

Unplasticized polyvinyl chloride (PVC-U) profiles for windows and doors — Specification

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Committees responsible for this British Standard

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British Wood Preserving and Damp-proofing Association
British Woodworking Federation
Centre for Window and Cladding Technology
Construction Fixings Association
Consumer Policy Committee of BSI
Council for Aluminium in Building
Flat Glass Manufacturers' Association
Glass and Glazing Federation
Guild of Architectural Ironmongers
Health and Safety Executive
LHC Building Components and Services
NHBC National House-building Council
Royal Institute of British Architects
Security Facilities Executive
Society of Chief Architects of Local Authorities
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Foreword

This British Standard has been prepared by Subcommittee B/538/1. It is a revision of BS 7413:1991, which is withdrawn.

This edition of the standard has been produced to update various test methods and offer guidance on evaluation of conformity and durability and recycling.

The requirements for plastics windows made from unplasticized polyvinyl chloride (PVC-U) extruded hollow profiles are specified in BS 7412.

Methods of test are given in Annex A, Annex B, Annex C, Annex D, Annex E, Annex F, Annex G, Annex H, Annex I, and Annex J, which are normative.

Guidance on evaluation of conformity is given in Annex K, which is informative.

Information on durability and recycling is given in Annex L, which is informative.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 23 and a back cover.

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1 Scope

This British Standard specifies requirements for the raw materials and properties of unused white or near-white PVC-U profiles or co-extruded profiles for windows and doors up to the point of fabrication of the profiles into windows, provided the profiles have been stored in accordance with the system's suppliers recommendations.

This standard applies to profiles with exposed surfaces in the colour range $L^* \geq 82$ (chromaticity co-ordinate $Y \geq 60$), $-2.5 \leq a^* \leq 5$, and $-5 \leq b^* \leq 15$ when determined in accordance with BS 3900-D8, -D9 and -D10 (ISO 7724) and under the following conditions:

- a) BS ISO 10526:1999/CIE S005/E-1998 illuminant D65 including specular reflectance;
- b) measuring condition 8/d or d/8 (without gloss trap).

This standard does not apply to cellular plastics (PVC-UE) profiles, acrylic capped or painted profiles.

NOTE Plastics windows made from PVC-U extruded hollow profiles are specified in BS 7412. Plastics doors made from PVC-U extruded hollow profiles are specified in PAS 23-1.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 817, *Specification for surface plates*.

BS 869, *Specification for toolmakers' flats and high precision surface plates*.

BS 2782-1:Method 130A, *Methods of testing plastics — Part 1: Thermal properties — Determination of the thermal stability of polyvinyl chloride by the Congo red method*.
[ISO 182-1]

BS 2782-3:Methods 320A to 320F, *Methods of testing plastics — Part 3: Methods 320A to 320F: Mechanical properties — Tensile strength, elongation and elastic modulus*.

BS 3900-D8, *Methods of test for paints — Part D8: Optical tests on paint films — Determination of colour and colour difference: principles*.
[ISO 7724-1]

BS 3900-D9, *Methods of test for paints — Part D9: Optical tests on paint films — Determination of colour and colour difference: measurement*.
[ISO 7724-2]

BS 3900-D10, *Methods of test for paints — Part D10: Determination of colour and colour difference: calculation*.
[ISO 7724-3]

BS 6100-1.3.5, *Glossary of building and civil engineering terms — Part 1: General and miscellaneous — Section 1.3: Parts of construction works — Subsection 1.3.5: Doors, windows and openings*.

BS 6100-1.5.1, *Glossary of building and civil engineering terms — Part 1: General and miscellaneous — Section 1.5: Operations; associated plant and equipment — Subsection 1.5.1: Co-ordination of dimensions; tolerances and accuracy*.

BS EN ISO 105-A01:1996, *Textiles — Tests for colour fastness — Part A01: General principles of testing*.

BS EN ISO 178 (BS 2782-3:Method 335A), *Plastics — Determination of flexural properties*.

BS EN ISO 179:1997, *Plastics — Determination of Charpy impact strength*.

BS EN ISO 179-2 (BS 2782-3:Method 359B), *Plastics — Determination of Charpy impact properties — Part 2: Instrumented impact test*.

BS EN ISO 306 (BS 2782-1:Methods 120A, 120B, 120D and 120E), *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*.

BS EN ISO 1163-2, *Plastics — Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*.

BS EN ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources*.
BS ISO 10526:1999/CIE S005/E-1998, *CIE Standard illuminants for colorimetry*.

3 Terms and definitions

For the purposes of this British Standard the terms and definitions given in BS 6100-1.3.5 and BS 6100-1.5.1 and the following apply.

3.1

batch

known amount of material of consistent constituents

NOTE When the feedstock alters significantly, this signifies the end of a batch and the start of a new one.

3.2

die line

continuous longitudinal mark on the external faces of a profile that originates during extrusion

3.3

co-extruded profile

3.3.1

co-extruded main profile

profile which consists of two or more feedstocks in different areas of its cross-section

3.3.2

co-extruded rigid and flexible profile

profile combining flexible and rigid elements, e.g. a glazing bead with a co-extruded glazing gasket

3.4

post calibration co-extruded profile (PCE)

system of co-extrusion in which the flexible element is fused to the rigid element after calibration and cooling of the rigid element

NOTE The fusion may be either full fusion or partial fusion.

3.5

full fusion

fusion of a post calibration co-extrusion where the fusion is not designed to be separated

3.6

partial fusion

fusion of a post calibration co-extruded profile where the fusion is designed to be separated by manual tension

3.7

own reprocessable material

material of defined formulation, free from contamination and degradation, prepared from unused PVC-U profiles, including offcuts, which is to be reprocessed in the same factory in which it was previously extruded

NOTE Own reprocessable material includes unused products, such as mis-measured windows, incorporating the same material as that to be processed, but excludes items such as gasket materials and surface covered profiles.

3.8

external reprocessable material (ERM_a)

material free from contamination and degradation, prepared from unused PVC-U window or door profiles, including offcuts, which has been processed by a manufacturer other than that carrying out the reprocessing

NOTE 1 Material prepared from PVC-U products other than window or door profiles, or a mixture of PVC-U products with PVC-U window or door profiles, regardless of where they were originally manufactured is not covered by this definition and cannot be used.

NOTE 2 Co-extruded rigid and flexible profiles and surface covered profiles may be used in external reprocessable material.

3.9**recyclable material (RM_a)**

material prepared from used PVC-U window or door profiles which is free from contamination

NOTE 1 Material prepared from used PVC-U products other than window or door profiles, or a mixture of PVC-U products with PVC-U window or door profiles is not covered by this definition and cannot be used.

NOTE 2 Co-extruded rigid/flexible profiles and surface covered profiles may be used in recyclable material.

3.10**surface separation**

surface delamination separation of the external surface layer from the core of a co-extruded profile

3.11**sight surface**

surface of a profile that is exposed to view when the window is closed

3.12**visible surface**

any surface of a profile visible after installation with any opening lights open or shut

3.13**profile**

length of extruded material of defined cross-section

3.14**sink mark**

depression on the surface of an extrusion

3.15**main profile**

profile that forms the main structure of the window, i.e. frame, mullion/transom, opening light and sub-sill

3.16**ancillary profile**

glazing bead or other profile which is essential to the function of the window but does not form the main structure

3.17**perimeter wall**

that part of the profile forming the substantial part of the outer perimeter

NOTE The perimeter wall excludes features such as gasket retention grooves and glazing bead retention nibs, but includes fittings retention grooves.

3.18**virgin material**

material of defined formulation, in powder or granular form, which has not been used or processed other than for its manufacture and to which no reprocessable or recyclable material has been added

4 Raw materials**4.1 Composition**

Profiles shall be made from materials consisting substantially of unplasticized polyvinyl chloride (PVC-U) including own reprocessable material, external reprocessable material (ERM_a), recyclable material (RM_a) and virgin material.

When materials ERM_a and RM_a are used they shall be used as the core of a co-extrusion where all visible surfaces are completely covered by a layer of minimum thickness 0.5 mm of virgin or own reprocessable material.

4.2 Physical properties

Unweathered PVC-U material from which profiles are made shall conform to the requirements in Table 1 when tested in accordance with the test methods in Table 1.

Tests shall be carried out on samples cut from the visible surfaces of extruded profiles except for the apparent modulus of elasticity test for which samples shall be tested on pressed plaques prepared from milled sheet under the conditions specified in BS EN ISO 1163-2.

Core material of a co-extruded profile shall be tested on pressed plaques for the following tests from Table 1:

- softening point;
- Charpy impact strength;
- apparent modulus of elasticity;
- heat stability.

Samples shall be selected from a single face of a single profile selected at random. The Charpy test to be used shall be based on the actual wall thickness of the sample selected.

Table 1 — Physical properties of PVC-U material

Property	Test method	Minimum value
Softening point	BS EN ISO 306 (BS 2782-1:Method 120B)	75 °C
Apparent modulus of elasticity	BS EN ISO 178 (BS 2782-3:Method 335A) (Rate of strain 5 mm/min)	2 200 MPa
Colour fastness	Annex A	$\Delta E^* \leq 5$
Tensile yield stress at 23 °C	BS 2782-3:Method 320C (Rate of strain 5 mm/min)	38 MPa
Heat stability ^a	BS 2782-1:Method 130A	85 min
Charpy impact strength ^b (Wall thickness >2.60 mm)	Annex B (see BS EN ISO 179)	12 kJ/m ²
Charpy impact strength ^b (Wall thickness ≤ 2.60 mm)	BS EN ISO 179	60 kJ/m ²
Retention of Charpy impact strength after artificial ageing	Annex C	70 % of original value
^a This test is not suitable for all materials but it represents the best current knowledge available. ^b The Charpy impact strength test is selected based on the thickness of the sample submitted and not on the nominal wall thickness.		

5 Profile properties

5.1 General

All profiles shall be tested in accordance with the testing schedule in Table 2 and shall conform to the requirements of 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8 and 5.9.

Table 2 — Schedule of testing

Test	Main profiles	Glazing and beads including co-extruded PCE	Other ancillary profiles	Co-extruded main profiles
Appearance and finish	Y	Y	Y	Y
Manufacturing tolerances	Y	Y	Y	Y
Heat reversion	Y	Y	Y	Y
Impact resistance at low temperature	Y	—	—	Y
Heat ageing	Y	Y	Y	Y
Weldability	Y	—	—	Y
Tear resistance	Co-extruded rigid and flexible profiles only	Co-extruded rigid and flexible profiles only	Co-extruded rigid and flexible profiles only	Co-extruded rigid and flexible profiles only
Profile marking	Y	—	—	Y

5.2 Storage of test samples

All samples shall be stored at 20 ± 5 °C.

5.3 Appearance and finish

The colour of profiles shall be uniform when viewed by normal or corrected vision at a range of 1 m, in 45° north sky light viewing perpendicular to the surface in accordance with BS EN ISO 105-A01:1996, clause 14. Sight surfaces of profiles shall be free from foreign bodies, cracks, sink marks or die lines when similarly viewed.

The total colour difference (ΔE^*), determined in accordance with BS 3900-D8, -D9 and -D10, between any profile and the manufacturer's stated reference colour shall not exceed the manufacturer's declared value.

5.4 Manufacturing tolerances

5.4.1 When measured in accordance with Annex D, main profiles shall be straight such that the longitudinal axis of the profile deviates from the straight line by not more than 2 mm/2 m over any 2 m length. The cross-section of the profile shall be in accordance with Table 3.

5.4.2 Tolerances on dimensions, perimeter wall thickness and surface flatness shall be in accordance with Table 3 when tested in accordance with Annex E.

5.4.3 If internal webs are present they shall be controlled so that reinforcement can be fitted without prior machining of the webs and so that the integrity of the drainage chamber is not breached. The integrity of the drainage chamber shall be confirmed by visual inspection.

5.5 Heat reversion

When tested in accordance with Annex F, none of the samples tested shall have a mean reversion greater than 2 %. Individual sight surfaces of each sample shall not differ from each other by more than 0.4 %.

Ancillary profiles shall be tested in accordance with Annex F. The maximum reversion shall be not more than 3 %.

NOTE There is no requirement for differences between individual surfaces.

When co-extruded main profiles are tested in accordance with Annex F there shall be no surface separation.

5.6 Impact resistance at low temperature

When main profiles are tested in accordance with Annex G, no sample shall exhibit cracking through the entire wall thickness of the profile.

Ten samples per main profile shall be tested (five samples being used for each sight surface) and there shall be no failures. Five samples per sub-sill profile shall be tested on the upper sight surface and there shall be no failures.

In addition, for co-extruded main profiles there shall be no surface separation.