

BS EN ISO 14270:2016



BSI Standards Publication

**Resistance welding —
Destructive testing of welds
— Specimen dimensions and
procedure for mechanized peel
testing resistance spot, seam
and embossed projection welds**

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National foreword

This British Standard is the UK implementation of EN ISO 14270:2016. It supersedes BS EN ISO 14270:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/-/1, Briefing committee for welding.

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

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Published by BSI Standards Limited 2016

ISBN 978 0 580 82612 2

ICS 25.160.40

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2016.

Amendments/corrigenda issued since publication

Date	Text affected
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EUROPEAN STANDARD

EN ISO 14270

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2016

ICS 25.160.40

Supersedes EN ISO 14270:2001

English Version

Resistance welding - Destructive testing of welds -
Specimen dimensions and procedure for mechanized peel
testing resistance spot, seam and embossed projection
welds (ISO 14270:2016)

Soudage par résistance - Essais destructifs des
soudures - Dimensions des éprouvettes et mode
opératoire pour l'essai de pelage mécanisé des
soudures par résistance par points, à la molette et par
bossages (ISO 14270:2016)

Widerstandsschweißen - Zerstörende Prüfung von
Schweißverbindungen - Probenmaße und Verfahren
für die mechanisierte Schälprüfung an
Widerstandspunkt-, Rollennaht- und
Buckelschweißungen mit geprägten Buckeln (ISO
14270:2016)

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European foreword

This document (EN ISO 14270:2016) has been prepared by IIW International Institute of Welding in collaboration with Technical Committee CEN/TC 121 "Welding and allied processes" the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

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The text of ISO 14270:2016 has been approved by CEN as EN ISO 14270:2016 without any modification.

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Foreword

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The committee responsible for this document is ISO/IIW, *International Institute of Welding*, Commission III.

This second edition cancels and replaces the first edition (ISO 14270:2000), which has been technically revised.

Requests for official interpretations of any aspect of this International Standard should be directed to the ISO Central Secretariat, who will forward them to the IIW Secretariat for an official response.

Introduction

This edition of ISO 14270 no longer includes figures showing failure types and modes for tensile shear and cross tension testing in accordance with ISO 14329.

ISO 14270 has been revised to align it with ISO 17677-1. This edition of ISO 14270 is now applicable to testing of welds made in high strength materials including ultra-high strength materials as well as ordinary strength materials. Some of the figures related to the failure types and modes have been revised in accordance with ISO 17677-1.

Resistance welding — Destructive testing of welds — Specimen dimensions and procedure for mechanized peel testing resistance spot, seam and embossed projection welds

1 Scope

This International Standard specifies specimen dimensions and a testing procedure for mechanized peel testing of single spot, seam and embossed projection welds, in overlapping sheets, in any metallic material of thickness 0,5 mm to 3 mm, where the welds have a maximum diameter of $7\sqrt{t}$ (where t is the sheet thickness in mm).

For welds of diameter between $5\sqrt{t}$ and $7\sqrt{t}$, the peel strength values obtained may be lower than expected when using the recommended test specimen dimensions because the test specimen width is designed for welds of diameter of $5\sqrt{t}$ or less.

The object of mechanized peel testing is to determine the peel strength that the test specimen can sustain.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 17677-1, *Resistance welding — Vocabulary — Part 1: Spot, projection and seam welding*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17677-1 and the following apply.

3.1

mechanized peel strength

MPS

maximum peel force obtained from this test

3.2

peel force

force applied on test specimen during mechanized peel testing

3.3

minimum seam weld width

W_{\min}

minimum width of the seam weld measured at the faying surface

Note 1 to entry: See [Figure A.1](#).

Note 2 to entry: For interface failures, the seam weld width is measured in the plane of the interface in a transverse direction to the longitudinal axis of the linear seam weld.

4 Test pieces and specimens

[Table 1](#) gives test specimen dimensions for mechanized peel tests. The positional accuracy of the weld on the test specimen shall be ± 1 mm or less in every direction.

Table 1 — Test specimen dimensions and weld position

Thickness	Flange length	Specimen width	Specimen length	Free length between clamps	Edge distance
t mm	a mm	b mm	l_s mm	l_f mm	e mm
$0,5 < t \leq 3,0$	50	50	≥ 160	105	25

NOTE See [Annex B](#) for an explanation of the influence of weld position on mechanized peel test results of spot welds.

Spot welded test specimens can be produced by

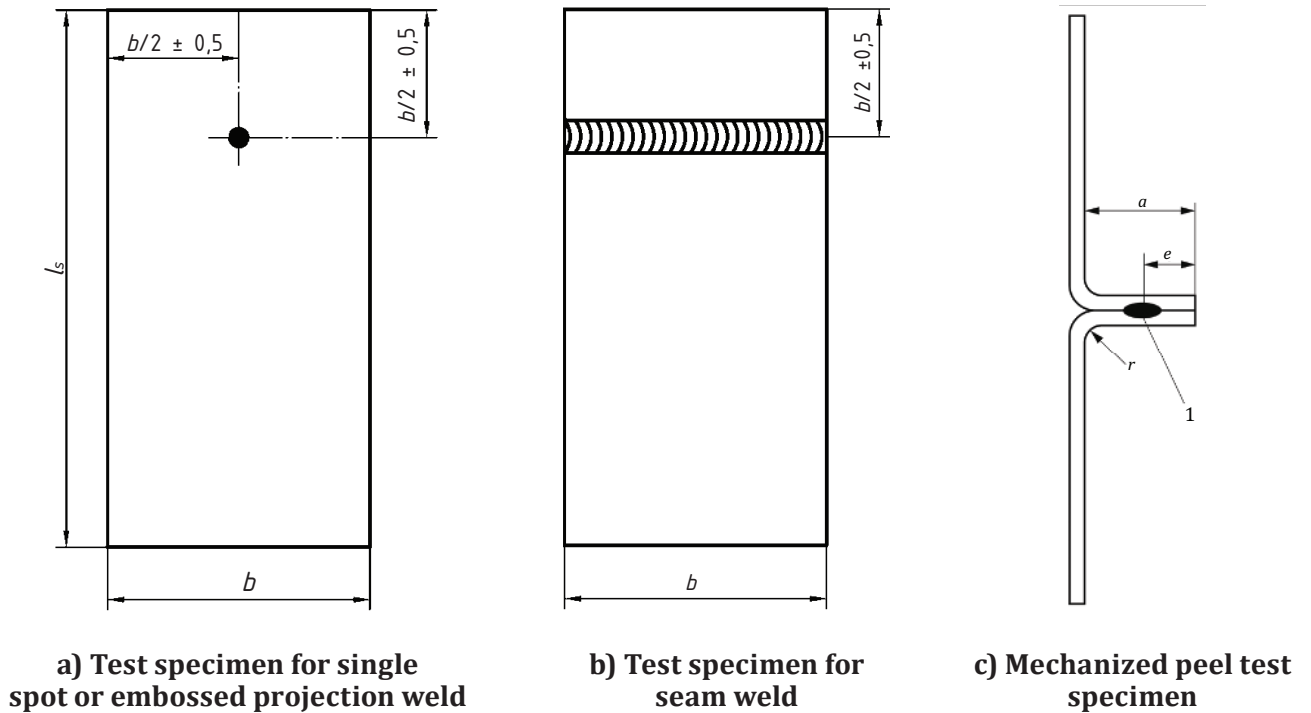
- welding each one separately in accordance with [Figure 1 a](#)), or
- making a number of individual welds joining two test plates as a multiple weld test piece, and then cutting them in accordance with [Figure 2](#).

Embossed projection weld test specimens shall only be produced by welding a single weld specimen as shown in [Figure 1 a](#)).

In order to obtain statistically significant average results, it is recommended that several specimens are tested.

In the case of unequal sheet thicknesses, the test specimen dimensions shall be based on those of the thinner sheet. Mechanized peel test specimens in accordance with [Figure 1 c](#)) shall be produced in accordance with [Clause 5](#) or [Clause 6](#).

Dimensions in millimetres



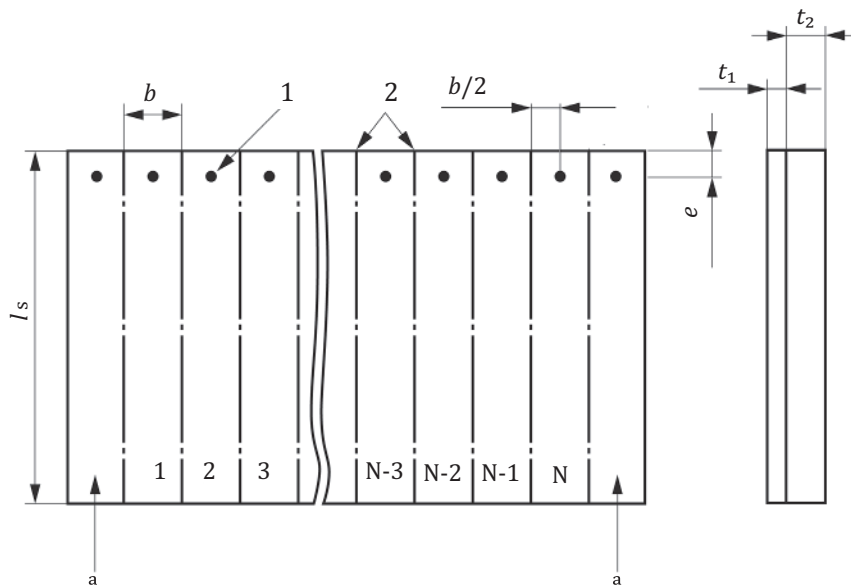
Key

1 weld

Figure 1 — Form of test specimen with weld position for single weld

When using multi-spot welding equipment, each electrode shall weld an individual test specimen as shown in [Figure 1 a\)](#).

For multiple weld test pieces in large sheets, welding starts from an end location to the other end as shown in [Figure 2](#). Since shunting occurs during welding of multiple weld test pieces, the welding current used shall be higher than that for welding for a single weld test specimen. For multiple weld pieces, the first and last welds shall be discarded as shown in [Figure 2](#).

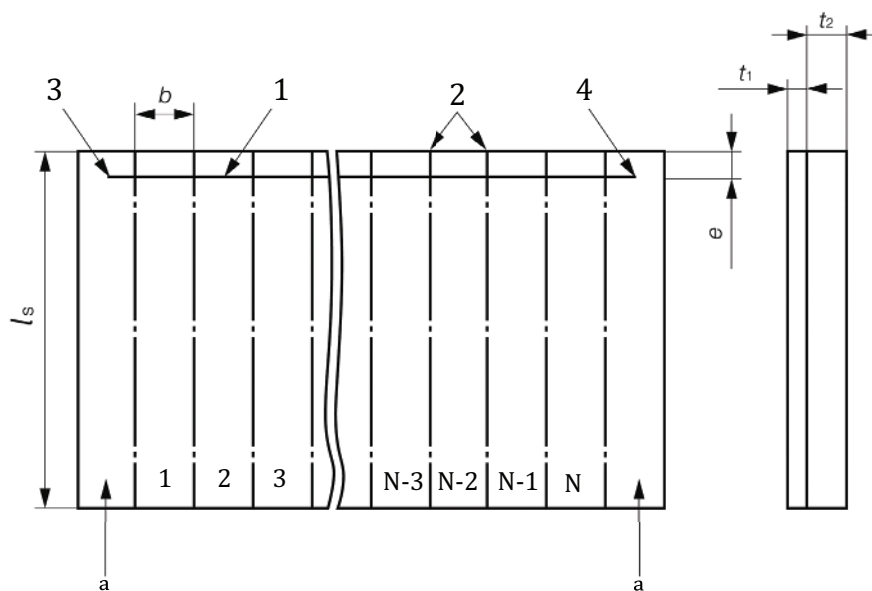


Key

- | | | | |
|---|-----------------------------------|---|--------------------------|
| 1 | spot or embossed projection welds | N | number of test specimens |
| 2 | cuts | a | Discarded. |

NOTE For other symbols, see [Table 1](#).

Figure 2 — Example for preparation of multiple weld test pieces



Key

- | | | | |
|---|------------------|---|--------------------------|
| 1 | seam weld | 4 | stop position of welding |
| 2 | cuts | N | number of test specimens |
| 3 | start of welding | a | Discarded. |

Figure 3 — Example for preparation of seam welded test pieces

For seam welds, a continuous weld is made as shown in [Figure 3](#). Test specimens shall be made as shown in [Figure 1 b](#)). Both end parts of the seam weld shall be discarded.

The properties of the welded joints in the test pieces shown in [Figure 2](#) or [Figure 3](#) shall not be affected by the cutting process used to separate individual test specimens.

5 Preparation of mechanized peel test specimens

5.1 General

Mechanized peel test specimens can be made by the following two sequences, for peel testing using a tensile test machine.

a) bending-after-welding process:

Welding → Bending → Mechanized peel testing

b) welding-after-bending process:

Bending → Welding → Mechanized peel testing

The bending-after-welding process is only recommended for thin sheet materials and/or soft materials. The bending-after-welding process can be applicable to multiple weld specimens.

For high strength and/or thick materials, the welding-after-bending process is recommended using single weld test pieces.

For high strength steel test specimens and/or for mild steel test specimens in sheet thicknesses greater than 1,5 mm, the welding-after-bending process is strongly recommended.

5.2 Bending procedure of weld test specimens after welding

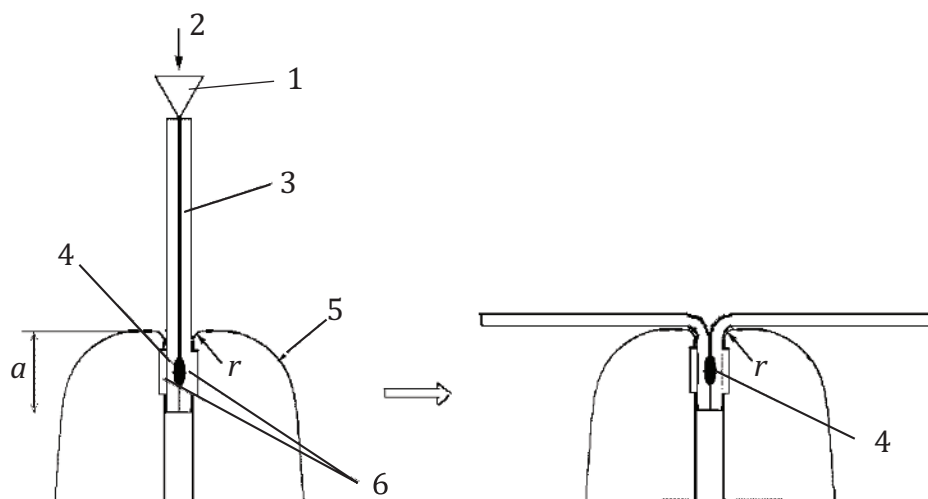
Single weld specimens as shown in [Figure 1 a\)](#) or [Figure 1 b\)](#) shall be bent by the method illustrated in [Figure 4](#) to make the shape shown in [Figure 1 c\)](#). When using multiple weld test pieces as shown in [Figure 2](#) or [3](#), single weld specimens shall be bent after cutting them from the multiple weld test piece. The properties of the joint shall not be influenced by the bending process.

An example of the welding-after-bending process is shown in [C.1](#).

5.3 Bending procedure of test specimens before welding — Alternative procedure

Alternatively, for single weld mechanized peel test specimens, the test specimens can be bent before welding as shown in [Figure 5 a\)](#). The test specimens are then welded as shown in [Figure 5 b\)](#). Recommended jig set-up conditions for bending with a press brake are given in [C.2](#).

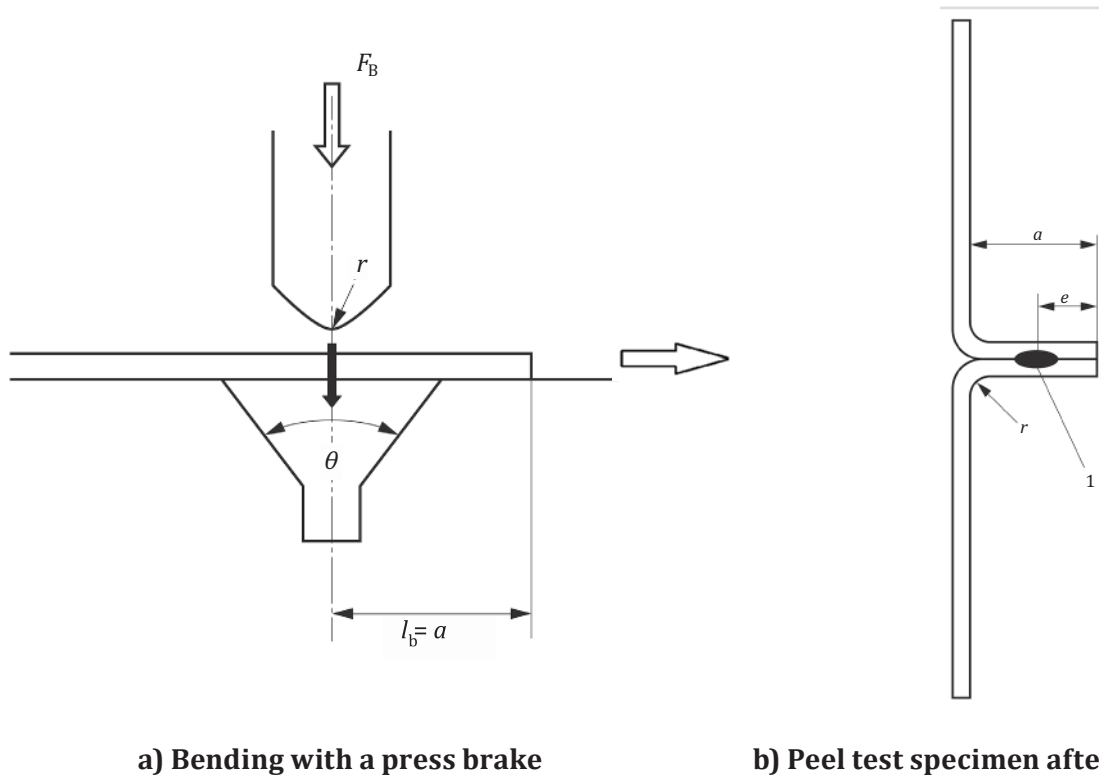
NOTE When setting the value $l_b = a$, as shown in [Figure 5](#), the maximum error of flange length is less than $\pm 0,5$ mm if $r = 2t$ and $t \leq 3$ mm, see detail in [Annex D](#).



Key

- | | | | |
|---|---------------|----------|--------------------------------|
| 1 | first tool | 5 | clamping for bending |
| 2 | applied force | 6 | clearance to protect weld part |
| 3 | test specimen | <i>r</i> | radius |
| 4 | weld | <i>a</i> | flange length |

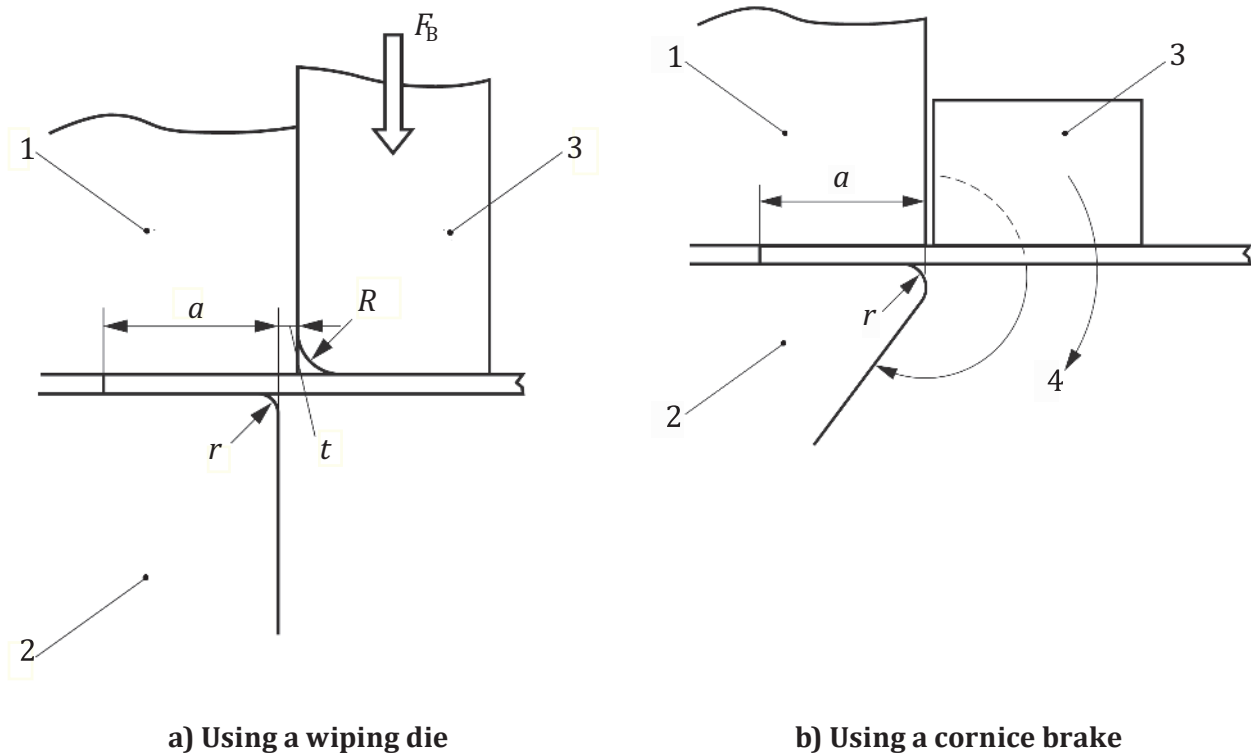
Figure 4 — Bending procedure for welded specimens by use of a wedge



Key

- | | | | |
|----------|-------------------|-----|-----------------------|
| 1 | weld | a | flange length |
| F_B | bending force | e | edge distance |
| l_b | centre of bending | r | radius of bent corner |
| θ | angle | | |

Figure 5 — Bending with a press brake before welding to make a bend test specimen



Key

- | | | | |
|-------|---------------|-----|----------------------------|
| 1 | upper jaw | r | radius of bent corner |
| 2 | lower jaw | R | edge radius of die |
| 3 | die | a | flange length |
| 4 | rotation | t | thickness of test specimen |
| F_B | bending force | | |

Figure 6 — Examples of edge bending

A mechanized press brake system is generally recommended for bending test specimens. A manual press brake can be used to bend test specimens in softer material and thinner test pieces. Other bending tools such as wiping dies and cornice brake systems, as shown in [Figure 6](#), can also be used to make test specimens. An example of edge bending is shown in [C.3](#).

NOTE These systems need less bending force than the press brake system shown in [Figure 5 a](#)). These can be applicable to large size test pieces, e.g. seam welded test pieces as shown in [Figure 3](#).

5.4 Dimensions and accuracy

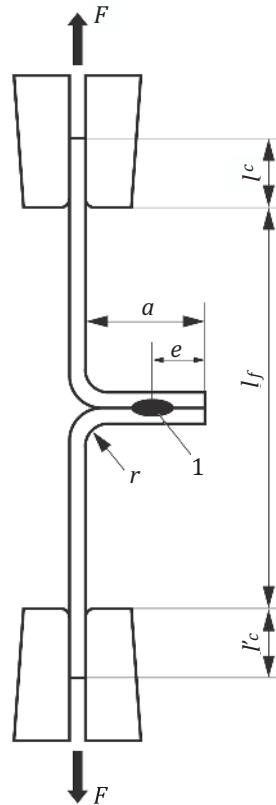
The value of the inner radius, r , shall be selected so that no large or deep cracking occurs at the outer surface during bending. An inner radius, r , of approximately $2t$, where t is plate thickness, is recommended. The value of the radius used for the test shall be recorded.

If any large and/or deep cracks are found after bending in accordance with [5.1](#) or [5.2](#), new test specimens with larger inner radii shall be made. The value of the inner radius shall be increased until no fracture occurs from the location of cracks. Cracks occurring on the outer surface of the specimen after bending can be measured using a magnifying lens with $2\times$ to $5\times$ magnification.

The accuracy of the flange length, a , after bending the test specimens shall be $\pm 1,0$ mm or less.

6 Peel testing procedure and test equipment

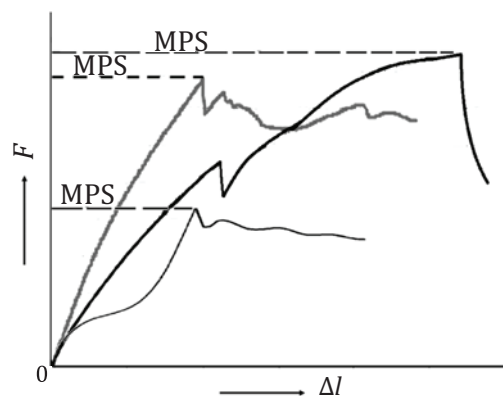
The test specimen is clamped in a tensile testing machine, which shall satisfy the requirements of ISO 7500-1 as shown in [Figure 7](#). Force measurement accuracy shall be less than or equal to $\pm 1\%$. Testing shall be carried out at room temperature, and performed at least 10 h after welding.



Key

1	weld	F	applied force (load)
r	bend radius	$l_c \approx l'_c$	clamping length
a	flange length	e	edge distance
l_f	free length between clamps		

Figure 7 — Test specimen clamping for mechanized peel testing



Key

- F load (applied force)
- Δl crosshead displacement
- MPS mechanized peel strength

Figure 8 — Examples of load-displacement curves (not to scale)

The test results shall be recorded with the mechanized peel strength (MPS) determined as the maximum load shown in [Figure 8](#), type of failure and weld diameter of each weld in accordance with ISO 17677-1 and [Annex A](#).

7 Re-test

If as a result of mechanized peel testing in accordance with [Clause 6](#), fracture occurs only from the bent corner of the test specimens, all test results shall be disregarded and new specimens with larger inner radii shall be tested. The value of the inner radius shall be increased until no fracture occurs from the bent corner, especially from cracks that appear on the bent corner. In the case of using larger radii, the actual radius value tested shall be recorded.

8 Test report

The test report shall contain at least the following:

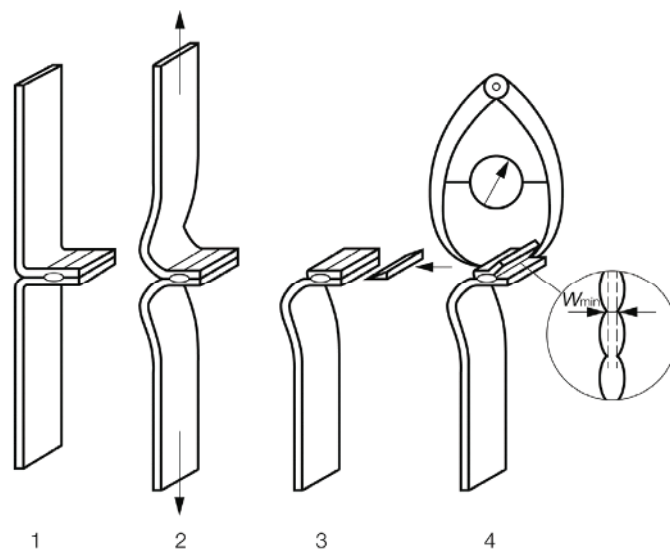
- a) a reference to this International Standard, i.e. ISO 14270:2016;
- b) the date of testing, and test location;
- c) the welding process;
- d) the welding conditions and equipment;
- e) the material and its condition;
- f) the dimensions of the test piece and specimens, including test specimen types (single or multiple);
- g) the value of bend radius;
- h) individual values, mean value and standard deviation of the mechanized peel strength;
- i) failure description (symmetrical plug failure, asymmetrical plug failure, partial plug failure, interfacial failure, etc.);
- j) individual values, mean value and standard deviation of the weld diameter;

k) special remarks, if any (e.g. waiting time for testing after welding).

Annex A (normative)

Measurement of seam weld size

The minimum seam weld size can be determined in accordance with [Figure A.1](#).



Key

- 1 before loading
- 2 under loading
- 3 opening using a chisel or wedge
- 4 measuring the weld width by using a gauge

Figure A.1 — Measurement of minimum seam weld width, w_{min}

Annex B (informative)

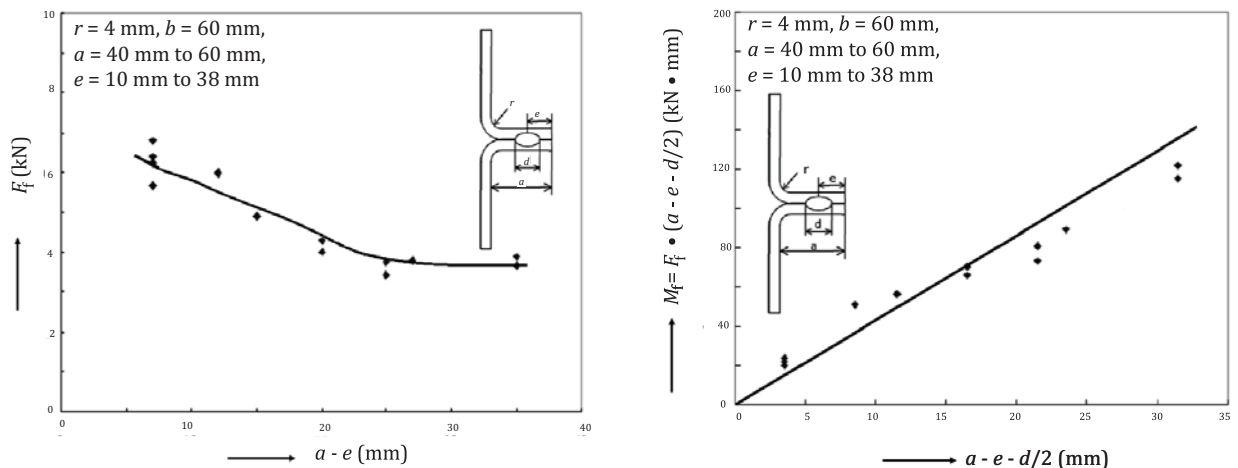
Influence of spot weld position on test results

The mechanized peel strength of test specimens (shown in [Figure B.1](#) as fracture load) depends on the materials, plate thickness and weld position ($a - e$). A typical mechanized peel strength result, which is shown as fracture strength, F_f is shown in [Figure B.1 a](#)).

The strength decreases in accordance with increased length, $a - e$. However, when the fracture moment, $M_f = F_f (a - e - d/2)$, is defined as the bending moment, the product of the fracture strength F_f and the weld edge position ($a - e - d/2$) is almost proportional to the length of ($a - e - d/2$) as shown in [Figure B.1 b](#)). The relationship is defined in Formula (B.1):

$$M_f = F_f (a - e - d/2) = C_1 + C_2 (a - e - d/2) \quad (\text{B.1})$$

C_1 and C_2 are constants determined by the linear regression analysis for the measured data. Usually, the constant C_1 is almost zero as seen in [Figure B.1 b](#)).



a) Fracture load vs. centre position of weld

b) Fracture moment vs. notch edge position (edge of weld)

Key

F_f fracture load
 F_m fracture moment
 d weld diameter
 a flange length

e edge distance
 r bend radius
 b specimen width

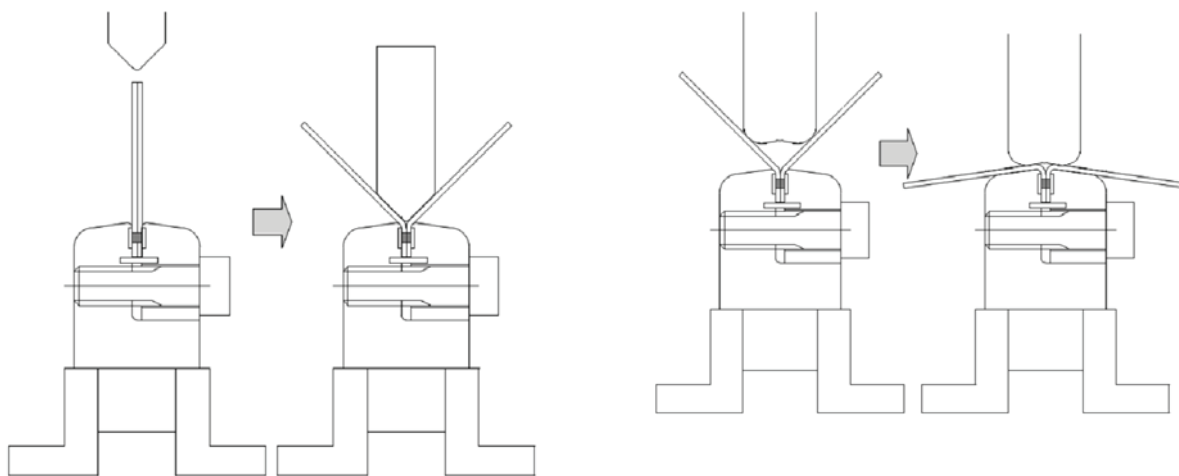
**Figure B.1 — An example of the influence of weld position on test results
[Materials: mild steel, Plate thickness ($t = 2$ mm), weld diameter ($d_w = 5\sqrt{t}$)]**

Annex C (informative)

Examples of bending tools

C.1 Example of bending procedure for welded specimens using a wedge

A recommended bending process for bending after welded test pieces is shown in [Figure C.1](#). In this procedure, the faying surface shall be separated with a sharp edge punch as the first step. The test specimens shall be bent with another shaped tool to make the final form as the second step. The load can be applied by a tensile testing machine.

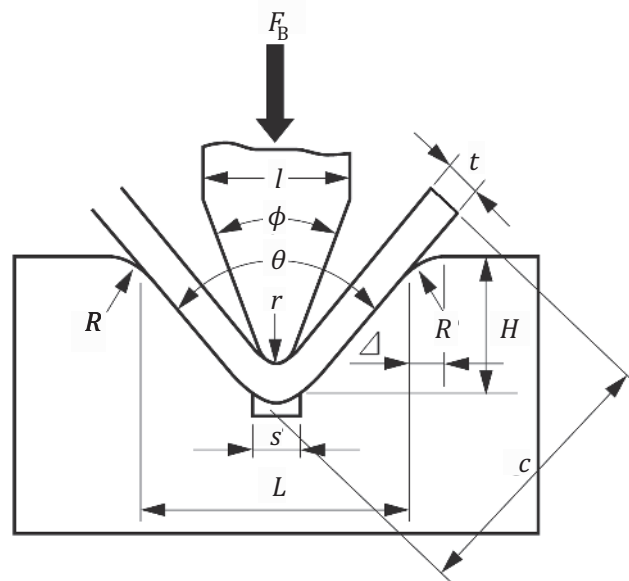


a) The first step to separate the faying surface b) The second step to open both specimens

Figure C.1 — Example of a bending procedure for welded specimens to make the test specimen

C.2 Recommended set-up conditions for bending with a press brake

Recommended set-up conditions for bending the test specimen with a press brake are given in [Figure C.2](#).



Key

$r \approx 2t$

$L = 6t \sim 15t$, where $L + 2\Delta < 2a$

$l = 0,5L \sim L$

$\theta = 86^\circ \sim 88^\circ$

$\phi = 80^\circ \sim 86^\circ$

$s \approx \sqrt{2} r + 0,5t$

$c = a + t \geq \sqrt{2} H$

$R: 3 \text{ mm} \sim 8 \text{ mm}$

Figure C.2 — Example of recommended dimensions of die and punch when using the press brake to make bent test specimens

C.3 An example of edge bending tool

An example of a tool for edge bending of test specimens before welding is shown in [Figure C.3](#).

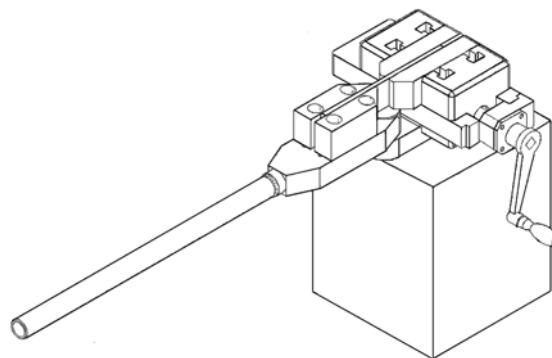
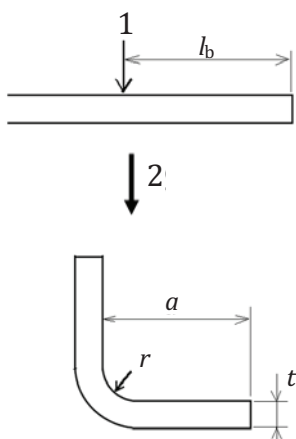


Figure C.3 — Example of another bending tool like the pipe bender to make bent test specimens

Annex D (informative)

Determination of the bending centre position with press brake systems

When the test specimen is prepared using a press brake system, the location of punch tip centre l_b can be determined from Formula (D.1) based on the flange length value, a .



Key

- 1 centre of punch
- 2 bending with press brake system

Figure D.1 — Determination of the bending centre position with press brake systems

$$l_b = a + \frac{\alpha\pi}{4}t - \frac{4-\pi}{4}t \tag{D.1}$$

Where the value of parameter, α , is given in [Table D.1](#).

Table D.1 — Value of parameter α

$\frac{r}{t}$	$\frac{r}{t} = 0$	$0 < \frac{r}{t} \leq 2$	$2 < \frac{r}{t} \leq 5$	$5 < \frac{r}{t}$
α	0,31	0,34	0,4	0,5

When the value of r/t is 2 to 5, the location l_b is almost the same value of the value a . The error of flange length is less than 0,5 mm if the location l_b is set as the value a .

$$l_b \approx a \tag{D.2}$$

Bibliography

- [1] ISO 14329, *Resistance welding — Destructive tests of welds — Failure types and geometric measurements for resistance spot, seam and projection welds*

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