British Standard

BRITISH STANDARD

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12814-1:2000

Testing of welded joints of thermoplastics semi-finished products —

Part 1: Bend test

The European Standard EN 12814-1:1999 has the status of a British Standard

ICS 25.160.40

National foreword

This British Standard is the English language version of EN 12814-1:1999.

The UK participation in its preparation was entrusted to Technical Committee PRI/80, Welding thermoplastics, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 15 and a back cover.

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Essai des assemblages soudés sur produits semi-finis thermoplastiques - Partie 1: Essais de pliage

Prüfen von Schweißverbindungen aus thermoplastischen Kunststoffen - Teil 1: Biegeversuch

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EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 249, Plastics, the Secretariat of which is held by IBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2000, and conflicting national standards shall be withdrawn at the latest by May 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies the dimensions and the method for sampling and preparing test specimens, together with the conditions for carrying out the bend test.

The result of the test is also influenced by the deformation behaviour of the tested material, the kind of welding process and the geometry of the sample.

The test is applicable to plate and tube butt jointed assemblies made from thermoplastic materials filled or unfilled, but not reinforced, irrespective of the welding process used. It is not applicable to assemblies with a wall thickness < 3 mm.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 2768-1	General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications
ISO 2818	Plastics - Preparation of test specimens by machining
ISO 5893	Rubber and plastics test equipment - Tensile, flexural and compression types (constant rate of traverse) - Description

3 Terms and definitions

For the purposes of this European Standard, the following definitions apply:

3.1
face bend

the face corresponding to the open side of the groove is subjected to extension.

3.2
root bend

the face corresponding to the root of the weld is subjected to extension.

3.3
side bend

one of the faces of the test specimen corresponding to the cross section of the weld is subjected to extension.

3.4
initial angle "α_i"

angle between the two sides of the test specimen above the rollers before the test.

3.5
final angle "α_f"

angle between the two sides of the test specimen above the rollers when the test is terminated.

3.6
bend angle "α"

angle calculated from the difference between the initial angle and final angle.

4 Symbols and designations

Symbols and designations are given in Table 1.

Table 1 - Symbols and designations

Symbols	Designation	Units
a	Thickness of test piece	millimetre
b	Width of test specimen	millimetre
d	Diameter of ram end	millimetre
D	Diameter of rollers	millimetre
D_a	Distance between axes of rollers	millimetre
D_n	Nominal outside diameter of tube	millimetre
H	Ram displacement	millimetre
H_o	Initial ram position	millimetre
H_f	Final ram position	millimetre
L	Length of test specimen	millimetre
α_i	Initial angle	Degree
α_f	Final angle	Degree
α	Bend angle	Degree

5 Principle of the test

A bend test may be used in conjunction with other tests (e.g. tensile, tensile creep, macrographic, ...), to assess the performance of butt jointed assemblies, made from thermoplastics materials [1)].

The test consists of subjecting a test specimen to deformation by bending at a constant speed without reversing the direction of bending during the test.

The bend angle (ram displacement) and fracture appearance provide a guide to the ductility of a welded joint and hence the weld quality [2)].

The final angle, α_f, (final ram position) is taken when either fracture occurs, a crack is visible with the naked eye or a maximum load is reached [3)]. If no crack occurs the test is terminated at either a bend angle of 160° or at a ram displacement given in Table 2.

[1)] The test may also be used to optimize welding conditions. In this case it is acceptable to use non standard test conditions: for example to decrease the test temperature or increase the speed of bending.

[2)] Simple manual test is described in annex A (informative).

[3)] The maximum load may not correlate with the failing of the welded sample.

Table 2 - Ram displacements corresponding to the bend angle of 160°

Dimensions in millimetres

Thickness of test specimens	Ram displacement
$3 < a \leq 5$	60
$5 < a \leq 15$	70
$15 < a \leq 20$	85
$20 < a \leq 25$	170
$25 < a \leq 30$	150

The bend angle and the ram displacement are determined as described in Figures 1a and 1b.

$\alpha = \alpha_i - \alpha_f$ and $H = H_f - H_o$

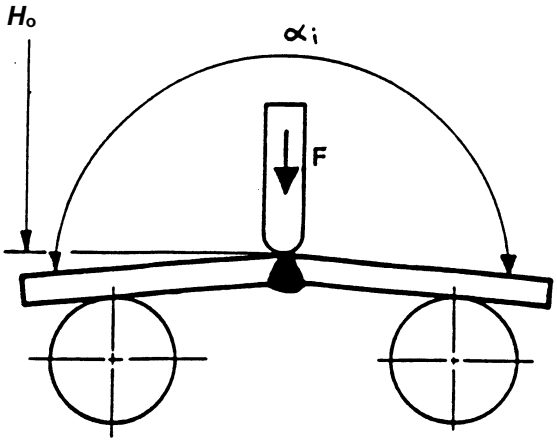


Figure 1a - Initial position

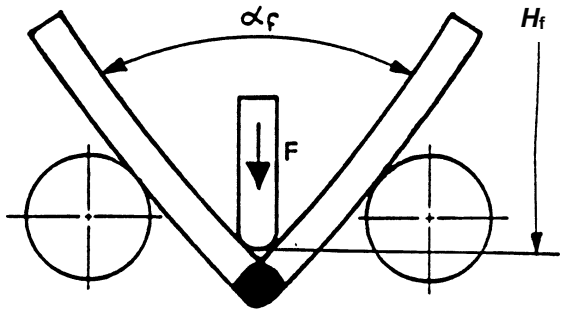


Figure 1b - Final position

Figure 1 - Determination of bend angle "α" and ram displacement *H*

The three different cases for the test are:

- asymmetrical welds (see Figures 2 and 3);

- symmetrical welds (see Figures 4 and 5);

- side bend test (see Figure 6).

For a thickness equal or above 30 mm the side bend test can be used, or the thickness of the test specimen can be reduced to less than 30 mm by machining from the side in contact with the ram end.

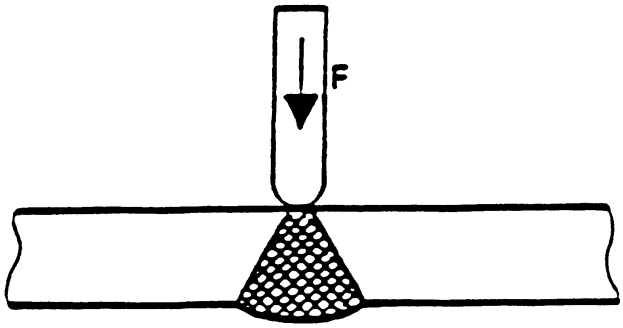


Figure 2 - Face bend test for asymmetrical welds

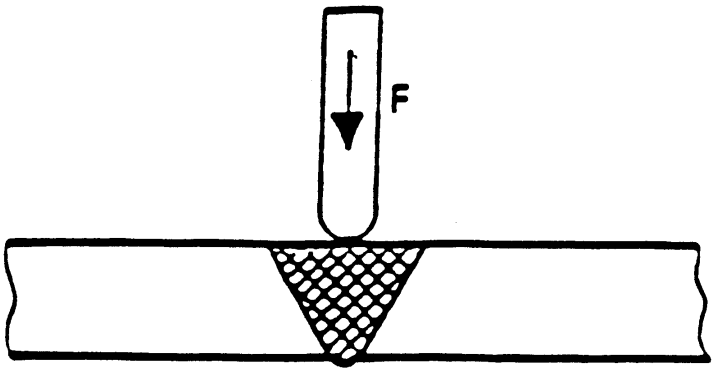
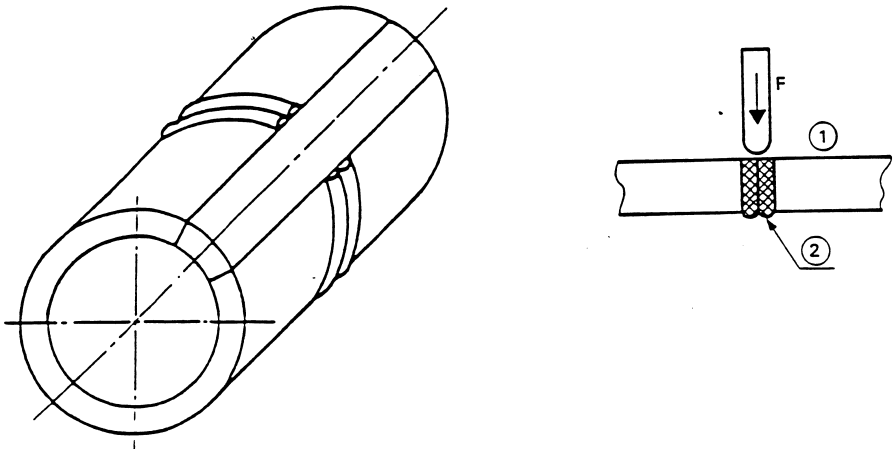


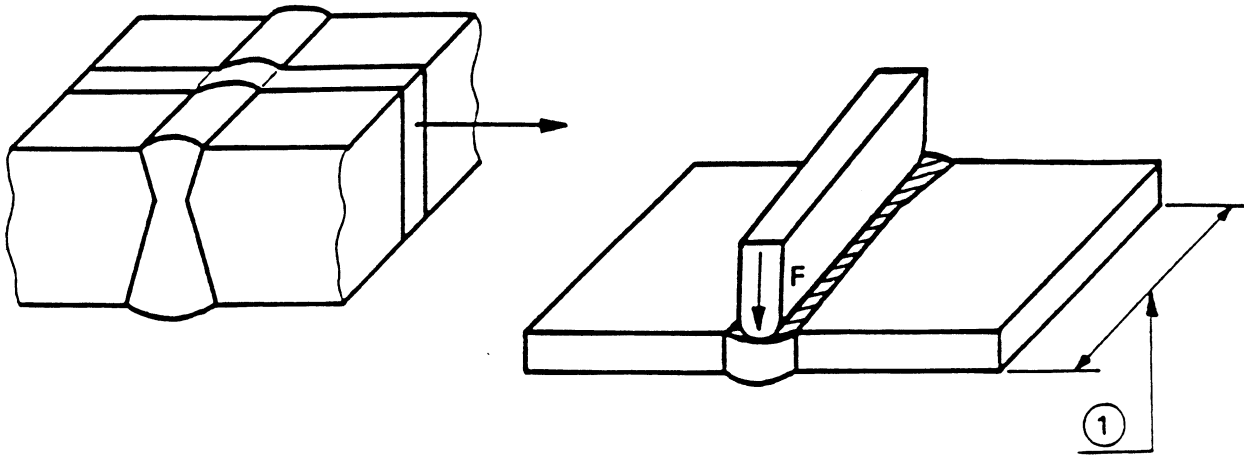
Figure 3 - Root bend test for asymmetrical welds

Figure 4 - Bend test for symmetrical welds



1 Outside
2 Inside bead

Figure 5 - Bend test on tubes



1 Thickness of the test piece

Figure 6 - Side bend test

6 Sampling procedures

The test specimens shall be cut perpendicular to the welded joint and machined at least eight hours after welding.

Each test specimen is marked so that its original position in the test piece can be identified.

No heat treatment or mechanical straightening operations are carried out on the test specimen.

The bead shall be removed from the side in contact with the ram end.

7 Dimensions of test specimens and test arrangement

The values for the dimensions of the test specimens and the test arrangement are given in Table 3.

All dimensions are given with tolerances in accordance with ISO 2768-1

In the case of tubes, the internal diameter shall not be less than 15 mm.

The preparation of plastics test specimens is described in ISO 2818.

The joint is situated at the centre of the test specimen.

The diameter of the rollers is 50 millimetres.

For tubes, the width of the test specimen shall be equal to 0,1 D_n with a minimum value of 6 mm and a maximum value of 20 mm.

Table 3 - Dimensions of test specimens and test arrangement

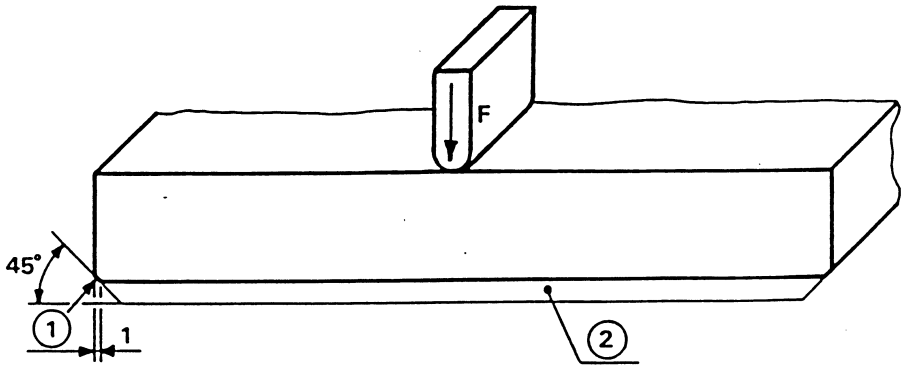
Dimensions in millimetres

Test type	Test specimen			Distance between rollers axes	Diameter of ram end
	a	*b* For plates	*L*	D_a	*d*
Face and root bend	$3 \leq a < 5$	30	150	80	4
	$5 \leq a < 10$	30	200	90	8
	$10 \leq a < 15$	30	200	100	12,5
	$15 \leq a < 20$	30	250	120	16
	$20 \leq a \leq 30$	30	380	160	25
Side bend	10 + 0,5	*a*	200	90	8

8 Cutting of test specimens

8.1 General requirement

A maximum of 1 mm of the longitudinal edges of the test specimen to be subjected to extension shall be removed at an angle of approximately 45°. These chamfers shall be continuous through the bead according to Figure 7.



1 Chamfer
2 Bead

Figure 7 - Longitudinal chamfer of test specimens

8.2 Cutting of tubes

The bend test specimens shall be cut either radially or with parallel sides; as shown in Figures 8a and 8b.

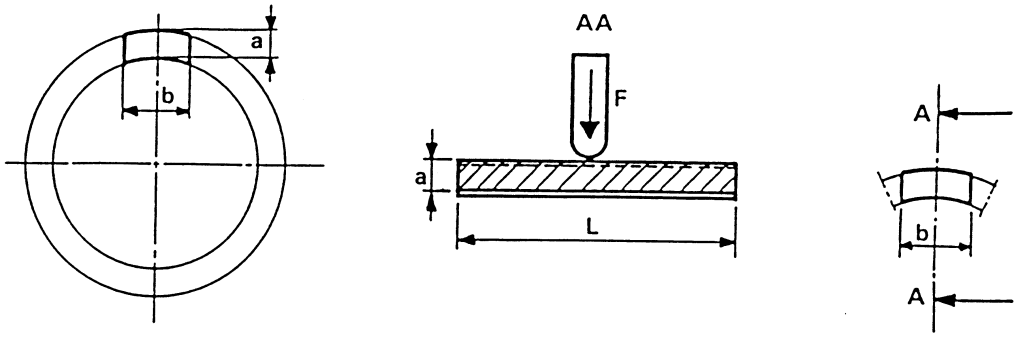


Figure 8a - Parallel cutting

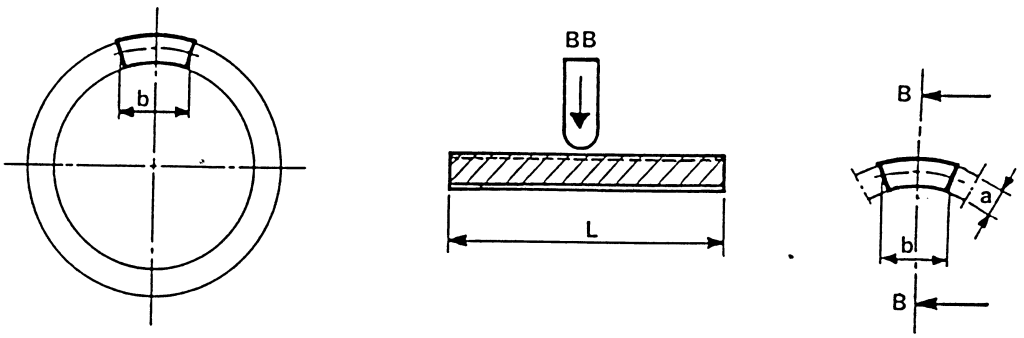


Figure 8b - Radial cutting

Figure 8 - Cutting of test specimens

9 Mechanical testing

Test specimens shall be conditioned to a temperature of 23 °C ± 2 °C, and unless otherwise specified, the test shall be carried out at a room temperature of 23 °C +2/-5 °C.

The ram speeds for some relevant thermoplastics materials are listed in Table 4.

The ram speeds tolerances shall be in accordance with ISO 5893.

Table 4 - Ram speed for some thermoplastics

Material	Speed mm/min
PVC-U	10
PP-H, PP-B, PVDF	20
PP-R, PE	50
NOTE For other materials the ram speed shall be chosen to ensure that the test is terminated in about one minute.	

At least five test specimens shall be tested for each welded test piece.

In the case of asymmetrical welds, at least five test specimens shall be tested for each face of the weld.

If up to two test specimens do not achieve the minimum bend angle as specified in the requirements, two further test specimens from the same welded test piece can be tested at the same face.

No more than two additional test specimens shall be tested.

10 Testing machine

The rate of travel of the ram shall be continuous, uniform and in accordance with clause 9.

The rollers shall be free to rotate.

11 Practical determination of bend angle

Several methods are possible to determine the bend angle:

11.1 Method 1

The indicator fixed to the ram permits direct reading of the initial and final angles as described in Figure 9.

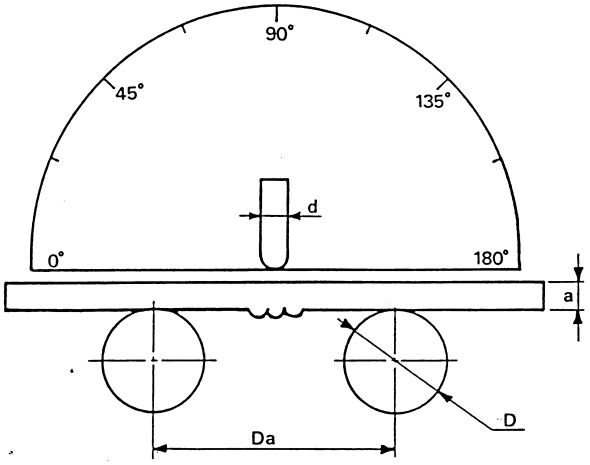


Figure 9 - Determination of bend angle with indicator

11.2 Method 2

The bend angle can be measured with arms which remain in contact with the free ends of the test specimen throughout the test, as described in Figure 10.

In order to determine the correct angle at fracture, the value shall be recorded at the moment of fracture.

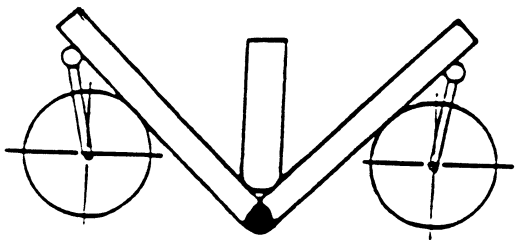


Figure 10 - Determination of bend angle with arms

12 Test report

The test report shall refer to this standard and it shall include at least the following information:

- complete identification of the test piece and test specimens;
- temperature of the test specimen;
- temperature of the test;
- the ram speed;
- the method used to determine the bend angle;
- the value of the bend angle required, if applicable;
- the appearance of the test specimen following the test: visual examination of the ruptured surface;
- the date of the test and the name and the signature of the operator;
- initial angle for each test specimen;
- final angle for each test specimen;
- bend angle for each test specimen;
- bending direction;
- thickness of test specimen;
- thickness of test piece (if different to test specimen);
- width of test specimen;
- diameter of ram end;
- length of test specimen;
- distance between axes of rollers;
- ram displacement (if applicable);
- initial ram position (if applicable);

- final ram position (if applicable);
- outside diameter of tube (if applicable);
- parallel or radial cut (if applicable);
- number of test specimens;
- test type;
- weld type.

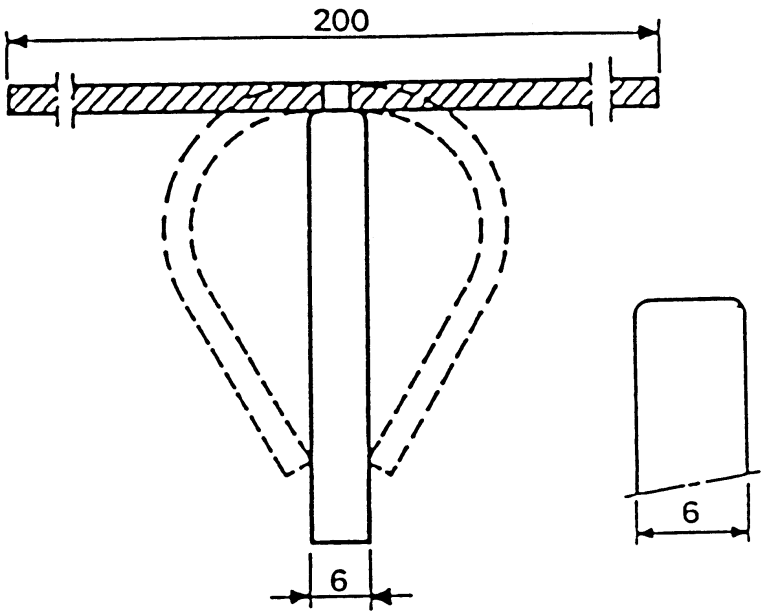
Annex A (informative)

Manual test

The manual bend test can be used in the field to provide some information regarding the weld quality.

The test specimen, with the weld bead in contact with the bar machined off, is bent over a rounded 6 mm thick bar by means of a vigorously applied force, according to Figure A.1, until fracture occurs or the two free ends of the test specimen rest against the bar.

If at the end of the test no crack is visible with the naked eye, the weld is considered satisfactory.



Dimensions in millimetres

Figure A.1 - Manual test

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