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# Testing of welded joints of thermoplastics semi-finished products

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Part 7: Tensile test with waisted test specimens

## National foreword

This British Standard is the UK implementation of EN 12814-7:2024 and it supersedes BS EN 12814-7:2002, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/3, Welding of thermoplastic moulded components.

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

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NORME EUROPÉENNE

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March 2024

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English Version

## Testing of welded joints of thermoplastics semi-finished products - Part 7: Tensile test with waisted test specimens

Essais des assemblages soudés sur produits semi-finis en thermoplastiques - Partie 7 : Essai de traction avec éprouvettes entaillées

Prüfen von Schweißverbindungen an Halbzeugen aus thermoplastischen Kunststoffen - Teil 7: Zugversuch an Probekörpern mit Rundkerbe

This European Standard was approved by CEN on 15 January 2024.

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## European foreword

This document (EN 12814-7:2024) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by SIS.

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of an identical text or by endorsement, at the latest by September 2024, and conflicting national standards shall be withdrawn at the latest by September 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12814-7:2004.

In comparison with the previous edition, the following technical modifications have been made:

- the symbols in “Figure 1 — Waisted tensile test specimen” have been added to “Table 1 — Symbols and designations”;
- modification in Clause 6 following dimensions of test specimens;
- “Table 2 — Dimensions of test specimens” has been added;
- in Table B.1, the test speed for PA-U materials has been added.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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## 1 Scope

This document specifies the dimensions, the method of sampling, the preparation of the test specimens and the conditions for performing the tensile test with waisted test specimens in order to determine the tensile energy welding factor.

A tensile test with waisted specimens can be used in conjunction with other tests (e.g. bend, tensile, tensile creep, macro, etc.) to assess the performance of welded assemblies, made from thermoplastics materials.

The test is applicable to co-axial or co-planar heated tool butt welded assemblies made from thermoplastics materials filled or unfilled, but not reinforced. It is not applicable to tubular assemblies with a nominal outside diameter less than 90 mm.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13100-1, *Non-destructive testing of welded joints of thermoplastics semi-finished products — Part 1: Visual examination*

EN ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1)*

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

## 4 Symbols and designations

Symbols and designations are given in Table 1.

Table 1 — Symbols and designations

Symbols and abbreviations	Designations	Units
$f_e$	The tensile energy welding factor	—
$E_w$	The value of energy to break of the welded test specimen used in the calculation of $f_e$ <sup>a</sup>	Joule
$E_r$	The value of energy to break of the unwelded test specimens taken from the same test piece, used in the calculation of $f_e$ <sup>b</sup>	Joule
$a_n$	Nominal thickness of the test piece	millimetre
$D_n$	Nominal outside diameter of the tube	millimetre
$b_1$	Width of shoulder of the test specimen	millimetre
$b$	Width of narrow portion of test specimen	millimetre
$D$	Diameter of loading holes	millimetre
$\emptyset$	Diameter of waisted section notch	millimetre
$L_h$	Distance between loading holes	millimetre
$L$	Specimen length	millimetre
<sup>a</sup>	Area under the load/extension curve of the welded test specimen.	
<sup>b</sup>	Area under the load/extension curve of the unwelded test specimen.	

## 5 Principle of the test

The test specimen is extended along its major longitudinal axis at constant speed until the test specimen fractures. During this procedure the load and extension sustained by the test specimen is measured and the energy to break is calculated.

## 6 Sampling procedures

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

Each test specimen shall be marked in order to identify its original position within the test piece.

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

## 7 Dimensions of test specimens

The dimensions of test specimens are given in Figure 1 and Table 2.

Dimensions in millimetres

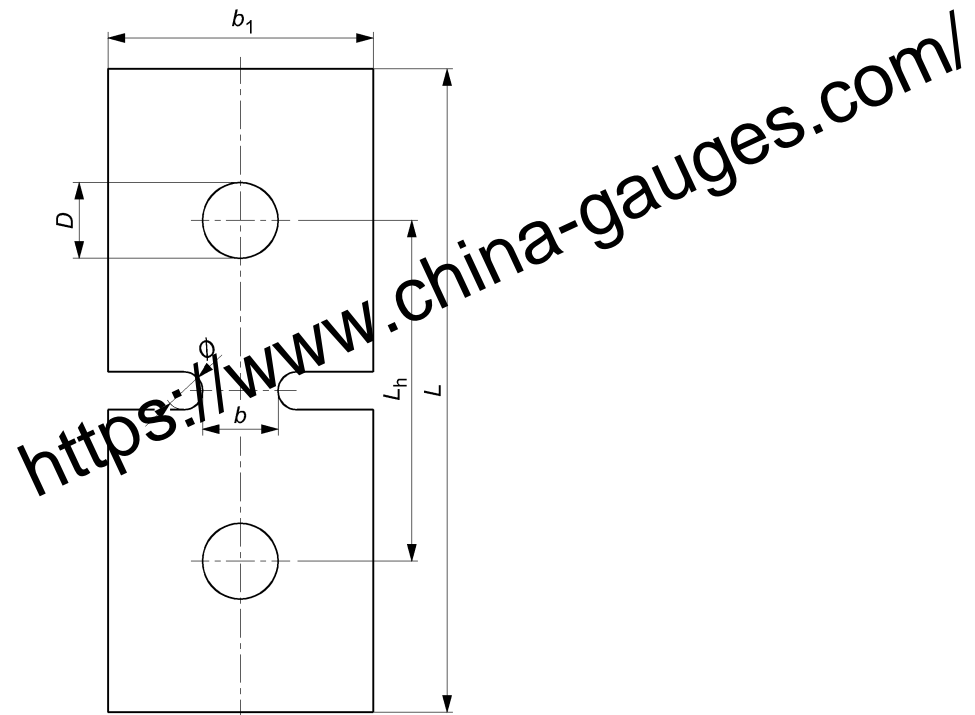


Figure 1 — Waisted tensile test specimen

Table 2 — Dimensions of test specimens

Dimensions in millimetres

$a_n$	$b$	$b_1$	$L_h$	$L$	$D$	$\phi$
$< 20$	$15 \pm 1$	$\geq 70$	$100 \pm 2$	$\geq 190$	$20 \pm 2$	$20 \pm 0,5$
$20 \leq a_n < 25$	$25 \pm 1$	$\geq 80$	$105 \pm 2$	$\geq 200$	$25 \pm 2$	$20 \pm 0,5$
$25 \leq a_n \leq 30$	$30 \pm 1$	$\geq 80$	$110 \pm 2$	$\geq 210$	$30 \pm 2$	$20 \pm 0,5$

For test piece thicknesses greater than 30 mm, the specimens shall be cut equally into two or more layers (according to Annex A). The maximum thickness of any specimen shall be 30 mm. The outer surfaces of the test piece shall not be machined other than to remove the weld beads.

## 8 Cutting of test specimens

The tensile test specimens shall be cut with parallel sides as shown in Figure 1.

During cutting, heating of the test specimen shall be minimized.

The radiused portions of the test specimen shall be smooth and shall contain no notches but the surface finish of the other remaining edges is not critical.

After cutting, a visual examination of the weld, according to EN 13100-1, shall be carried out and recorded.



## 9 Mechanical testing

Test specimens shall be conditioned at a temperature of  $(23 \pm 2)$  °C for not less than 12 h for test specimen thicknesses less than or equal to 12 mm, or for not less than 24 h for test specimen thicknesses greater than 12 mm. Unless otherwise specified, the temperature of the test specimen at the beginning of the test shall be  $(23 \pm 2)$  °C.

The test speeds and tolerances shall be in accordance with EN ISO 527-1.

Examples of test speeds for some relevant thermoplastic materials are listed in Annex B.

An extensometer can be attached to either side of the specimen waisted section, between the loading holes, to measure true elongation of the specimen during the test. If used, the extensometer shall comply with EN ISO 527-1.

The complete load/extension curve and failure mode (brittle, ductile or mixed) shall be recorded for each specimen.

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

Welded and unwelded test specimens shall be of the same geometry and shall be tested at the same speed.

## 10 Test equipment

The test equipment shall conform to the requirements given in ISO 5893.

The crosshead displacement shall be continuous, uniform and in accordance with Clause 9 of this document.

## 11 Determination of the tensile energy welding factor

In order to determine the tensile energy welding factor, welded and unwelded test specimens shall be tested.

The tensile energy welding factor is determined from the arithmetic mean values of the energy to break of the welded test specimens ( $E_w$ ) and the unwelded test specimens ( $E_r$ ).

Tensile energy welding factor,  $f_e = \frac{\bar{E}_w}{\bar{E}_r}$

The values of  $E_w$  and  $E_r$  are determined from the areas under the load/extension curves of the welded and unwelded test specimens, respectively, and can be determined using an electronic integrator, planimeter, counting squares or weighing the cut-out curve.

At least ten test specimens (five welded and five unwelded) shall be used in the evaluation of the tensile energy welding factor. No test specimen shall be disregarded unless failure occurs at the loading holes.

## 12 Test report

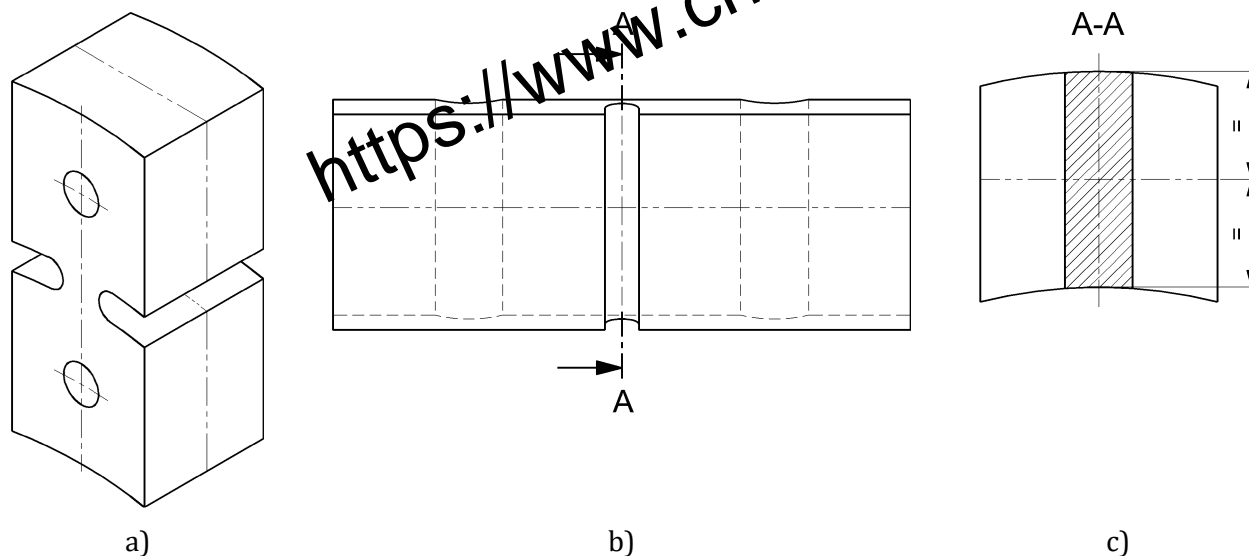
The test report shall refer to this document and it shall include at least the following information:

- a) reference to this standard;
- b) description and identification of the test piece and test specimens;
- c) appearance of the test pieces before the test:
  - 1) visual examination of weld;
  - 2) beads removed or not;
- d) weld type;
- e) nominal outside diameter of the tube, if applicable;
- f) number of test specimens;
- g) appearance of all surfaces of the test specimens, (e.g. flaws, scratches, visual imperfections);
- h) thickness of test specimen;
- i) type of extensometer (if applicable);
- j) temperature of the test specimen at the beginning of the test;
- k) room temperature during the test;
- l) crosshead speed;
- m) visual examination of the ruptured surface (failure mode);
- n) calculated individual energy to break values;
- o) calculated average energy to break values ( $\bar{E}_w$  and  $\bar{E}_r$ );
- p) calculated value of the tensile energy welding factor ( $f_e$ );
- q) identification of the laboratory;
- r) date of the test;
- s) name and signature of the person responsible for the test report.

**Annex A**  
(normative)

**Cutting specimens of thickness > 30 mm into two or more layers**

Figure A.1 shows how to cut specimens of thickness > 30 mm into multiple layers. When cutting the specimens, a fine-toothed saw shall be used to minimize the material removed.



**Key**

- a) isometric view of specimen before cutting, showing the position of the cut
- b) side view
- c) section A-A

**Figure A.1 — Cutting of specimens with a thickness > 30 mm into multiple layers**

## Annex B (informative)

### Test speeds for some thermoplastic materials

The test speeds used for some thermoplastic materials are given in Table B.1.

Table B.1 — Test speeds for some thermoplastic materials

Material	Speed mm/min
PE	5
PP	5
PA-U	5
<b>Key</b> PE polyethylene PP polypropylene PA-U unplasticized polyamide (PA-U 11 or PA-U 12)	

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