 1 mm and for measurement of other dimensions the length of sample shall be 300 mm ± 5 mm. In case of dimension measurement on optical instruments, suitable size of specimen shall be taken for measurement of dimensions.

6.2.3 *Conditioning*

Condition the test specimen at 27 °C ± 5 °C for at least 1 h prior to testing.

6.2.4 *Procedure*

6.2.4.1 *External dimensions, wall thicknesses and flatness*

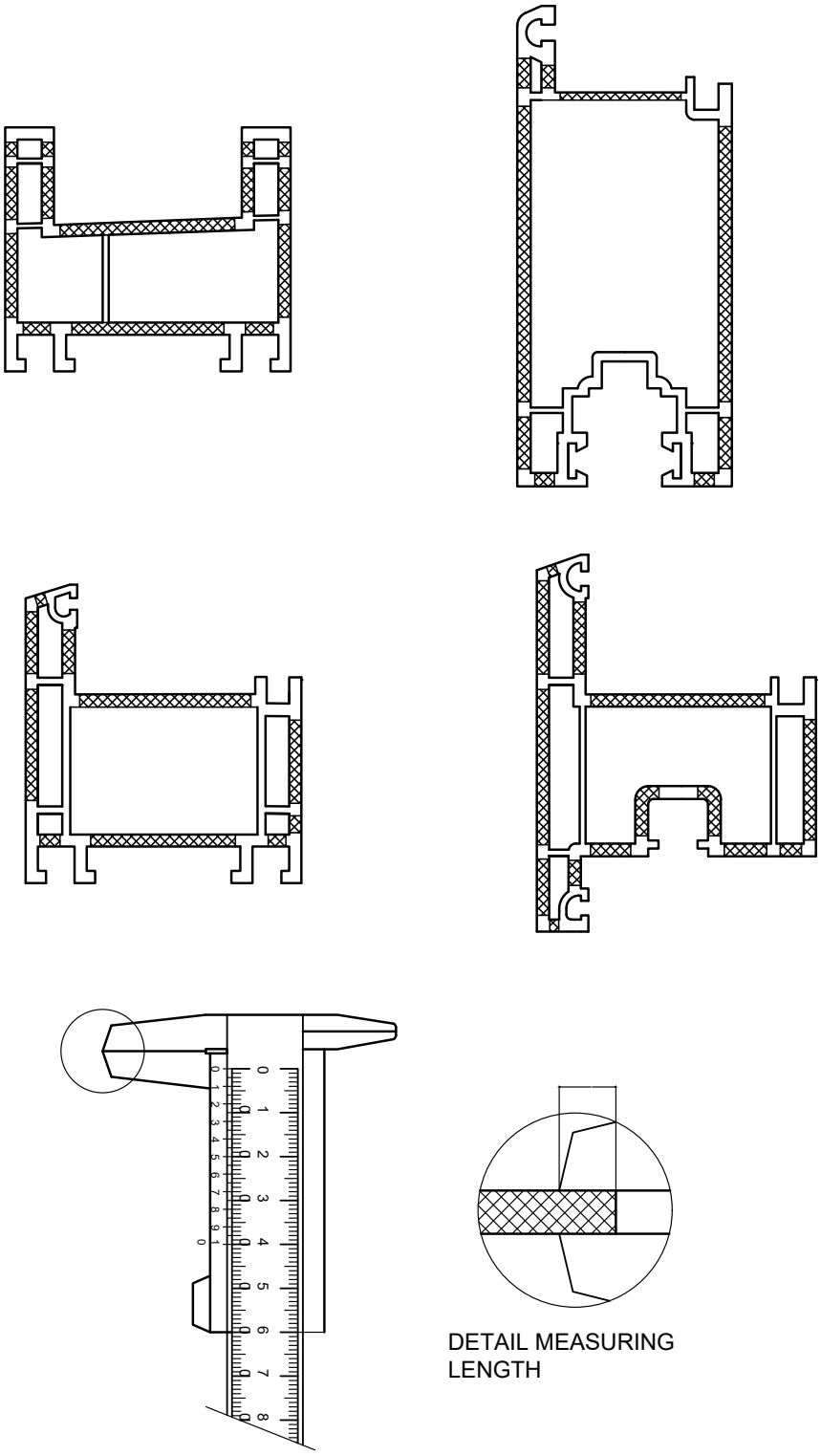
Dimensions, wall thicknesses and parallelism shall be measured with vernier caliper or projector or scanner. Wall thickness of the external wall shall be measured 1 mm towards an edge or ridge (*see* Fig. 4). Flatness shall be measured with dial or plunger gauge or straight edge.

6.2.4.2 *Deviation from straightness*

Put the test specimen on flat surface (such as a surface table). Measure the gap(s) between the profile and the flat base with an appropriate measuring device (distance gauges or filler gauge). Rotate the sample in 90° and again check the gap(s). Record the gap observed between profile and flat surface.

6.2.4.3 *Measurement*

Make 3 measurements on test specimen and the smallest value shall be considered for external dimensions and wall thickness; and largest valueshall be considered for flatness and deviation from straightness.



All dimensions in millimetre

FIG. 4 AREAS OF WALL THICKNESS MEASUREMENT

6.3 Determination of Profile Mass

6.3.1 *Apparatus*

Weighing balance shall be capable of measuring upto 1 g. For determination of profile length, measuring device capable of measurement upto 0.5 mm shall be used.

6.3.2 *Test Specimen*

The length of the profile to be tested shall be 200 mm to 300 mm.

6.3.3 *Conditioning*

Condition the profiles before measuring at 27 °C ± 5 °C for at least 1 h.

6.3.4 *Procedure*

Measure the length of the test specimen to 1 mm, weigh the test specimen to the nearest 1 g. Determine the mass per length expressed in g/m to the nearest 10 g.

6.4 Determination of Thickness of a Co-extruded Layer

The thickness of the co-extruded layer shall be measured with suitable measuring devices (example magnifying glass or measuring microscope) on a thin section or a ground cut edge.

6.5 Determination of Colorimetric Co-ordinates

The colorimetric co-ordinates and the colour differences shall be determined in accordance to **G-4.3**.

NOTE — The colorimetric co-ordinates are of the CIE 1976 L*a*b* is a color space defined by the International Commission on Illumination.

6.6 Permissible Tolerances on Standard Colours

When determined in accordance with **6.5**, following tolerances are permitted:

a) $\Delta L^* \leq 1.0$
b) $\Delta a^* \leq 0.5$
c) $\Delta b^* \leq 0.8$
d) $\Delta E^* \leq 1.0$

7 SAMPLING AND CRITERIA FOR CONFORMITY

7.1 Sampling

7.1.1 All uPVC profiles manufactured from same formulation of raw material shall constitute a material lot.

7.1.2 All uPVC profiles of same nominal profile shape, dimensions (depth, width and thickness of main profiles) and manufactured from same raw material shall constitute a profile lot.

7.1.3 The required number of uPVC profiles depend upon the size of the profile lot and shall be selected at random.

7.2 Criteria for Conformity

7.2.1 All the uPVC profiles selected in accordance with **7.1** shall be measured for depths, widths, wall thickness, sight visible surface flatness, straightness and parallelism tests. These parameters shall comply with the requirements specified in **5.3**, before proceeding with further testing.

7.2.2 If any sample fails to conform the requirements given in **5.3**, further samples shall be taken from the profile lot, double in number, and the profile lot shall be considered to have passed, if these samples conform to the requirements prescribed in this standard.

8 MARKING

8.1 Each profile shall be legibly and indelibly marked in an unobtrusive position not visible when the window or door is closed, at least once in every 1 m along the length of the profile, with the following:

a) Name or trade mark of the manufacturer;
b) Profile identification code as per uPVC profile nominal shape and dimensions, as declared by the manufacturer;
c) Profile lot number/batch number or any other code to enable traceability (to date of manufacture, machine, raw material used, etc); and
d) In case of use of recycled material: r-uPVC.

8.2 BIS Certification Marking

8.2.1 Each profile and its packaging may also be suitably marked with the standard mark.

8.2.2 The use of Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A
(*Clause* 2)

LIST OF INDIAN STANADRDS REFERRED

IS No.	*Title*
IS 10148 : 1982	Positive list of constituents of polyvinyl chloride (PVC) and its copolymers in contact with foodstuffs, pharmaceuticals and drinking water
IS 11472	Specification for artificial daylight for the assessment of Colour:
(Part 1) : 1985	Illuminant for colour matching and colour appraisal
IS 13360	Plastics — Methods of testing
(Part 3/Sec 10) : 2016	Physical and dimensional properties, Section 10 Determination of density of non-cellular plastics — Immersion method, liquid pyknometer method and titration method
(Part 5/Sec 5) : 2017	Mechanical properties, Section 5 Determination of charpy impact properties — Non-instrumented impact test
(Part 5/Sec 7) : 2017	Mechanical properties, Section 7 Determination of flexural properties
(Part 5/Sec 27) : 2022	Mechanical properties, Section 27 Determination of tensile-impact strength
(Part 6/Sec 1) : 2018	Thermal properties, Section 1 Determination of vicat softening temperature of thermoplastic materials (*second revision*)
IS 17863	Plastics — Methods of exposure to laboratory light sources:
(Part 1) : 2022	General guidance
(Part 2) : 2022	Xenon-arc lamps
IS 17864 : 2022	Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method
IS/ISO 105 : Part A01	Textiles Tests for colour fastness: Part A01 General principles of testing
IS/ISO 105 : Part A02	Textiles Tests for colour fastness: Part A02 Grey scales for assessing change in colour

ANNEX B
(*Clauses* 5.1.1 *and* 5.1.2)

MATERIAL CHARACTERISTICS, PREPARATION OF SAMPLES AND REQUIREMENTS

B-1 GENERAL

It describes a procedure for the determination of the characteristics and the requirements for those characteristics for uPVC profiles.

B-2 TEST SPECIMENS

The test specimens for the determination of the material characteristics according to **B-3** shall be taken from profiles.

B-3 MATERIAL CHARACTERISTICS

B-3.1 Vicat Softening Temperature

When tested in accordance with IS 13360 (Part 6/Sec 1) with a temperature rate of 50 ± 5 °C/h the average Vicat softening temperature (VST) shall be ≥ 75 °C and each individual value shall be ≥ 73 °C. The test specimens shall be taken directly from the profiles or from pressed plates.

NOTE — In case of dispute, the test on pressed plates is the reference method.

B-3.2 Flexural Modulus of Elasticity

When tested at 27 ± 5 °C in accordance with IS 13360 (Part 5/Sec 7) the average flexural modulus of elasticity (E_f) shall be ≥ 2 200 N/mm^2 and each individual value shall be ≥ 2 000 N/mm^2. The test specimens shall be taken directly from the profiles or from pressed plates.

NOTE — In case of dispute the test using pressed plates prepared is the reference method.

B.3.3 Tensile Impact Strength

When tested at (27 ± 5) °C in accordance with IS 13360 (Part 5/Sec 27), using type 5 test specimen, the average-tensile impact strength shall be ≥ 600 kJ/m^2. Every single value shall be ≥ 450 kJ/m^2. The test specimens shall be taken directly from the profiles.

B-4 TEST REPORT

The test report shall include the following information:

a) Reference to this Indian Standard;

b) Details of the test specimens; and

c) Values obtained and average values.

ANNEX C
(*Clause* 5.5)

METHOD OF TEST FOR HEAT REVERSION

C-1 GENERAL

This specifies a method for the determination of the heat reversion of unplasticized polyvinylchloride (uPVC) profiles for the fabrication of windows and doors by a test at 100 °C in an oven.

C-2 PRINCIPLE

The heat reversion of the specimen is calculated as the change in percentage of the final length relative to the initial length per pair of marks, after the specimen of specified length is maintained in an oven at 100 °C for 1 h. For main profiles the differential heat reversion is calculated as the difference between the heat reversion of opposite sight visible surfaces of each test specimen.

C-3 APPARATUS

C-3.1 Thermostatically controlled hot air oven,with forced air circulation, in which the test specimen can be exposed to a temperature of 100 °C. The oven shall be equipped with a thermostat capable of maintain the temperature at 100 ± 2 °C.

C-3.2 Thermometer, graduated in 0.5 °C.

C-3.3 Heat resistant glass plate or stainless steel plate and talc/PTFE foil.

C-3.4 Measuring device, to measure the length of the test specimen upto 0.1 mm.

C-4 TEST SPECIMEN

C-4.1 Three test specimen per length of profile, with each specimen shall be of length 250 mm to 300 mm.

C-5 CONDITIONING

The test specimen shall be conditioned for at least 1 h at room temperature.

C-6 PROCEDURE

C-6.1 Two marks perpendicular to profile axis shall be scribed on the test specimen 200 mm apart and in such a way that one of these marks is approximately 25 mm from one end of the specimen.

C-6.2 Each test specimen shall be measured at room temperature for the distance between the two marks and reported upto 0.1 mm.

C-6.3 Set the oven temperature to 100 °C. The specimen shall be kept horizontally in the oven on a glass or steel plate sprinkled with talc/PTFE foil and the time measured from the moment at which the oven regains a temperature of 100 °C. The test specimens shall be kept in the oven for a time $60\ ^{+3}_{-0}$ min.

C-6.4 After the specified periods, the specimen shall be removed from the oven, laid on its side and allowed to cool to room temperature. Under identical conditions to those used in **C-6.2**, the distance between the two scribed marks shall be measured along the surface of the profile using a pair of vernier calipers and the percentage change in length is calculated.

C-6.5 In cases of dispute, the cooling of the profiles and the measuring of the distance between the marks shall be performed at 27 ± 2 °C.

C-7 EXPRESSION OF RESULTS

C-7.1 For each test specimen, calculate the heat reversion *R* for each pair of marks, as a percentage using the following equation

$$R = \frac{L_o - L_1}{L_o} \times 100$$

where

L_o is the distance between the marks before heating in the oven in millimetre;

L_1 is the distance between the marks, after heating in the oven in millimetre.

C-7.2 For the main profiles the differential heat reversion ΔR is the difference between the values of the heat reversions *R* of the two opposite sight visible surface of each test specimen.

C-8 TEST REPORT

The test report shall include the following information:

a) Reference to this Indian Standard;
b) Details of test specimen; and
c) The value *R* for each pair of marks for each test specimen and for the main profiles the differential heat reversion ΔR for each test specimen.

ANNEX D

(*Clause* 5.6)

METHOD OF TEST FOR RESISTANCE TO IMPACT OF FALLING MASS

D-1 PRINCIPLE

Test specimens are subjected to blows from a falling mass, of specified mass and shape, dropped from a known height on the sight visible surface at a mid-way between two supporting webs at a fixed temperature. After testing the profiles shall be examined visually for failures.

D-2 APPARATUS

An impact testing machine shall incorporate the following basic components (*see* Fig. 5):

a) Main Frames with Guide Rails — which can be fixed in the true vertical position, to accommodate a falling mass and release mechanism to release the falling mass to fall vertically and freely;

b) Test Specimen Rigid Support — Consisting of a rounded off support with a in between distance of 200 ± 1 mm. The support shall be made from steel rigidly fixed in a solid foundation or on a table with a mass of more than 50 kg;

c) Release Mechanism — Such that the falling mass can fall from a minimum height of 1 000 mm, measured from the top surface of the test piece; and

d) Falling Mass — 1 000 ± 5 g, comprising of a hemispherical striking surface of radius (R) 25 ± 0.5 mm. The striking surface shall be of solid steel, polished and free from flats, indentations or other imperfections which may influence the result.

D-3 TEST SPECIMEN

Ten test specimens, each of length of 300 mm shall be taken from a main profile.

D-4 CONDITIONING

The test specimens shall be conditioned at a temperature of $-10\ ^{+0}_{-2}$ °C for at least 1 h before testing. Each test specimen shall be tested within 10 s of removal from the conditioning chamber.

D-5 PROCEDURE

The test shall be executed on sight visible surface of the main profile. The falling mass shall be dropped from $1000\ ^{+10}_{-0}$ mm height measured from the top surface of the test piece at a point mid-way between two supporting webs.

NOTES

1 Wherever it is impracticable for the mass to hit the profile due to its geometry, other impact position for the falling mass shall be agreed upon between the profile manufacturer and testing laboratory.

2 When due to its geometry, the profile tends to tilt sideways at the impact of falling mass, any tilting shall be prevented, by attaching additional stays to the two supports.

3 During the test, care shall be taken to prevent multiple impacts of the falling mass on the test specimen

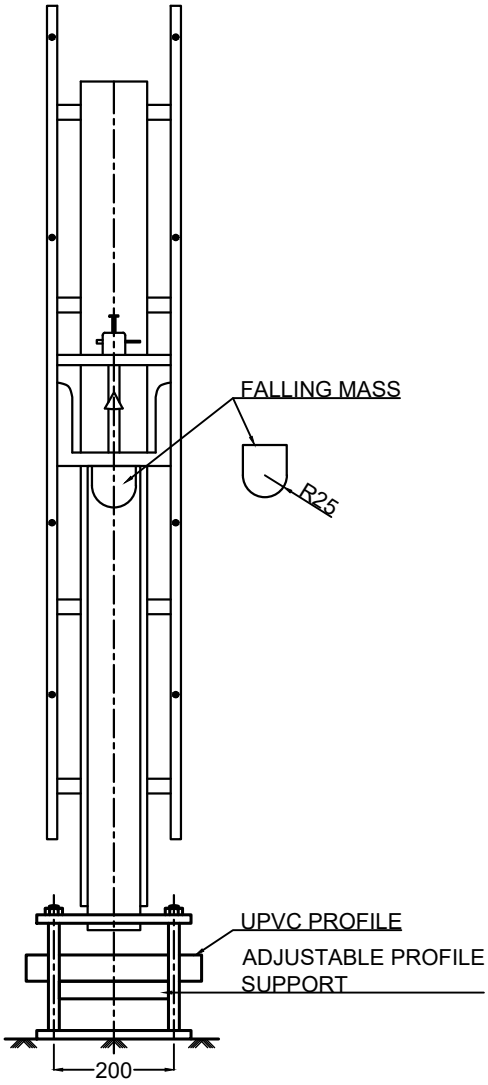
D-6 EXPRESSION OF RESULTS

The number of test specimens tested and the number of test specimens broken shall be reported for each type of main profile.

D-7 TEST REPORT

The test report shall include the following information:

a) Reference to this standard;
b) Details of test specimen;
c) Number of test specimen tested; and
d) Number of test specimen broken.



All dimensions in millimetres

FIG. 5 TYPICAL IMPACT TEST APPARATUS

ANNEX E
(*Clause* 5.7)

METHOD OF TEST FOR HEAT AGING BEHAVIOR AT 150 °C

E-1 PRINCIPLE

The heat ageing behavior of profile specimen is determined by placing the specimen of specified length in an oven or liquid bath at 150 °C for 30 min and inspecting visually on the inside, outside and the cross section of the wall for defects after heating.

E-2 APPARATUS

E-2.1 Ventilated Oven

Thermostatically controlled hot air oven, with forced air circulation, in which the test specimen can be exposed to a temperature of 150 °C. The oven shall be equipped with a thermostat capable of maintain the temperature at 150 ± 2 °C. The capacity of the oven shall be such that, after insertion of the test specimen, the test temperature is regained within 15 min.

E-2.2 Liquid Bath

Thermostatically controlled liquid bath, in which the test specimen can be exposed to a temperature of 150 °C. The bath shall be equipped with a thermostat capable of maintain the temperature at 150 ± 2 °C. The capacity of the bath shall be such that after insertion of the test specimen, the test temperature is regained within 5 min. The liquid to be used shall be glycerin or an aromatic free hydro-carbon. This liquid shall be free of substances which may affect the properties of uPVC.

E-2.3 Thermometer

Graduated in 0.5 °C.

E-3 TEST SPECIMEN

The test specimen per length of profile, shall be of length 200 mm for testing in oven and 300 mm for testing in liquid bath shall be used.

E-4 PROCEDURE

E-4.1 Oven Method

E-4.1.1 Set the oven temperature to 150 °C. The specimen shall be kept horizontally in the oven and the time measured from the moment at which the oven regains a temperature of 150 °C. The test specimens shall be kept in the oven for a time 30^{+3}_{-0} mm.

E.4.1.2 Remove the test specimen from the oven and allow the test specimen to cool in air, taking care not to distort or otherwise damage it. When the test specimen is cool enough for handling, examine it for defects.

E-4.2 Liquid Bath Method

E-4.2.1 Set the liquid bath temperature to 150 °C. The specimen shall be hanged vertically in the test liquid, so that the upper part does not protrude more than 100 mm out of the fluid. The means of suspending a test specimen shall be such that it does not touch either the floor or wall of the bath. The time shall be measured from the moment at which the liquid bath regains a temperature of 150 °C. The test specimens shall be kept in the liquid bath for a time 30^{+3}_{-0} min.

E-4.2.2 Remove the test specimen from the liquid bath and allow the test specimen to cool in air, taking care not to distort or otherwise damage it. When the test specimen is cool enough for handling, examine it for defects.

E-5 EXPRESSION OF RESULTS

The nature and the location of any defects shall be reported.

NOTE — An increase in gloss does not constitute failure.

E-6 TEST REPORT

The test report shall include the following information:

a) Reference to this standard;
b) Details of test specimen;
c) Apparatus used and, for the liquid bath method, the type of liquid; and
d) Results of the examination of the test specimen.

ANNEX F
(*Clause* 5.8)

DETERMINATION OF THE STRENGTH OF WELDED CORNERS AND T JOINTS

F-1 PRINCIPLE

Welded corners and T joints made from uPVC profiles are subjected to a tensile bending or compression bending test at specified temperature and test speed. The failure load is recorded and the failure stress is calculated.

F-2 APPARATUS

F-2.1 Tensile or compression testing machine, with the following specifications:

a) Range of measuring load: 2 000 N to 20 000 N;
b) Load indication with zero point setting and peak recording;
c) Measurement accuracy: ± 1 percent; and
d) Test speed: 50 ± 5 mm/min.

F-2.2 Test Arrangement

a) Corner weld sample for tensile bending test (*see* Fig. 7)
b) T joint weld samples for tensile bending test (*see* Fig. 8)
c) Corner weld sample for compression bending test (*see* Fig. 9)
d) T joint weld samples for compression bending test (*see* Fig. 10)

F-3 TEST SPECIMEN

F-3.1 Welding of Corner Test Specimen

The test specimen shall be a welded corner with an angle of 90° ± 1° made from two lengths of same profile cut at 45° and heat welded.

F-3.2 Welding of T Joint Test Specimen

The test specimen shall be a welded T-joint with an angle of 90° ± 1°. The joint is fabricated by heat welding one specimen of sash or outer frame profile at least 500 mm long and transom profile at least 400 mm long.

Before welding, the sash or outer frame profile shall be notched at 2 x 45° to depth in accordance with the formula:

$$0.5 \times (w - s)$$

where

w = Width of transom profile

s = Welded head stroke

NOTE — For details see Fig. 6.

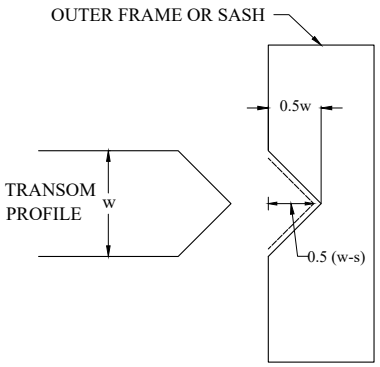


FIG. 6 WELDING OF T JOINT SPECIMEN

The transom profile end is sawn into a symmetrical 90° point. The position of the 90° notch in the sash or frame is such as to leave a minimum 400 mm leg measured from the top of the transom profile (*see* Fig. 8).

F-3.3 Tensile Bending Test Specimen

F-3.3.1 The inside leg length of the test specimen for the corner testing shall be at least 400 mm (*see* Fig. 7).

F-3.3.2 The T joint test specimen is fabricated with the sash or frame arms of inside length minimum 400 mm and 100 mm, and the transom or mullion stem length minimum 400 mm (*see* Fig. 8).

F-3.4 Compression Bending Test Specimen

F-3.4.1 The legs of the corner test specimen are cut at an angle of 45 ± 1° in such a way that the neutral axis of the end sections are located vertically over the axis of rotation of the carriage (approximately the middle of the main chamber of the profile (*see* Fig. 9). The inside length of the leg (L_i) in millimeters is obtained from the following formula:

$$L_i = L_n - 2e$$

$$L_n = \frac{400}{\sqrt{2}} = 283$$

$$L_i = 283 - 2e$$

where

L_n = Length of the neutral axis of the profile in mm; and

e = Distance between the inside of the section and the neutral axis in mm.

F-3.4.2 The short arm of the T-joint test specimen is cut off level with the outer face of the stem to produce a 90° corner. Further preparation of the corner is in accordance with **F-3.4.1** (*see* Fig. 10).

F-4 NUMBER OF TEST SPECIMEN

Three samples of the same profile type and made on the same welding machine head, shall be tested to obtain a mean value.

F-5 CONDITIONING

The test specimens shall be conditioned at 27 ± 5 °C for at least two hours immediately prior to testing.

F-6 PROCEDURE

F-6.1 Test Temperature

The test is carried out at a temperature of 27 ± 5 °C.

F-6.2 Tensile Bending Test

a) The test specimen shall be clamped in the apparatus as shown in Fig. 7 or Fig. 8. Contoured support block may be used, if necessary, to limit twisting;

b) Apply the load to the test specimen in such a way that the speed of application is 50 mm/min and continue until the test specimen fails; and

c) Note the failure load F_t and calculate the failure stress in accordance with **F-7**.

F-6.3 Compression Bending Test

a) Place the test specimen on the trolley as shown in Fig. 9 or Fig. 10. In order to avoid excessive deflection, the open frame end of the T-joint can be supported in the corner area by inserting a cavity filling block (for example, a specimen of metal reinforcement or wooden block);

b) Apply the load to the test specimen in such a way that the speed of application is 50 mm/min and continue until the test specimen fails; and

c) Note the failure load F_c and calculate the failure stress in accordance with **F-7**.

F-7 METHOD FOR THE CALCULATION OF THE FAILURE STRESS

F-7.1 Tensile Bending Test

The failure stress of a welded corner or T-joint depends on the failure load, the profile geometry and the test arrangement (*see* Fig. 7 or Fig. 8). It shall be calculated by the formula:

$$\sigma t = \frac{(LF_t)}{W}$$

where

F_t = Failure load determined by tensile bending testing, expressed in N;

L = Distance between the corner in the highest flange and the point of application of the load, expressed in mm;

W = Moment of resistance (Section Modulus) in the loading direction (= I_x/e, expressed in mm^3);

σt = Failure stress by tensile bending, expressed in N/mm^2.

F-7.2 Compression Bending Test

The failure stress of a welded corner or T-joint depends on the failure load, the profile geometry and the test arrangement (*see* Fig. 9 or Fig. 10). It shall be calculated by the following formula:

$$\sigma_c = F_c[(a/2) - e/\sqrt{2})/2W]$$

where

F_c = Compression bending failure load, expressed in N;

W = Moment of resistance in the loading direction (= I_x/e, expressed in mm^3);

I_x = Moment of inertia about the neutral axis ZZ' (see Fig. 10) of the cross section of the profile given by the manufacturer, expressed in mm^4; for T-joints with different profiles, the lower moment of inertia shall be used;

e = Distance between the critical point A and the neutral axis ZZ' (see Fig 10), expressed in mm;

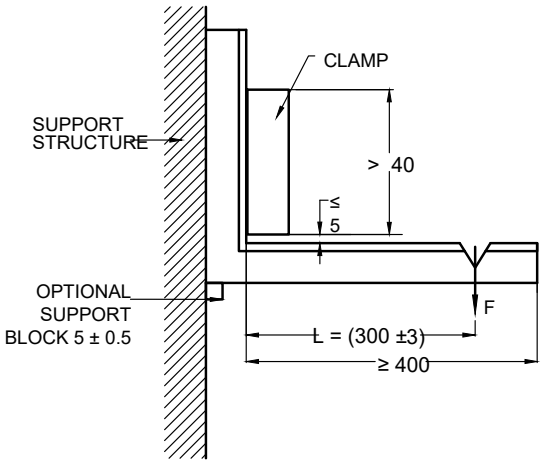
a = Distance between the axis of rotation of the carriages (= 400 ± 2 mm); and

σ_c = Failure stress by compression bending, expressed in N/mm^2.

F-8 TEST REPORT

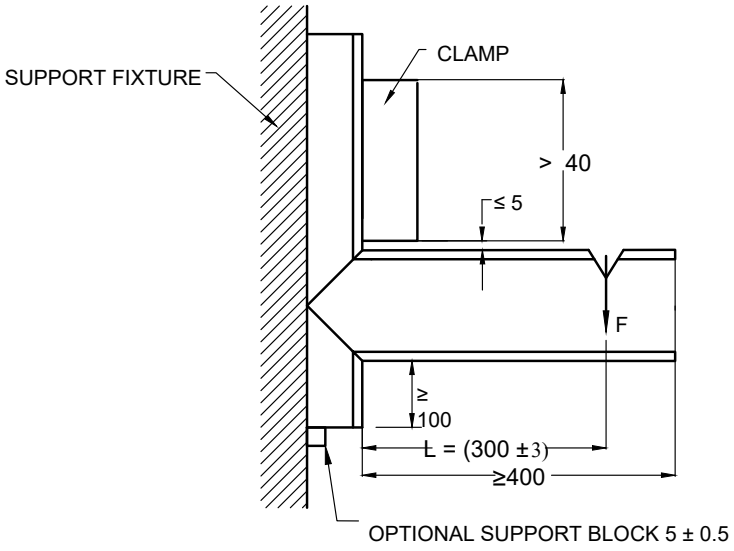
The test report shall include the following information:

a) Reference to this standard;
b) Identification of joint;
   1) Type of joint (corner or T joint);
   2) Presence or absence of welding sprue (bead); and
   3) If more than one welding head is in use, the nominated head;
c) The welding conditions – temperature, time and pressure applied;
d) The test method (tensile bending or compression bending);
e) For compression bending testing the inside length of the leg of the test specimen;
f) The failure load of every test specimen; and
g) The calculated failure stress for every test specimen and the average failure stress.



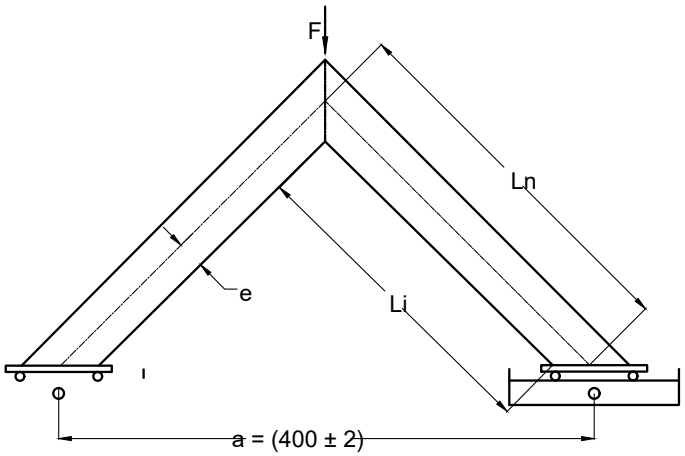
All dimensions in millimetres

FIG.7 EXAMPLE OF A TEST RIG FOR A TENSILE BENDING TEST OF CORNERS



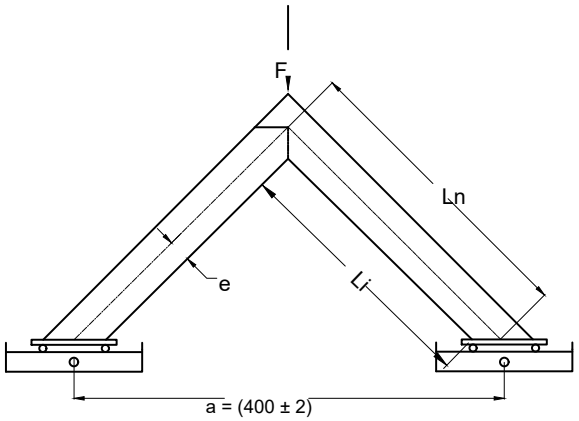
All dimensions in millimetres

FIG. 8 EXAMPLE OF A TEST RIG FOR A TENSILE BENDING TEST OF T JOINTS



All dimensions in millimetres

FIG. 9 EXAMPLE OF A TEST RIG FOR COMPRESSION BENDING TEST OF CORNERS JOINTS



All dimensions in millimetres

FIG. 10 EXAMPLE OF A TEST RIG FOR COMPRESSION BENDING TEST OF T JOINTS

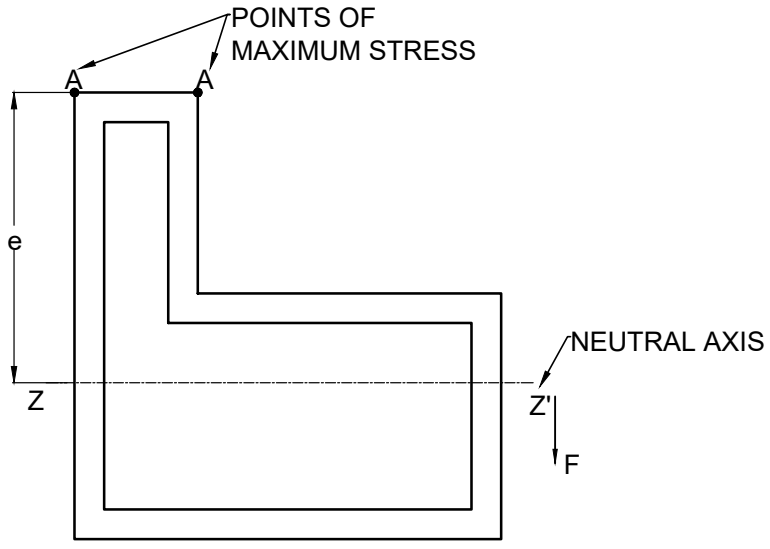


FIG. 11 POSITION OF POINT OF MAXIMUM BENDING STRESS

ANNEX G
(*Clause* 5.10)

DETERMINATION OF THE RESISTANCE TO ARTIFICIAL WEATHERING

G-1 GENERAL

This specifies a method for exposing test specimens from an uPVC profile for the fabrication of windows and doors to a xenon arc laboratory light source, in order to assess changes in impact strength and colour. The determination of changes in colour and variations of properties after exposure of profiles to xenon arc radiation is described in an informative **G-4** and **G-5**.

G-2 PRINCIPLE

Test specimens shall be taken from the sight visible surface of the uPVC profiles and exposed in a xenon arc artificial weathering apparatus at a specified irradiance, black and white standard temperatures, relative humidity and spray cycle. After specified radiation doses, the changes in charpy impact strength and colour of the test specimens are determined.

G-3 APPARATUS

The apparatus shall comply with IS 17863 (Part 1) and IS 17863 (Part 2) and shall include the following:

G-3.1 A Xenon Arc Source

In accordance with method A of IS 17863 (Part 2) with a spectral irradiance in the band pass of 300 nm to 800 nm of 550 ± 55 W/m^2 or a spectral irradiance in the band pass of 300 nm to 400 nm of 60 ± 2 W/m^2 or a spectral irradiance at 340 nm of 0.51 ± 0.02 W/m^2 nm.

G-3.2 Specimen Holder

In the form of an open frame, leaving the back of the specimen exposed according to **4.6** of IS 17863 (Part 2).

G-3.3 Spray Nozzles

To provide uniform and continuous wetting of the exposed test specimens for defined periods of time.

NOTE — The intention of the spraying is not to scour loosely bound solid material. It is important, therefore, that the combination of droplet size and velocity is chosen to minimize the removal of solid material.

G-3.4 A mechanism of providing controlled humidity at the defined level.

G-3.5 A mechanism of controlling air temperature within the test chamber.

G-3.6 A Black Standard Thermometer (BST)

In accordance with of **5.2.2** of IS 17863 (Part 1) and **6.2.1** of IS 17863 (Part 2) and a means of recording maximum temperatures during one cycle.

G-3.7 A White Standard Thermometer (WST)

In accordance with of **5.2.5** of IS 17863 (Part 1) and **6.2.1** of IS 17863 (Part 2) and a means of recording maximum temperatures during one cycle.

G-3.8 A Device to Determine the UV Radiant Exposure

Stated in **G-3.1** according to IS 17864.

G-4 DETERMINATION OF VISUAL CHANGE IN COLOUR

G-4.1 Test Specimens for Visual Change in Colour

For the assessment of the change in colour and visual evaluation, two test specimens of minimum dimensions 50 mm x 40 mm, one of which is an unexposed reference, shall be used. Before determination of visual change in colour and determination of colorimetric coordinates, test specimens shall be conditioned at 27 °C ± 5 °C for atleast 1 h prior to testing. Determine the difference in colour between the exposed test specimen and unexposed reference specimen not more than 24 h after removing the test specimen from the exposure chamber.

G-4.2 Grey Scale

The colour difference in terms of the grey scale shall be determined in accordance with either IS/ISO 105–A02 (day light or equivalent cabinet source; D65). The appearance is determined by viewing by normal or corrected vision at a range of 1 m, in 45° north day light perpendicular to the surface as specified in **14** and **15** of IS/ISO 105-A01 or with equivalent light of source.

G-4.3 Determination of Colorimetric Coordinates

The coordinates of the CIE 1976 L*a*b* colour space and the colour differences ΔE^*_{ab}, as below:

$$\Delta L^* = L^*_1 - L^*_0$$

$$\Delta a^* = a^*_1 - a^*_0$$

$$\Delta b^* = b^*_1 - b^*_0$$

$$\Delta E^*_{ab} = [\ (\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\ ]^{1/2}$$

where

L^* = CIE 1976 lightness (CIE LAB lightness);

a^*, b^* = CIELAB a^*, b^* coordinates;

ΔL^* = CIELAB lightness difference;

Δa^*, Δb^* = CIELAB a^*, b^* difference; and

ΔE^*_{ab} = CIELAB colour difference

Differences between two stimuli denoted by subscripts 0 (the reference sample) and 1 (the test sample) — values of L*,a*, b* shall be determined using with spectrophotometers. The spectral measuring range shall be at least 400 nm to 700 nm. The spectral step width and optical bandwidth shall be ≤ 20 nm (preferable 5 nm to 10 nm), with the following conditions:

a) Standard CIE illuminant D65, as per IS 11472 (Part-1) or equivalent;
b) Using observing fields of 2° or 10° angular subtense; and
c) Measurement including the specular reflection and the geometry di:8° (without gloss trap)

Record the colour difference, ΔL^*, Δa^*, Δb^* and ΔE^*_{ab} for every 1 000 h.

G-5 DETERMINATION OF CHARPY IMPACT STRENGTH

The Charpy impact strength shall be determined in accordance with IS 13360 (Part 5/Sec 5) with the conditions and parameters as follows. When the uPVC window profiles are tested, the pendulum energy shall be 1 J or 2 J.

G-5.1 Test Specimens

The test specimens shall be of length of 50 ± 1 mm, a width of 6 ± 0.2 mm and a thickness equal to the wall thickness of the sight visible surface of the uPVC profile. The residual width between the notches shall be 3 ± 0.1 mm. The support shall have a span of $40^{+0.5}_{-0}$ mm. The test specimens shall be conditioned at 27 ± 5 °C for at least 16 h. Test specimens from uPVC profiles for determination of change in charpy impact strength shall be prepared in two stages:

Stage 1 — Two series each of six test specimens with a length of 50 ± 1 mm, a width of 6 ± 0.2 mm and a thickness equal to the wall thickness of the sight visible surface of the uPVC profile are prepared for weathering or storage.

Stage 2 — After storage or weathering, all test specimens are notched with the same tool at the same time in accordance with IS 13360 (Part 5/ Sec 5) by using method designation 'ISO 179-1/1fA'. The residual width between the notches of 3 ± 0.1 mm.

Method designation 'ISO 179-1/1fC' may be referred with a residual width between the notched of 3 ± 0.1 mm (*see* **5.9**)

All test specimens shall be inspected for imperfections such as crazes in the machined surface. When the imperfections are found, those test specimens are discarded.

NOTE — Due to the possibility of discarding defective test specimens**,** it may be advisable to increase the initial number of test specimens in the light of particular experience.

Determine the charpy impact strength from both stages of test specimens in accordance to IS 13360 (Part 5/Sec 5) mounting the test specimens in such a way that the exposed surface is in tension during the test (the pendulum shall be directed to the inner surface).

Record the value in kilojoules per square meters (kJ/m^2).

Calculate for both stages, the mean charpy impact strength and the standard deviation in kilojoules per square meters (kJ/m^2). Calculate the difference between the mean values of charpy impact strength of the two stages as a percentage.

G-6 WEATHERING TEST CONDITIONS

The conditions shall be as given in Table 6.

Table 6 Weathering Conditions for Test
(*Clause* G-6)

Exposure Period	UV Irradiance		Black Standard Temperature (BST)	White Standard Temperature (WST)	Relative Humidity
	Broadband (300 nm to 400 nm)	Narrowband (340 nm)			
	W/m^2	W/m^2 nm	°C	°C	(Percent)
(1)	(2)	(3)	(4)	(5)	(6)
114 min, dry	60 ± 2	0.51 ± 0.02	65 ± 3	45 – 50	65 ± 10
6 min, water spray	60 ± 2	0.51 ± 0.02	-	-	-

NOTES

1 The air temperature and/or the air velocity in the test chamber shall be controlled to a constant value such that the BST and WST temperature equals the required values at the end of dry period.

2 Typical chamber temperature settings are below 38 °C depending on the instrument type.

G-7 PROCEDURE

Test specimens shall be placed in the specimen holders in accordance with **G-3.2**. Select the appropriate filter arrangement to achieve the spectral irradiance distribution in accordance with IS 17863 (Part 2), method A. Before placing the test specimen in the test chamber, be sure that the apparatus is operating under the test conditions. (*see* **G-6**). Expose the test specimens with surfaces exposed to UV radiation towards the xenon arc lamp, to the radiant exposure as specified.

During the exposure:

a) Control and record the air temperature in the test chamber;
b) Control and record the BST temperature; and
c) Monitor the WST temperature

At regular intervals check and record the irradiance in accordance with **G-3.1**. When the specified radiant exposure is reached according to **5.10**, stop the exposure. Take the specimens out of the specimen holder. Do not clean the test specimen, unless specified. Any deviation shall be noted in the test report. Prepare the test specimens and determine the changes in properties as specified in **G-4** and **G-5**.

G-8 TEST REPORT

The test report shall include the following information:

a) Reference to this Indian Standard;
b) Details of the specimen;
c) Period of testing;
d) Apparatus and testing conditions including
   1) Type of apparatus;
   2) Type of radiation source and filter system used;
e) Radiant exposure in gigajoules per square meter; and
f) Exposure time in hours.

ANNEX H
(*Foreword*)

COMMITTEE COMPOSITION

Doors, Windows and Shutters Sectional Committee, CED 11

Organization	*Representative(s)*
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