



BSI Standards Publication

Testing of welded joints of thermoplastics semi-finished products

Part 2: Tensile test

EUROPEAN STANDARD

EN 12814-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2021

ICS 25.160.40

Supersedes EN 12814-2:2000

English Version

Testing of welded joints of thermoplastics semi-finished products - Part 2: Tensile test

Essais des assemblages soudés sur produits semi-finis
en thermoplastiques - Partie 2 : Essai de traction

Prüfen von Schweißverbindungen aus
thermoplastischen Kunststoffen - Teil 2: Zugversuch

This European Standard was approved by CEN on 20 December 2020.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword.....	3
1 Scope.....	4
2 Normative references.....	4
3 Terms, definitions, symbols and abbreviated terms	4
3.1 Terms and definitions	4
3.2 Symbols and abbreviated terms.....	4
4 Principle of the test	5
5 Sampling procedures.....	5
6 Dimensions of test specimens	6
7 Cutting of test specimens	8
8 Mechanical testing.....	8
9 Test equipment.....	8
10 Determination of the short-term tensile welding factor	8
11 Test report.....	9
Annex A (informative) Tensile test specimen for overlap joints	11
Annex B (informative) Recommended test speeds for some thermoplastics materials	12
Annex C (normative) Notched tensile test specimen.....	13
Bibliography	14

European foreword

This document (EN 12814-2:2021) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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 July 2021, and conflicting national standards shall be withdrawn at the latest by July 2021.

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 12814-2:2000.

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

- the reference standards ISO 5893 and ISO 13953 have been changed to undated;
- a new annex (Annex A), describing the tensile test specimen geometry for overlap joints, has been added.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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 in order to determine the short-term tensile welding factor.

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

The test is applicable to welded semi-finished products made from thermoplastics materials filled or unfilled, but not reinforced, irrespective of the welding process used.

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*

ISO 13953, *Polyethylene (PE) pipes and fittings - Determination of the tensile strength of test specimens from a butt-fused joint*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

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

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in Table 1 apply.

Table 1 — Symbols and abbreviated terms

Symbols and abbreviated term	Designations	Units
a	Minimum measured thickness of the test specimen within calibrated and parallel length	mm
a_n	Nominal thickness of the test piece	mm
b	Width of calibrated and parallel length of the test specimen	mm
b_1	Width of shoulder of the test specimen	mm
D_n	Nominal outside diameter of the tube	mm
F_r	The value of force of the unwelded test specimens taken from the same test piece, used in the calculation of f_s	N
f_s	The short-term tensile welding factor	None
F_w	The value of force of the welded test specimen used in the calculation of f_s	N
L	Total length of the test specimen	mm
L_j	Minimum distance between the clamping jaws	mm
L_o	Calibrated and parallel length of the test specimen	mm
L_w	Maximum width of the weld bead of the test specimen	mm
r	Radius of shoulder of the test specimen	mm
a_r	The value of stress of the unwelded test specimens taken from the same test piece, used in the calculation of f_s	N/mm ²
a_w	The value of stress of the welded test specimens used in the calculation of f_s	N/mm ²

4 Principle of the test

The test specimen is extended along its major longitudinal axis at constant speed until the test specimen fractures or yields. During this procedure the load sustained by the test specimen is measured.

5 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.

6 Dimensions of test specimens

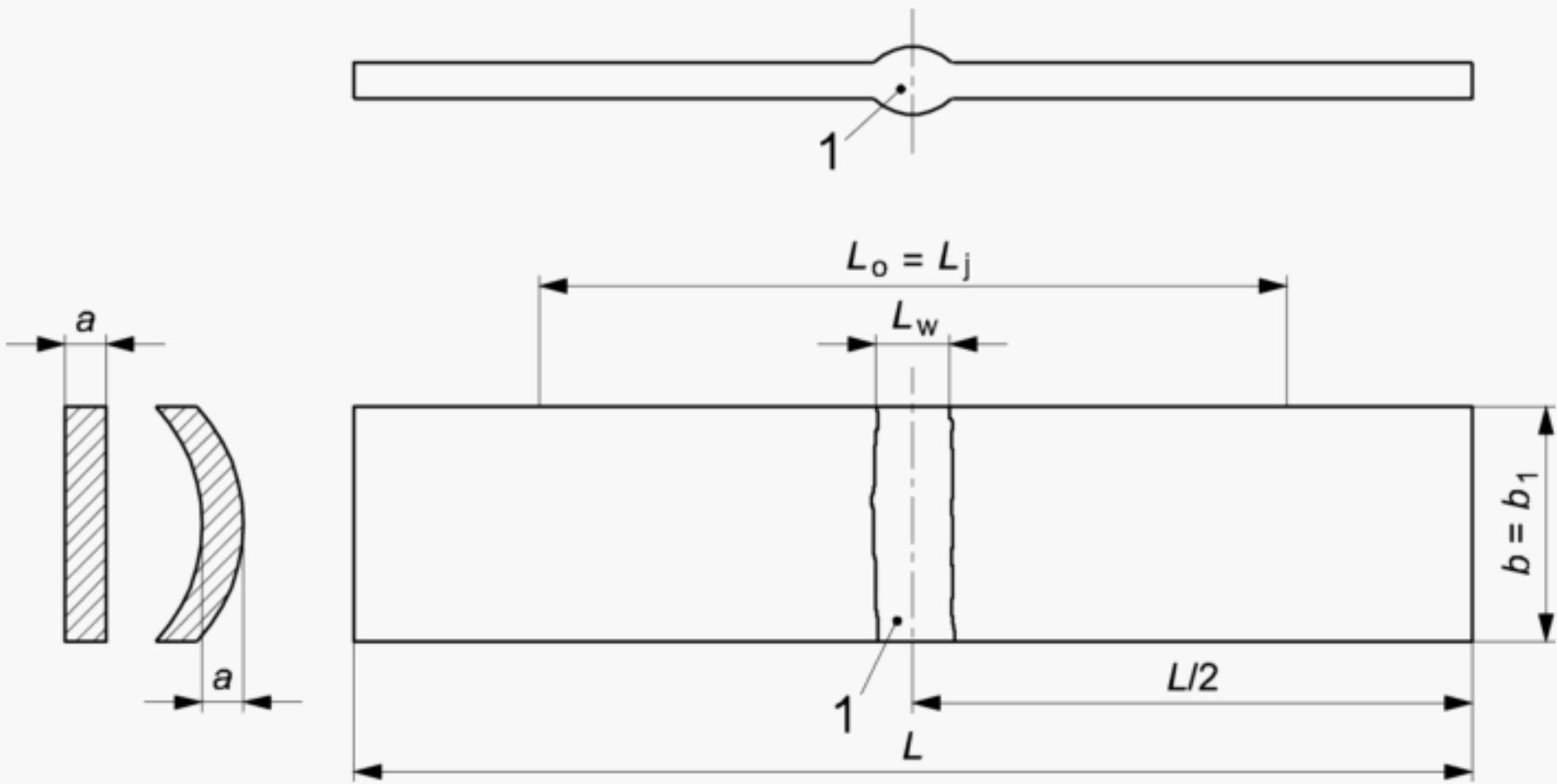
For tubes of nominal outside diameter D_n less than 20 mm, the whole tube shall be tested and the minimum distance between the clamps shall be 200 mm.

The dimensions of test specimens are given in Table 2 and Table 3.

Table 2 — Dimension of type 1 test specimens

Dimension in millimetres

D_n or a_n	b	L_o	L
$20 \leq D_n < 50$	$a_n + \frac{D_n}{10}$	80	≥ 120
$50 \leq D_n < 100$	$a_n + \frac{D_n}{10}$	120	≥ 170
$D_n \geq 100$ or flat assemblies: $a_n \leq 10$ $10 < a_n \leq 20$ $a_n > 20$	 15 30 $1,5 a_n$	 120 120 200	 ≥ 170 ≥ 300 ≥ 400

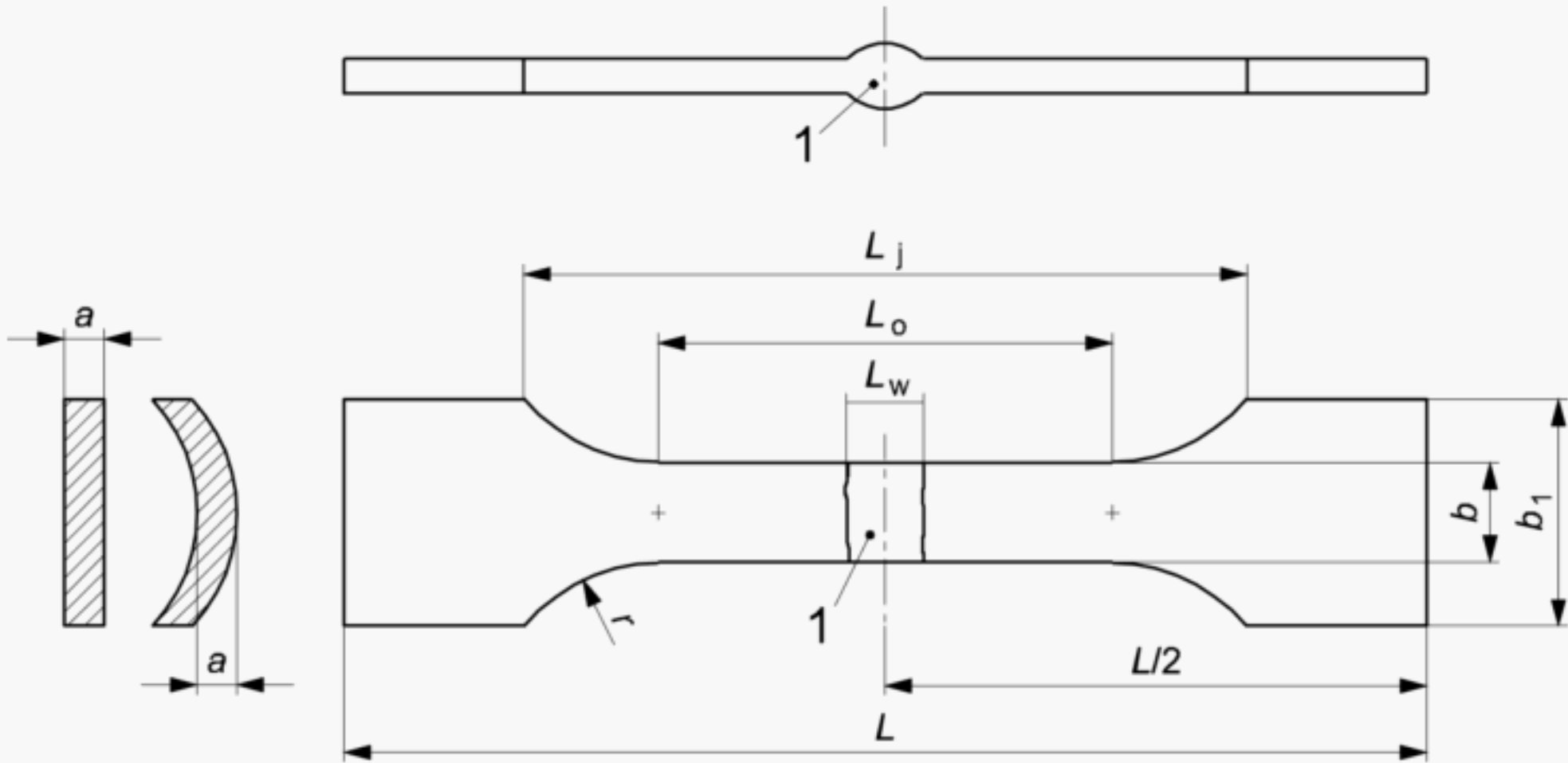


Key
1 weld

Figure 1 — Type 1 test specimen for flat and tubular assemblies

Table 3 — Dimension of type 2 test specimens

Dimensions in millimetres					
D_n or a_n	b	min. b_1	L_o	L	r
$20 \leq D_n < 50$	$a_n + \frac{D_n}{10}$	$b + 10$	80	≥ 120	60
$50 \leq D_n < 100$	$a_n + \frac{D_n}{10}$	$b + 10$	120	≥ 170	60
$D_n \geq 100$ or flat assemblies: $a_n \leq 10$ $10 < a_n \leq 20$ $a_n > 20$	15	20	120	≥ 170	60
	30	40	120	≥ 300	60
	$1,5 a_n$	80	200	≥ 400	60



Key
1 weld

Figure 2 — Type 2 test specimen for flat and tubular assemblies

Where the beads are left intact in service, they shall be left intact for the test. Where the beads are removed in service, they shall be removed prior to testing.

The tolerance for b shall be ± 1 mm and the minimum value shall be 6 mm. The tolerance for L_o shall be ± 2 mm.

The variation of b over the length L_o shall not exceed ± 2 % of the average value of b .

The forms of the test specimens are given in Figure 1 and Figure 2.

For overlap joints, the dimensions and form of the test specimens are given in Annex A.

7 Cutting of test specimens

The tensile test specimens shall be cut with parallel sides as shown in Figures 1 and 2. During cutting, heating of the test specimen shall be minimized.

Cutting of the test specimen shall not produce notches.

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

8 Mechanical testing

Test specimen shall be conditioned to a temperature of $(23 \pm 2) ^\circ\text{C}$ and unless otherwise specified, the test shall be carried out at a room temperature of $(23^{+2}_{-5}) ^\circ\text{C}$.

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

For all materials the test speed shall be chosen to ensure that the test is terminated in about one minute. Examples of test speeds for some relevant thermoplastics materials are listed in Annex B.

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 with the same distance between the clamps.

If all welded test specimens fracture or yield within the calibrated length, but outside of the weld (L_w), the unwelded test specimen do not need to be tested, and the short-term tensile welding factor shall be taken as 1.

In order to achieve a failure in the weld, the test specimens shall be as described in ISO 13953 (Type A only, for thickness less than 25 mm) or in Annex C.

9 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 8.

10 Determination of the short-term tensile welding factor

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

The short-term tensile welding factor is determined from the arithmetic mean values of the fracture stresses of the welded test specimens, σ_w , and the unwelded test specimens σ_r , where:

$$\sigma_w = \frac{F_w}{ab}$$

$$\sigma_r = \frac{F_r}{ab}$$

If the test specimens yield prior to fracture, the yield stress shall be used instead of fracture stress.

Short term tensile welding factor $f_s = \frac{\bar{a}_w}{\bar{a}_r}$

if $\bar{a}_w > \bar{a}_r$, then $f_s = 1$.

At least ten test specimens (five welded and five unwelded) shall be used in the evaluation of the short-term tensile welding factor. No test specimen shall be disregarded unless failure occurs in the clamps.

In the case of the type 1 test specimens, failure within a distance of 1 times specimen width b , from the clamps shall be regarded as failure in the clamp.

If type 1 test specimens consistently fail in the clamps then type 2 test specimens shall be used.

In the case of type 2 test specimens, failure outside of the calibrated length (L_0) shall be regarded as failure in the clamp.

In the case of the whole tube tensile test, failure within a distance of 1,5 D_n from the clamps shall be regarded as failure in the clamp.

11 Test report

The test report shall include at least the following information:

- 1) description and identification of the test piece and test specimens;
- 2) appearance of the test pieces before the test:
 - a) visual examination of weld;
 - b) beads removed or not;
- 3) weld type;
- 4) maximum width of the weld bead, if applicable (L_w);
- 5) nominal outside diameter of the tube, if applicable (D_n);
- 6) number of test specimens;
- 7) appearance of all surfaces of the test specimens, (e.g. flaws, scratches, visual imperfections);
- 8) thickness of test specimen (a);
- 9) type of test specimen;
- 10) appearance of all surfaces of the test specimens, (e.g. flaws, scratches, visual imperfections);
- 11) thickness of test specimen (a);
- 12) width of calibrated and parallel length (b);
- 13) calibrated and parallel length (L_0);
- 14) total length of the test specimen (L);
- 15) width of the test specimen shoulder, if applicable (b_1);
- 16) radius of shoulder (r);
- 17) distance between the clamping jaws;
- 18) temperature of the test specimen ($^{\circ}\text{C}$);

- 19) room temperature during the test ($^{\circ}\text{C}$);
- 20) the crosshead speed (mm/min);
- 21) visual examination of the ruptured surface, if applicable;
- 22) individual values of measured forces (F_w and F_r);
- 23) individual values of calculated stresses (a_w and a_r);
- 24) values of calculated average stresses (\bar{a}_w and \bar{a}_r);
- 25) calculated value of the short-term tensile welding factor (f_s);
- 26) identification of the laboratory;
- 27) date of the test;
- 28) name and signature of the responsible person for the test report.

Annex A
(informative)

Tensile test specimen for overlap joints

In order to determine a short-term tensile welding factor for overlap joints, the test specimen geometry used is described in Figure A.1 and Table A.1.

The values of f_s determined using this specimen geometry should not be correlated with the values of f_s determined using the type 1 or type 2 test specimens described in Clause 6.

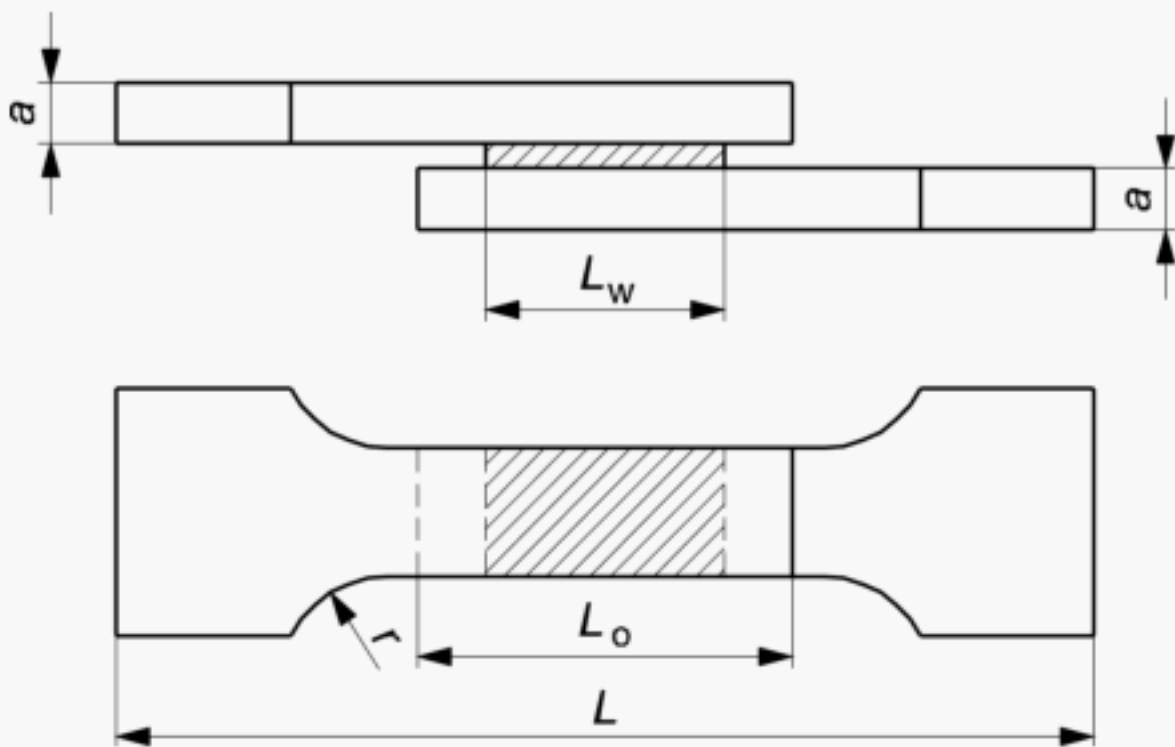


Figure A.1 — Test specimen for overlap joints

Table A.1 — Dimensions of test specimens for overlap joints

Dimensions in millimetres					
<i>a</i>	<i>b</i>	Min. <i>b</i> ₁	<i>L</i> ₀	<i>L</i>	<i>R</i>
<i>a</i> _n ≤ 5	15	20	120	≥ 170	60

Annex B
(informative)

Recommended test speeds for some thermoplastics materials

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

Table B.1 — Recommended test speeds for some thermoplastics materials

Material	Speed mm/min
PVC	10
PVDF, PP-H, PP-B	20
PE, PP-R	50

Annex C
(normative)

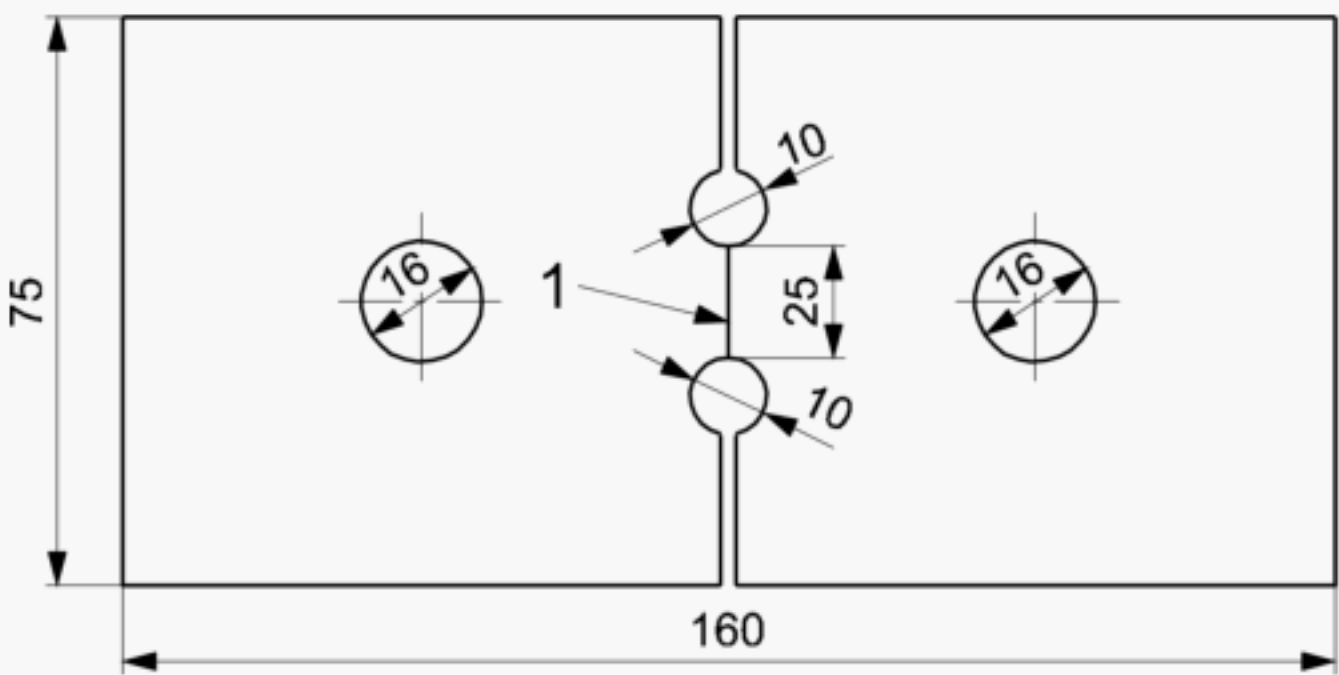
Notched tensile test specimen

A notched tensile test forces failure to occur in the weld and can be used in order to optimize welding parameters or to qualify welding personnel (e.g. EN 13067 [1]).

The values of f_s determined using the notched tensile test do not correlated with the values of f_s determined using type 1 or type 2 test specimens.

The test specimen used for the notched tensile test shall be as described in Figure C.1.

Dimension in millimetres



Key
1 weld line

Figure C.1 — Notched tensile test specimen

Bibliography

[1] EN 13067, *Plastics welding personnel - Qualification of welders - Thermoplastics welded assemblies*

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than one device provided that it is accessible by the sole named user only and that only one copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than one copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright and Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email cservices@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email: cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

