BUREAU OF INDIAN STANDARDS

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Draft Indian Standard

UPVC PROFILES FOR WINDOWS AND DOORS – SPECIFICATION

(ICS 91.060.50; 83.140.99)

Doors, Windows and Shutters Sectional Committee, CED 11	Last date of Comments 17 January 2022

FOREWORD

(*Formal clauses to be added later*)

Building materials industry is incorporating large options for users including the professionals. Window and door frames is one such area where the material options covered timber, mild steel, aluminum and sometimes concrete. Use of 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 that are needed to facilitate the manufacture of the profile and the production of sound and durable profile of good surface finish, mechanical strength and opacity under conditions of use are added.

As there is a demand on quality of UPVC profiles in our country, standardizing the same gains prominence. This draft standard has been prepared considering the raw material requirements and the final performance requirements of the UPVC profiles. This Indian standard covers the requirements and test methods for uncoated unplasticized polyvinyl chloride (UPVC) profiles with light coloured surfaces intended to be used for fabrication of windows and doors.

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 : 1960 Rules for rounding of numerical values (*revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft for Indian Standard

UPVC PROFILES FOR WINDOWS AND DOORS – SPECIFICATION

(ICS 91.060.50; 83.140.99)

1 SCOPE

This standard covers the requirements and test methods for non-coated unplasticized polyvinyl chloride (UPVC) profiles with light coloured surfaces intended to be used for fabrication of windows, doors and also their frames.

2 REFERENCES

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

3 TERMINOLOGY

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

NOTE - For editorial reasons in this document 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.

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 or decorative profile.

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

3.1.6 *Sight Surface* – Face surface of a profile that is seen from either side when the window is closed (*see* Fig. 1).

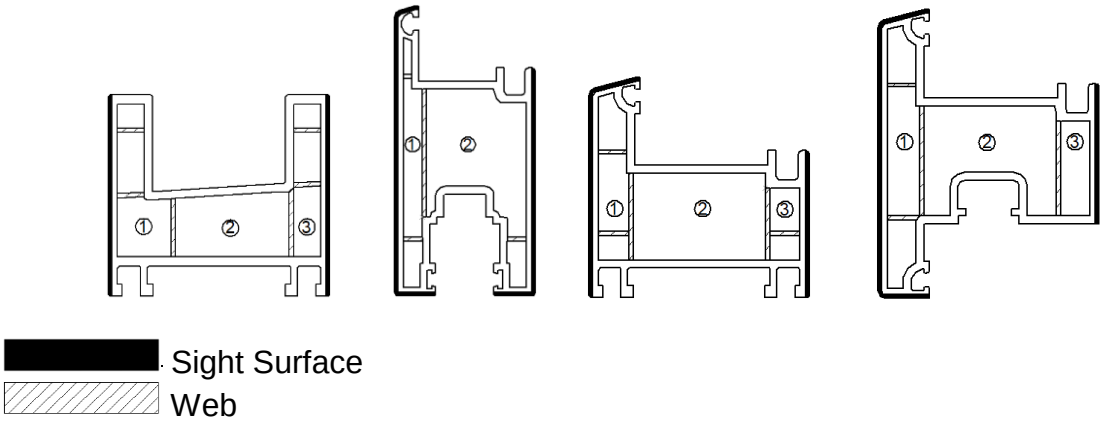


FIG. 1 SIGHT SURFACE, WEB AND CHAMBER

3.1.7 *Visible Surface* – Any surface or parts of surface of profile which can be exposed to UV radiation after installation of the window, open or closed (*see* Fig. 2).

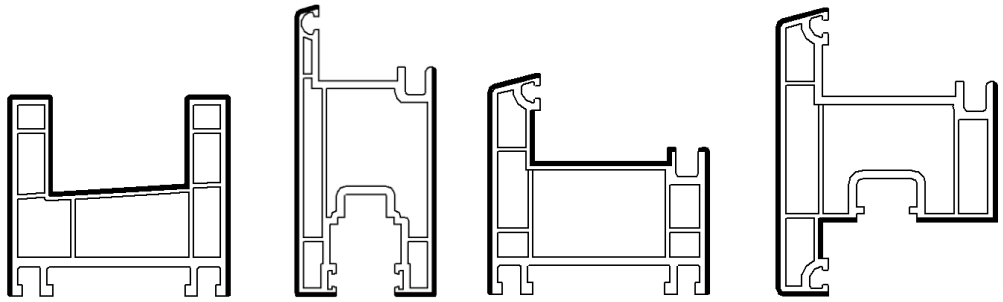


FIG. 2 VISIBLE SURFACE

3.1.8 *Co-Extruded UPVC Profile* – Profile produced by two or more feedstock in different areas of its cross section using co-extrusion technology.

3.1.9 *Co-Extruded Gasket Profile* – Profile combining rigid and flexible elements (such as glazing bead with co-extruded rubber gasket).

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

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

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. 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 surfaces with respect to each other.

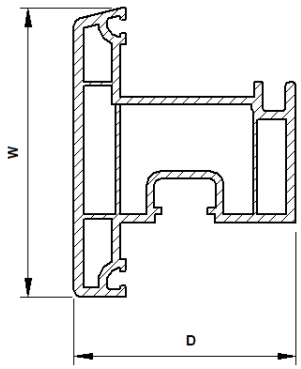


FIG. 3 SECTION OF A TYPICAL PROFILE

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 or 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 used or processed other than required for its manufacture and to which no reprocessed or recycled 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 *External Reprocessed Material*

3.3.6.1 *ERM_a* – Material free from contamination, prepared from pre-consumer uPVC profiles including off-cuts, which has been originally produced by other manufacturers than those carrying out the reprocessing.

3.3.6.2 *ERM_b* **–** Material prepared from pre-consumer uPVC profiles, regardless of where they were originally manufactured (for example, glazing beads with PVC coextrusion/gaskets, coated profiles).

3.3.7 *Recycled Material*

3.3.7.1 *RM_a* – Material prepared from post-consumer UPVC product, regardless of where they were originally manufactured (for example, glazing beads with PVC coextrusion/gaskets, coated profiles).

3.3.7.2 *RM_b* – Any material which is not defined in **3.3.3** to **3.3.7.1**

4 TESTS DEFINITION

4.1 Tests on Material Lot – Following tests shall be carried out on the profile of same raw material;

a) Material requirements,
b) Heat reversion,
c) Resistance to impact of falling mass
d) Heat ageing at 150 °C
e) Charpy impact resistance of main profile
f) Resistance to weathering, and
g) Density.

4.2 Tests on Profile Lot – Following tests shall be carried out on the same nominal profile shape:

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

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

4.4 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 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, mechanical strength and opacity under conditions of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic, 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*

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 *Reprocessed, Recycled 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 reprocessed, recycled and non UV resistant materials shall conform to Table 1;

b) Materials of types ERM_a, ERM_b or RM_a 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 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 ≤ 5 mm.

Table 1 Permitted use to of Reprocessed, Recycled and Non-UV Resistant Virgin Material

[*Clause* 5.1.3 (a)]

Sl No.	Application	Material					
		Own reprocessed material	Non UV-resistant virgin material	ERM[a]	ERM[b]	RM[a]	RM[b]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Monoextrusion or co-extrusion of a layer of any visible surface	Yes	No	No	No	No	No
ii)	Non-visible surface and material covered by co-extrusion	Yes	Yes	Yes	Yes* (*see* Note)	Yes* (*see* Note)	No
	NOTE – Materials as defined in **3.3** shall comply with the following requirement: A profile produced with this material shall fulfill below requirements, 1) when tested in accordance to Annex F, the strength of welded corners and T-joints of main profiles shall satisfy requirements of **5.8**. 2) when tested in accordance to Annex B, VST shall be ≥ 75°C and each single value shall be ≥ 73°C. 3) when tested in accordance to Annex B, the flexure modulus of elasticity shall be ≥ 2 200 N/mm^2 and each single value shall be ≥ 2 000 N/mm^2.						

5.2 Appearance

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:

a) L* ≥ 82 (chromaticity co-ordinate Y ≥ 60)
b) - 2.5 ≤ a* ≤ 5
c) - 5 ≤ b* ≤ 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 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

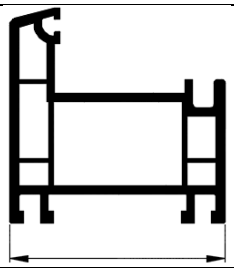
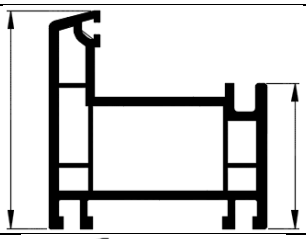
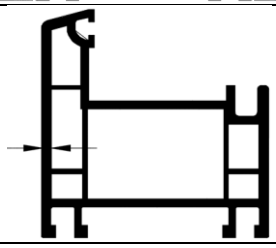
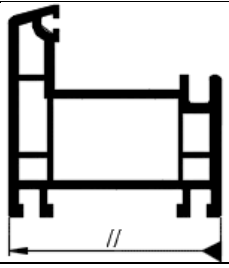
5.3.1 *Nominal* Shape

The cross section, perpendicular to longitudinal axis, shall conform to the nominal profile shape.

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 2 Tolerances on Dimensions
(*Clause* 5.3.1)

Sl No.	Dimension	Tolerance	Typical Illustration
(1)	(2)	(3)	(4)
i)	Depth (D) a) Less than or equal to 80 mm b) More than 80 mm	± 0.3 mm ± 0.5 mm	
ii)	Width (W)	± 0.5 mm	
iii)	Wall thickness	± 10 percent	
iv)	Sight surface flatness	0.3 mm, *max*	
v)	Parallelism	0.4 mm, *max*	

5.3.2 *Wall Thickness of Main* Profiles

The wall thickness of sight surfaces, when measured in accordance with **6.2**, shall be uniform and shall be declared by the manufacturer.

5.3.3 *Other* Dimensions

The other dimensions of profile other than thickness of sight surfaces and their tolerances shall be as declared by the manufacturer.

5.3.4 Straightness

The deviation from straightness 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 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 surfaces ≤ 0.4 percent.

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 surface.

For co-extruded profiles: Delamination of co-extruded layer shall be considered as a failure.

This test shall be applicable for main profiles only.

5.7 Heat Ageing at 150 °C

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 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 *For 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 *For 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 ≥ 30 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 IS 13360 (Part 5/Sec 5) – 1fa , the average Charpy impact strength of the profile shall conform to Table 3 for profile according to the wall thickness.

The test specimen shall be conditioned at (27 ± 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 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 ± 1 mm, a width of 6 ± 0.2 mm and a thickness equal to the wall thickness of the 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.

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

Sl No.	Type of Wall	Sight Surface Thickness	Non Sight Surface Thickness	Charpy Impact Strength Before Artificial Weathering kJ/m^2	Charpy Impact Strength After Artificial Weathering kJ/m^2	Maximum Impact of Reduction After Artificial Weathering
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)		≥ 2.8 mm	≥ 2.5 mm	≥ 55	≥ 33	40 *percent*
ii)		≥ 2.5 mm	≥ 2.0 mm	≥ 60	≥ 42	30 *percent*
iii)		< 2.5 mm	≥ 2.0 mm	≥ 65	≥ 52	20 *percent*

5.10 Resistance to Weathering

5.10.1 *Exposure Procedure*

Test specimens shall be taken from sight surfaces of the profiles and shall be exposed in accordance with Annex G 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.

A calculation method for the determination of the solar radiant exposure and exposure duration to be used is given in **5.10.2**

NOTE – For quality estimation purposes, the colour fastness results for time period 3 000 hours exposure can be referred for faster analysis. Values of ΔE* and Δ b* shall not be more than 50 percent of the values given in **5.10.3**

5.10.2 *Calculation for Determination of the Solar Radiant Exposure 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, it is necessary to consider not the total solar radiation energy as in **5.10.2.1**, but that part falling in the ultraviolet and visible regions between 300 nm to 800 nm. This 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 recommended radiation doses for the wavelength range between 300 nm to 800 nm are given in Table 4.

Table 4 Recommended 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 (in W/m^2) in the range 300 nm to 800 nm the exposure times are given in Table 5.

Table 5 Recommended 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)	(4)
i)	1 year equivalent	8.8 x 10^5 / I	1 600
ii)	2 year's equivalent	1.8 x 10^6 / I	3 300
iii)	5 year's equivalent	4.4 x 10^6 / I	8 000

where

I = 550 W/m^2,

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 recommended 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 the material (formulation), not for the profile.

5.10.3 *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 Δ b* shall be ≤ 3.

NOTE – The visual change in colour may 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 not be more than 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 a range 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 have an accuracy of 0.05 mm, for flatness shall have an accuracy of 0.01 mm and for the deviation from the straightness shall have an accuracy of 0.1 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 ± 1 mm and for measurement of dimensions the sample shall be 300 ± 5 mm. In case of dimension measurement on optical instruments, suitable size of specimen shall be taken for measurement of dimension.

6.2.3 *Conditioning*

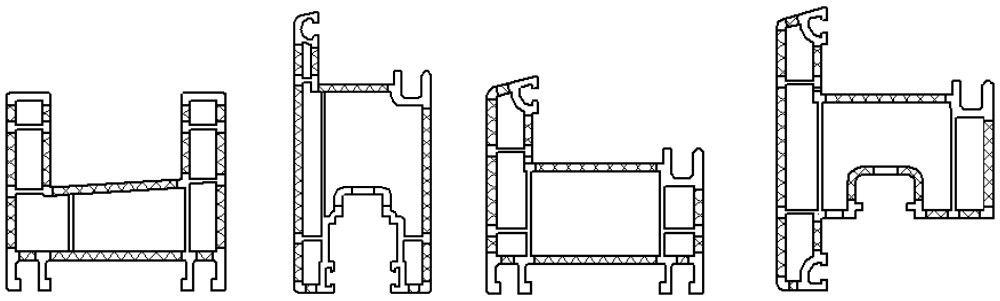
Condition the test specimen at (27± 5) °C for at least 1 h prior to testing.

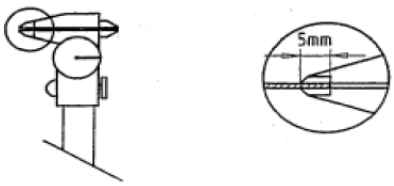
6.2.4 *Procedure*

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.





Detail measuring length

FIG. 4 AREAS OF WALL THICKNESS MEASUREMENT

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). Report the maximum gap observed between profile and flat surface.

6.3 Determination of Profile Mass

6.3.1 *Apparatus*

Balance with accuracy of 1 g. Use measuring device with an accuracy of 0.5 mm for the determination of the profile length.

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 ± 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 coordinates of the CIE 1976 L*a*b* colour space and the colour differences shall be determined in accordance to **G-4.3**.

NOTE - 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:

- $\Delta L^* \leq 1.0$
- $\Delta a^* \leq 0.5$
- $\Delta b^* \leq 0.8$
- $\Delta E^* \leq 1.0$

7 SAMPLING AND CRITERIA FOR CONFORMITY

7.1 Sampling

7.1.1 All UPVC Profiles manufactured from same raw material shall constitute a material lot.

7.1.2 All UPVC Profiles of same nominal profile shape and manufactured from same raw material shall constitute a profile lot.

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

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 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 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: RM_a.

7.2 BIS Certification Marking

7.2.1 Each profile or its packaging may also be suitably marked with the standard mark.

7.2.2 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 13360	Plastics – Methods of Testing:
(Part 3/Sec 10) : 2016	Part 3 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	Part 5 Mechanical Properties Sec 5 Determination of Charpy Impact Properties – Non-instrumented impact test
(Part 5/Sec 7) : 2017	Part 5 Mechanical Properties Section 7 Determination of Flexural Properties
(Part 6/Sec 1) : 2018	Part 3 Physical and Dimensional Properties Section 10 Determination of Density of Non-cellular Plastics - Immersion Method, Liquid Pyknometer Method and Titration 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
IS/ISO 105:Part A03	Textiles – Tests for colour fastness Part A03 Grey scale for assessing staining
IS/ ISO 4892-1:2016 (*under preparation*), Doc Number – PCD 27 (17726)	Plastics – Methods of exposure to laboratory light sources - Part 1 General guidance
IS/ ISO 4892-2:2013 (*under preparation*), Doc Number – PCD 27 (17727)	Plastics – Methods of exposure to laboratory light sources - Part 2 Xenon -arc sources
IS/ ISO 9370:2017 (*under preparation*), Doc Number – PCD 27 (17740)	Plastics – Instrumental determination of radiant exposure in weathering tests – General guidance and basic test method
IS/ ISO 8256:2004 (*under preparation*), Doc Number – PCD 27 (17730)	Plastics – Determination of tensile-impact strength

ANNEX B

(*Clauses* 5.1.1, 5.1.2 *and* Table 1)

MATERIAL CHARACTERISTICS, PREPARATION OF SAMPLES AND REQUIREMENTS

B-1 GENERAL

It describes a procedure to prepare samples from UPVC profiles or from granules or powder from virgin, reprocessed or recycled material for the determination of the characteristics and the requirements for those characteristics.

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.

For non-coextruded profiles, the test specimens shall be taken directly from the profiles or from pressed plates.

For coextruded profiles, the test specimens shall be taken from pressed plates made from materials separately or from profiles.

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.

For non-coextruded profiles the test specimens shall be taken directly from the profiles or from pressed plates

For coextruded profiles the test specimens shall be taken from pressed plates made from both materials separately or from profiles.

In case of dispute the test using pressed plates prepared according to **B-3** is the reference method.

B.3.3 Tensile impact strength

When tested at 27 ± 5 °C in accordance with IS/ISO 8256 (under preparation), 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.

For non-coextruded as well as coextruded profiles 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;
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

A test specimen of a specified length of profiles is maintained in an oven at 100 °C for 1 h. A marked length of this test specimen is measured under identical conditions, before and after heating the oven.

The heat reversion is calculated as the percentage change of the final length relative to the initial length per pair of marks.

For main profiles the differential heat reversion is calculated as the difference between the heat reversion of opposite sight surfaces of each test specimen.

C-3 APPARATUS

C-3.1 Air oven, thermostatically controlled, 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 and talc or stainless steel plate and talc.

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

C-4 TEST SPECIMEN

C-4.1 The test specimen shall be minimum length of 250 mm of profile.

C-4.2 Prepare three similar test specimens per length of profile.

C-5 CONDITIONING

Condition the test specimen for at least 1 h at room temperature.

C-6 PROCEDURE

C-6.1 Using a scriber or similar implement, trace on each test specimen two marks, perpendicular to the profiles axis, 200 mm apart, so that one of them is approximately 25 mm from one end of the test specimen.

C-6.2 Measure for every test specimen at room temperature, the distance between the two marks in one pair with an accuracy of 0.1 mm.

C-6.3 Set the oven temperature to 100 °C.

C-6.4 When the oven has reaches 100 °C, place the test specimen horizontally in the oven on a glass or steel plate sprinkled with talc.

C-6.5 Maintain the test specimen in the oven for 60^{+3}_{-0} min, after the temperature has regained to 100 °C.

C-6.6 Remove the glass or steel plate with the test specimen from the oven and let them cool down in air to room temperature. Under identical conditions to those used in **6.2**, measure the distance between the two marks per pair.

C-6.7 In cases of dispute, the cooling of the profiles and the measuring of the distance between the marks shall be performed at 23 ± 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

$$R = \frac{\Delta L}{L_o} \times 100$$

where

$$\Delta L = L_o - L_1;$$

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 profiles, take as the heat reversion *R* the value for each sight surface for each test specimen.

For the profiles take as the differential heat reversion *ΔR* the difference between the heat reversions of opposite sight of each test specimen.

C-8 TEST REPORT

The test report shall include the following information:

a) Reference to this Indian Standard;
b) Full identification of the profile;
c) The date of testing;

d) The distance between the marks before heating in the oven (L_o) for each pair of marks of each test specimen.
e) The distance between the marks after heating in the oven (L_1) for each pair of marks of each test specimen;
f) 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 cut from length of main profiles are subject to blow from a mass falling from a known height on the sight 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 incorporating the following basic components (*see* Fig. 5) shall be used:

a) **Main Frames** – Rigidly fixed in the vertical position;
b) **Guide Rails –** Fixed to main frame to accommodate the falling mass and allowing it to fall freely in the vertical plane;
c) **Test Specimen Support –** Consisting of a rounded off support with a distance between 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;
d) **Release Mechanism –** Such that the falling mass shall fall through a minimum 1000 mm height, measured from the top surface of the test specimen to be tested;
e) **Falling Mass** – 1 000 ± 5 gm. This has a hemispherical striking surface of 25 ± 0.5 mm radius. The striking surface shall be free from all imperfections.

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 surface of the main profile (preferably on the sight surface which is designed to be exposed to the weather). Drop the falling mass from a given height given in **D-2** 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 should 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 should be prevented, by attaching additional stays to the two supports.

3 During the test, care should 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) Profile identification code;
c) Date of testing;
d) Number of test specimen tested; and
e) Number of test specimen broken.

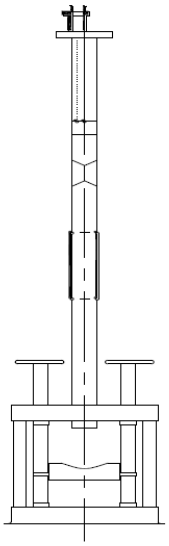


FIG. 5 TYPICAL IMPACT TEST APPARATUS

ANNEX E
(*Clause* 5.7)

METHOD OF TEST FOR HEAT AGING BEHAVIOR AT 150 °C

E-1 PRINCIPLE

A test specimen of a specified length of profile is maintained in an oven or liquid bath at 150 °C for 30 min and is inspected 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, with air circulation, in which the test specimens can be exposed to a temperature of 150 °C. The oven shall be equipped with a thermostat capable of maintaining 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, in which the test specimens can be exposed to a temperature of 150 °C. The capacity of the bath shall be such that after insertion of the test specimen, the test temperature shall 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 shall be as given under.

E-3.1 For testing in oven, a minimum length of 200 mm profile shall be used.

E-3.2 For testing in liquid bath, a minimum length of 300 mm of profile shall be used.

E-4 PROCEDURE

E-4.1 Oven Method

E-4.1.1 Set the oven temperature to 150 °C.

E-4.1.2 When the oven has reached 150 °C, place the test specimen horizontally in oven.

E-4.1.3 Maintain the test specimen in the oven for 30^{+3}_{-0} min, measuring from the time when the oven temp has returned to 150 °C

E.4.1.4 Remove the test specimen from the oven, taking care not to distort or otherwise damage it.

E-4.1.5 Allow the test specimen to cool in air. 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.

E-4.2.2 When the liquid bath has reached 150 °C, hang the test specimen 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.

E-4.2.3 Keep the test specimens in the liquid bath for 30^{+3}_{-0} min - 0min, measuring from the time when the liquid bath temperature has returned to 150 °C.

E-4.2.4 Remove the test specimen from the bath, taking care not to distort or otherwise damage it.

E-4.2.5 Allow the test specimen to cool in air. 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 noted.

When tested with surface covered profiles shall show no bubbles between the acrylic layer and the foil of more than 1 mm cracks, surface irregularities or delamination.

NOTE – There is no requirement for the flexible element of rigid and flexible co-extrusion. 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) Profile identification code;
c) Date of testing;
d) Apparatus used and, for the liquid bath method, the type of liquid; and
e) 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 unplasticized poly vinyl chloride (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) Measuring range of load : 2 000 N to 20 000 N;
b) Load indication with zero point setting and peak recording;
c) Measurement accuracy : ± 3 percent; and
d) Test speed: 50 ± 5 mm/min

F-2.2 Test Arrangement

a) Corner weld sample for tensile bending test (*see* Fig 6)
b) T joint weld samples for tensile bending test (*see* Fig 7)
c) Corner weld sample for compression bending test (*see* Fig 8)
d) T joint weld samples for compression bending test (*see* Fig 9)

F-3 TEST SPECIMEN

F-3.1 Welding of Corner Test Specimen

The test specimen is a welded corner with as angle of 90 ± 1 °C. Two lengths of profile cut at 45° are heat welded.

F-3.2 Welding of T Joint Test Specimen

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

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

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

where

w = width of transom profile, and
s = welded head stroke.

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. 7).

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. 6).

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. 7).

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 axes of the end sections are located vertically over the axes of rotation of the carriage (approximately the middle of the main chamber of the profile (*see* Fig. 8). 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 = the length of the neutral axis of the profile in mm
e = the 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 9).

F-4 NUMBER OF TEST SPECIMEN

A minimum of three samples per profile type, all made on the same welder 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) Clamp the test specimen in the apparatus as shown in Fig. 6 or Fig. 7. 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 per min.
c) Continue until the test specimen fails.
d) 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. 8 or Fig. 9. 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 per min.
c) Continue until the test specimen fails.
d) 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. 6 or Fig. 7). It is 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 in the loading direction
= I/e, expressed in mm^3;
σ_t 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. 7 or Fig. 8). It is calculated by the 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/e, expressed in mm^3;
I = Moment of inertia about the neutral axis ZZ' (see Fig. 9) 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 9), expressed in mm;

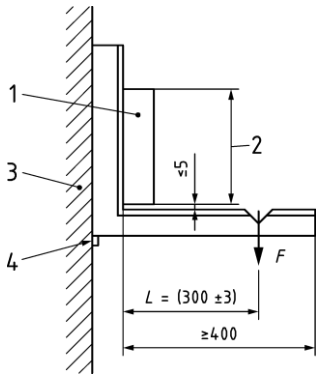
a = Distance between the axis of rotation of the carriages = 400 ± 2 mm;

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/Annex ;
b) The name of test laboratory;
c) Profile identification code;
d) Identification of joint;
   1 Type of joint (corner or T joint);
   2 Presence or absence of welding sprue (bead);
   3 If more than one welding head is in use, the nominated head;
e) Date of testing;
f) The welding conditions;
g) The test method (tensile bending or compression bending);
h) For compression bending testing the inside length of the leg of the test specimen;
j) The test temperature;
k) The failure load of every test specimen;
m) The calculated failure stress for every test specimen and the average failure stress.



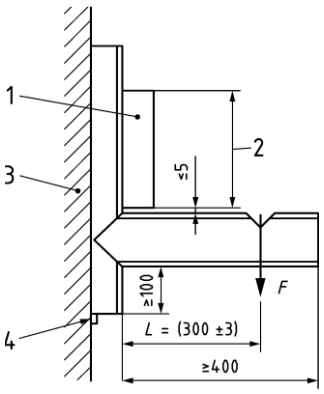
ALL DIMENSIONS IN MILLIMETRES

KEY

1 – Clamping device
2 – Rigid support over a minimum clamping length of 400 mm
3 – Frame
4 – Optional support block 5 ± 0.5 mm
L – Distance between the corner in the highest flange and the point of application of the load
F – Load applied on the profile

FIG.6 EXAMPLE OF A TEST RIG FOR A TENSILE BENDING

TEST OF CORNERS

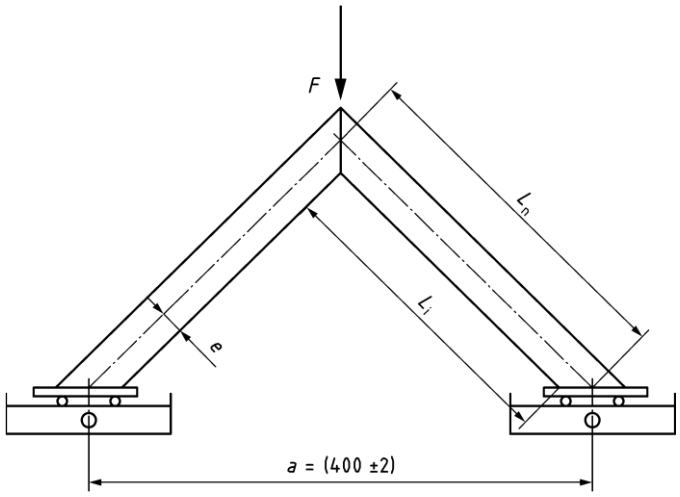


ALL DIMENSIONS IN MILLIMETRES

KEY

1 – Clamping device
2 – Rigid support over a minimum clamping length of 400 mm
3 – Frame
4 – Optional support block (5 ± 0.5) mm
L – Distance between the corner in the highest flange and the point of application of the load
F – Load applied on the profile

FIG. 7 EXAMPLE OF A TEST RIG FOR A TENSILE BENDING TEST OF T JOINTS

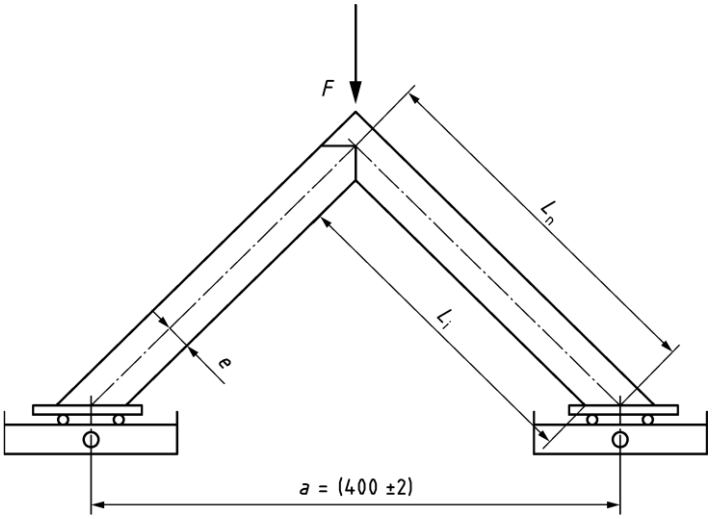


ALL DIMENSIONS IN MILLIMETRES

KEY

L_i – Inside length of the legs
L_n– Length of the neutral axis of the profile
e – Distance between the inside of the section and the neutral axis
a – Distance between the axis of rotation of the carriages
F – Load applied on the corner

FIG. 8 EXAMPLE OF A TEST RIG FOR COMPRESSION BENDING TEST OF CORNERS JOINTS

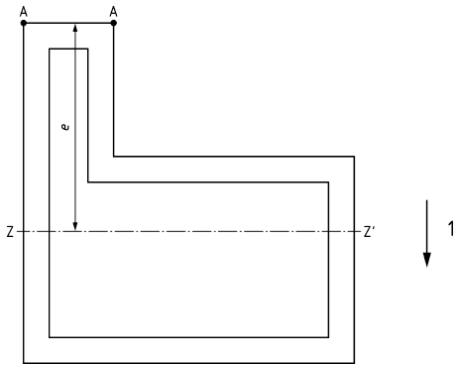


ALL DIMENSIONS IN MILLIMETRES

KEY

L_i – Inside length of the legs
L_n – Length of the neutral axis of the profile
e – Distance between the inside of the section and the neutral axis
a – Distance between the axis of rotation of the carriages
F – Load applied on the corner

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



KEY

1 – Direction of loading
A – Points of maximum stress
E – Distance between the critical point A and the neutral axis ZZ'
ZZ' – neutral axis

FIG. 10 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 unplasticized polyvinylchloride (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 taken from the sight surface of the profiles, submitted to weathering in practice, are 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/ ISO 4892-1 (*under preparation*) and IS/ ISO 4892-2 (*under preparation*) and shall include the following.

G-3.1 A Xenon Arc Source **–** In accordance with method A of IS/ ISO 4892-2 (*under preparation*) 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 340nm of 0.51 ± 0.02 W/m^2 nm.

G-3.2 Specimen Holder **–** In the form an open frame, leaving the back of the specimen exposed according to **4.6** of IS/ISO 4892-2 (*under preparation*).

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 means of providing controlled humidity at the defined level.

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

G-3.6 A Black Standard Thermometer (BST) – In accordance with of IS/ ISO 4892-1 (*under preparation*), **5.2** and IS/ISO 4892-1 (*under preparation*), **6.21** and a means of recording maximum temperatures during one cycle.

G-3.7 A White Standard Thermometer (WST) – In accordance with of IS/ISO 4892-1 (*under preparation*), **5.2** and IS/ISO 4892-1 (*under preparation*), **6.21** 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/ISO 9370 (*under preparation*).

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, one of which is an unexposed reference, of dimensions minimum 50 mm x 40 mm shall be used.

Before determination of visual change in colour and determination of colorimetric coordinates, test specimens shall be conditioned at 27 ± 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 or IS/ ISO 105 – A03 (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

$\Delta a^*, \Delta b^*$ = CIELAB a*, b* difference
ΔE^*_{ab} CIELAB colour difference

Differences between two stimuli denoted by subscripts 0 (usually the reference sample) and 1 (usually 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 -1 or equivalent;
b) Using observing fields of 2° or 10° angular subtense,
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 1000.

G-7 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 1J or 2J.

G-6.1 Test Specimens

The test specimens shall have a length of 50 ± 1 mm, a width of 6 ± 0.2 mm and a thickness equal to the wall thickness of the 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 profiles for determination of change in Charpy impact strength are prepared I 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 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 IS 13360 (Part 5/Sec 5)/1fA. The residual width between the notches of 3 ± 0.1 mm.

Method designation as per IS 13360 (Part 5/Sec 5)/1fC may be referred with a residual width between the notched of 3 ± 0.1 mm (refer **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 of both series of test specimens in accordance to IS 13360 (Part 5/Sec 5) mounting the test specimens in such a way that the exposed surfaces in 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 series 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 series as a percentage.

G-6 WEATHERING TEST CONDITIONS

The conditions shall be given below.

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

Put the test specimens 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/ ISO 4892-2 (*under preparation*), method A.

Before placing the test specimen in the test chamber, be sure that the apparatus is operating under the desired 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
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 the referring standard, stop the exposure.

Take the specimens out of the specimen holder.

Do not clean the test specimen, unless specified otherwise by the referring standard. 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) Full identification of the profile;
c) Period of testing;
d) Apparatus and testing conditions including
    1) Type of apparatus;
    2) Type of radiation source and filter system used;
    3) BST temperature set values with tolerances during exposure;
    4) WST temperature range during exposure;
    5) Relative humidity in the test chamber;
e) Air temperature in the test chamber;
f) Spray cycle used (114 min dry/6 min water spray);
g) Radiant exposure in gigajoules per square meter (GJ/m^2);
j) Exposure time in hour (h).