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ISO 14270

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

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

Reference number
ISO 14270:2016(E)

Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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 t mm	Flange length a mm	Specimen width b mm	Specimen length l_s mm	Free length between clamps l_f mm	Edge distance 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

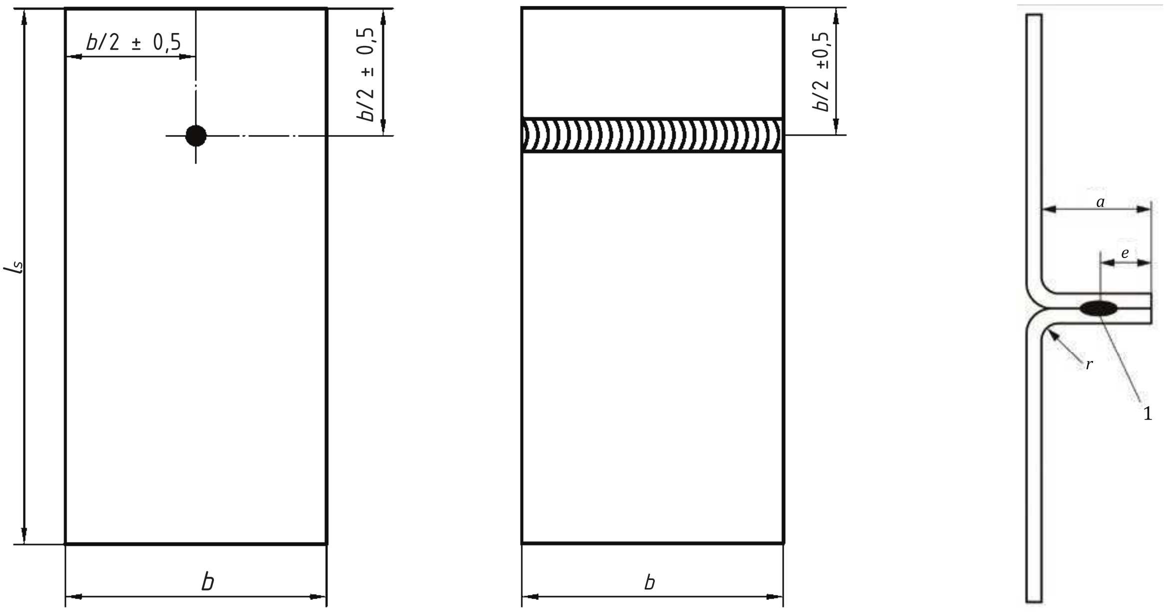
— making a number of individual welds joining two test plates as a multiple weld test piece, and then cutting them in accordance with Figure 2.

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



a) Test specimen for single spot or embossed projection weld

b) Test specimen for seam weld

c) Mechanized peel test specimen

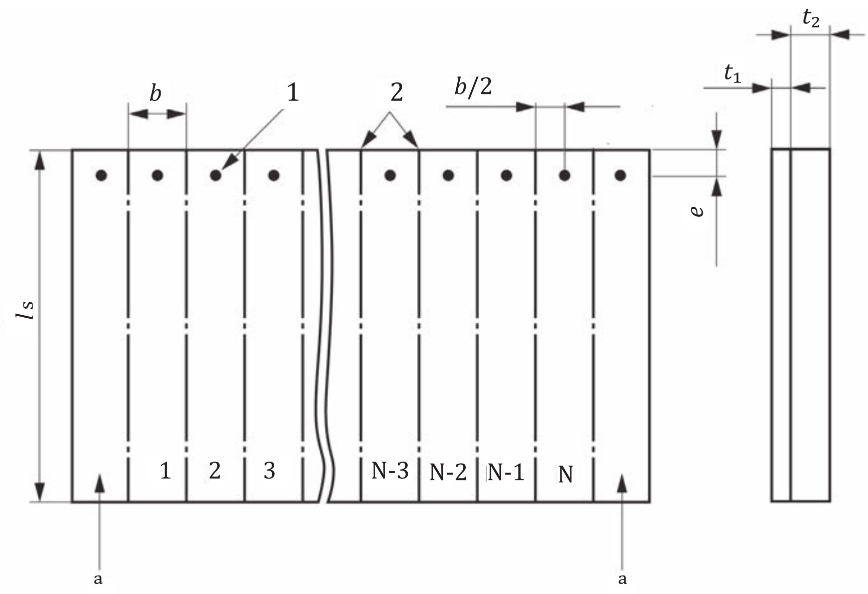
Key

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

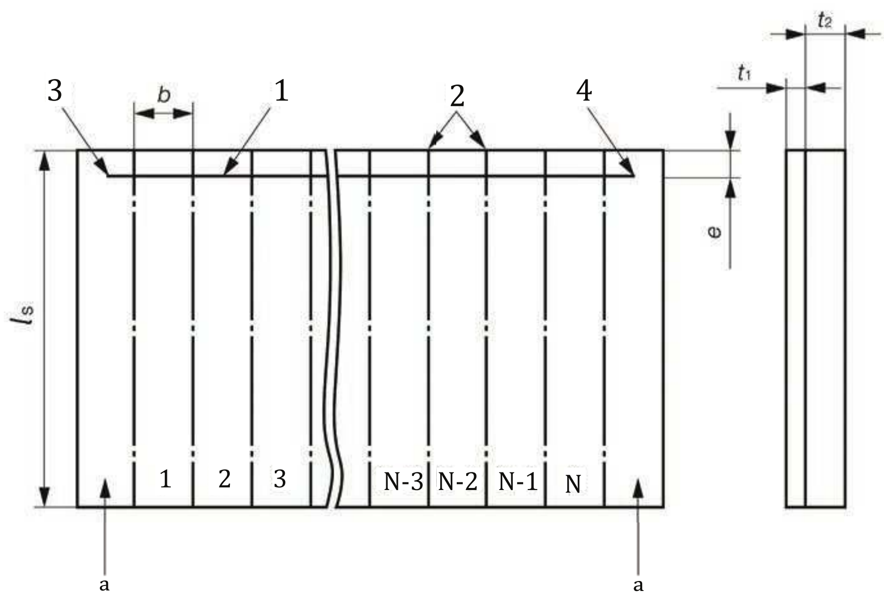
2 cuts

N number of test specimens

a Discarded.

NOTE For other symbols, see Table 1.

Figure 2 — Example for preparation of multiple weld test pieces



Key

1 seam weld

2 cuts

3 start of welding

4 stop position of welding

N number of test specimens

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

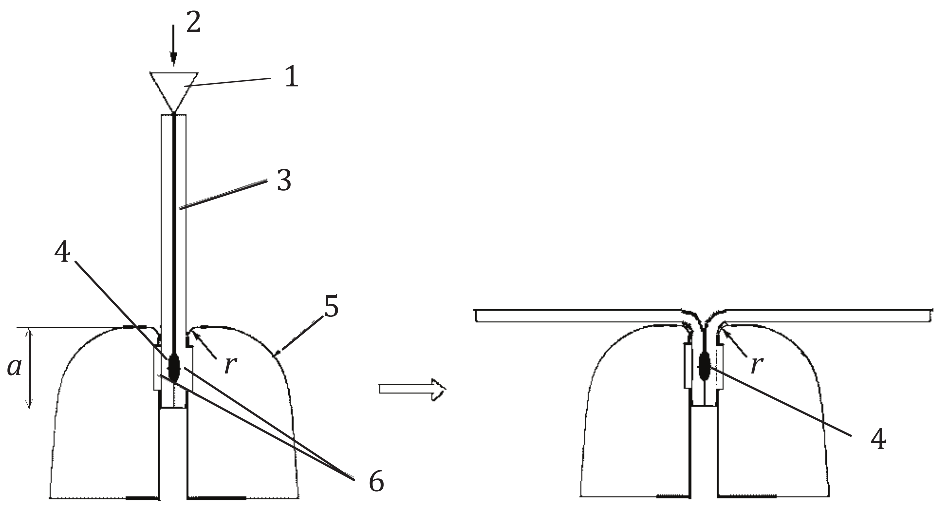
Single weld specimens as shown in Figure 1 a) or Figure 1 b) shall be bent by the method illustrated in Figure 4 to make the shape shown in Figure 1 c). When using multiple weld test pieces as shown in Figure 2 or 3, single weld specimens shall be bent after cutting them from the multiple weld test piece. 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 ±0,5 mm if $r = 2t$ and $t \leq 3$ mm, see detail in Annex D.



Key

1 first tool

2 applied force

3 test specimen

4 weld

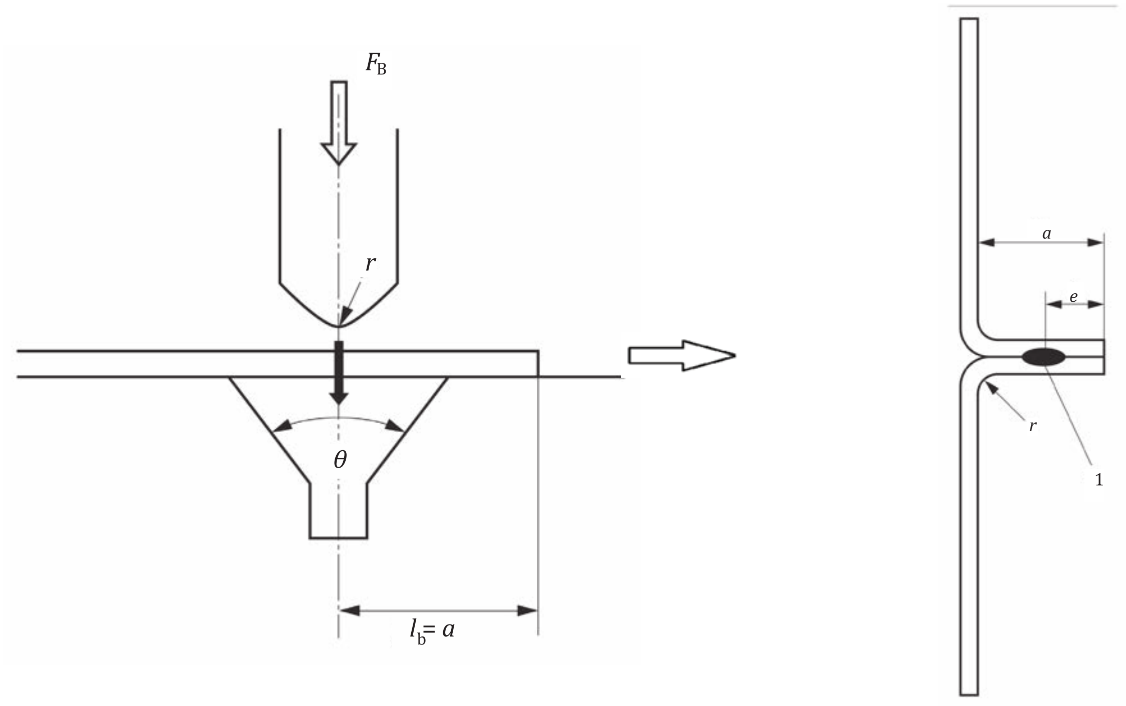
5 clamping for bending

6 clearance to protect weld part

r radius

a flange length

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

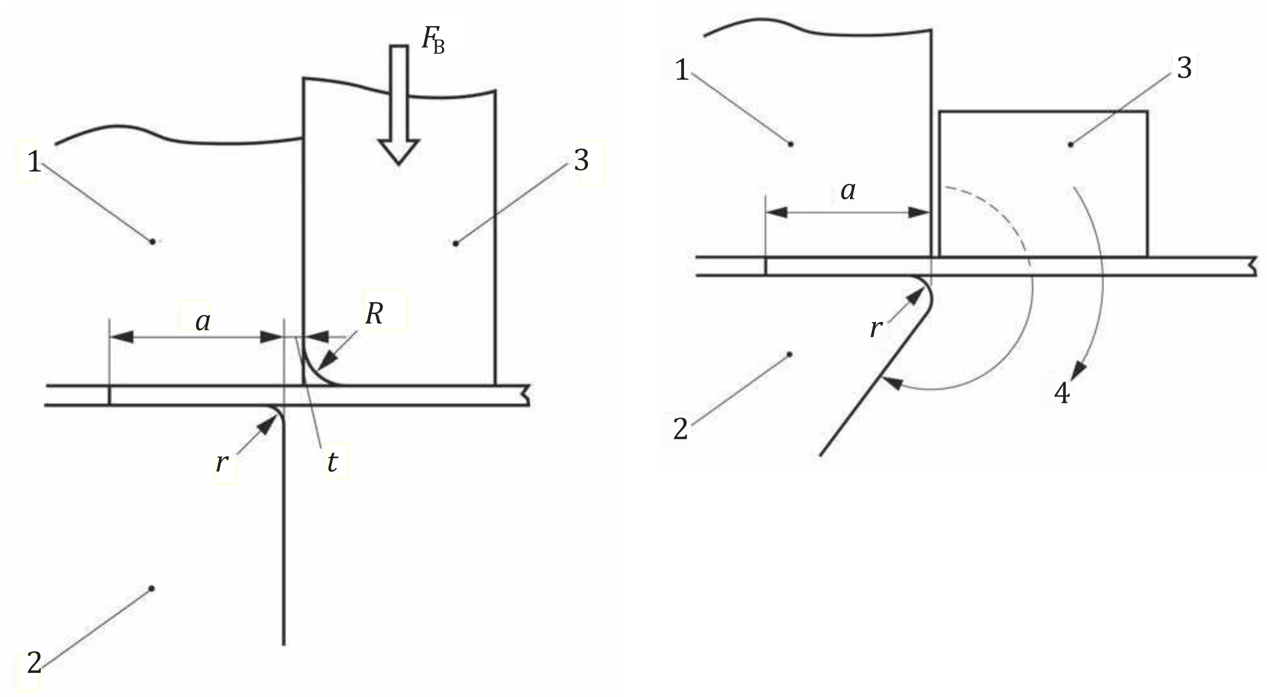


a) Bending with a press brake **b) Peel test specimen after welding**

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



a) Using a wiping die

b) Using a cornice brake

Key

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

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 then 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

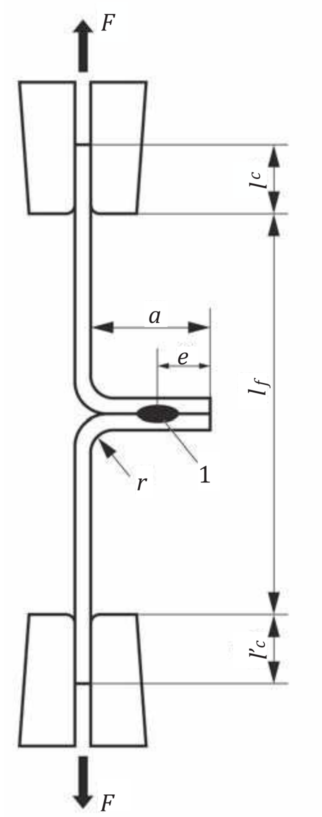
The value of the inner radius, *r*, shall be selected so that no large or deep cracking occurs at the outer surface during bending. An inner radius, *r*, of approximately 2*t*, where *t* is plate thickness, is recommended. The value of the radius used for the test shall be recorded.

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× to 5× magnification.

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

6 Peel testing procedure and test equipment

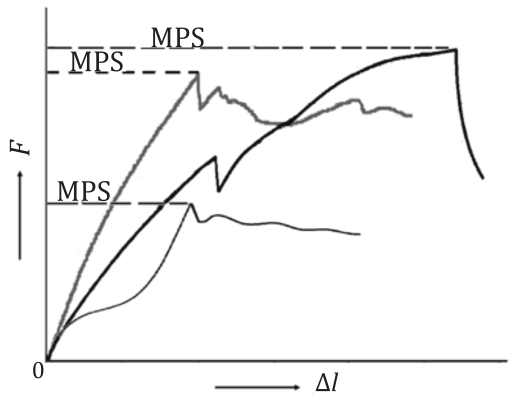
The test specimen is clamped in a tensile testing machine, which shall satisfy the requirements of ISO 7500-1 as shown in Figure 7. Force measurement accuracy shall be less than or equal to ±1 %. Testing shall be carried out at room temperature, and performed at least 10 h after welding.



Key

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

Figure 7 — Test specimen clamping for mechanized peel testing



Key

F load (applied force)

Δ*l* 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.);

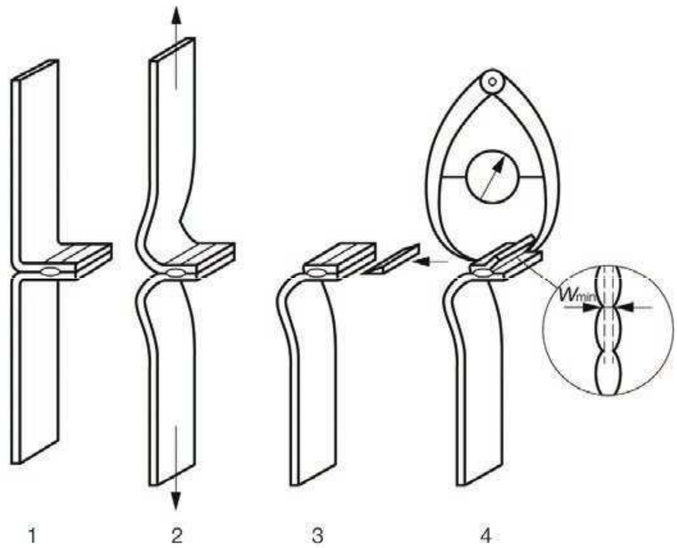
j) individual values, mean value and standard deviation of the weld diameter;

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)

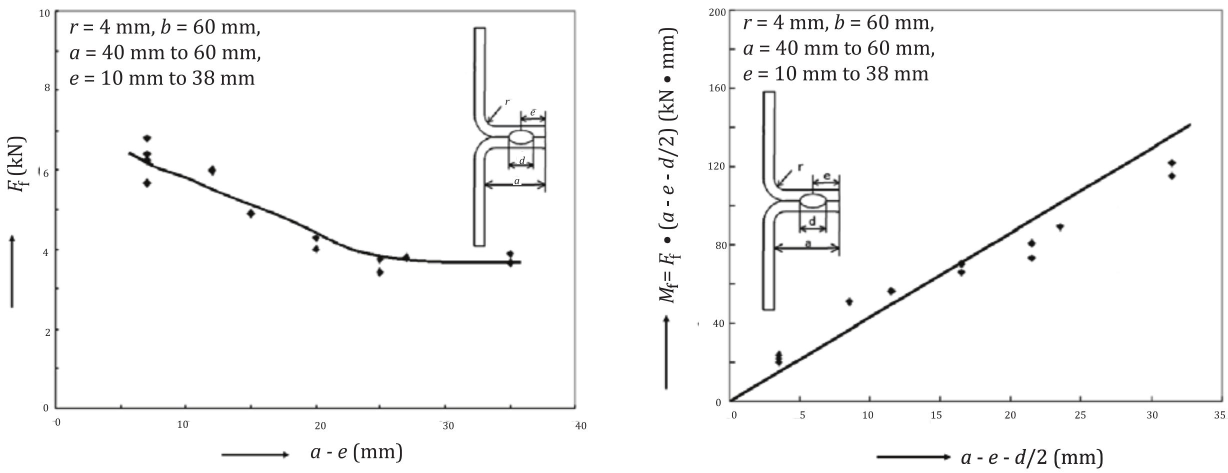
Influence of spot weld position on test results

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 degreases 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):

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

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	e	edge distance
F_m	fracture moment	r	bend radius
d	weld diameter	b	specimen width
a	flange length		

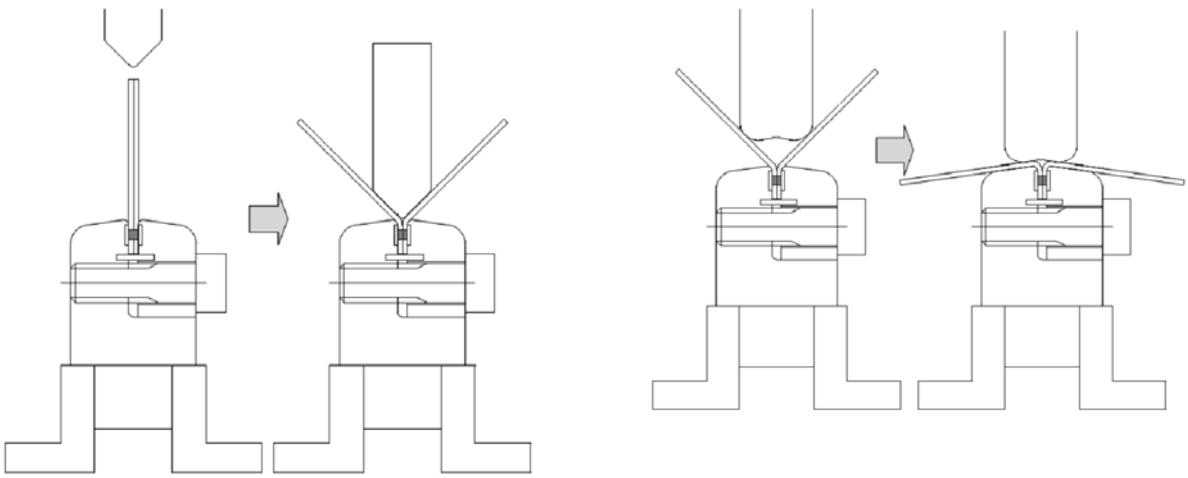
Figure B.1 — An example of the influence of weld position on test results [Materials: mild steel, Plate thickness (t = 2 mm), weld diameter ($d_W = 5\sqrt{t}$)]

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.

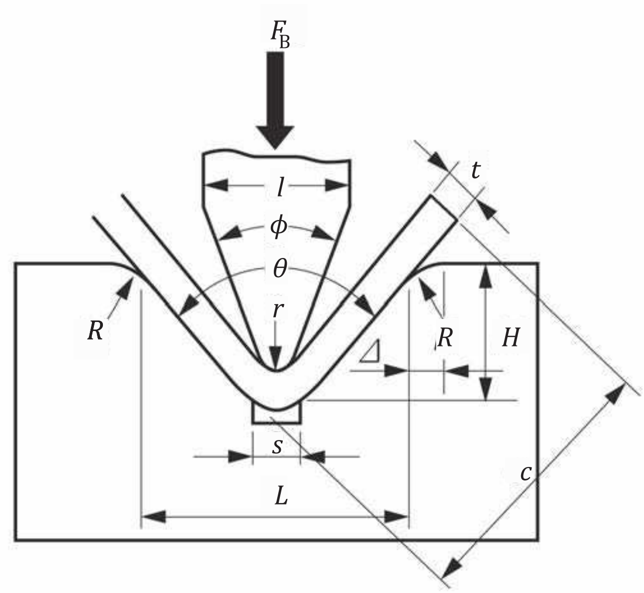


a) The first step to separate the faying surface **b) The second step to open both specimens**

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 $L + 2\Delta < 2a$

$l = 0{,}5L \sim L$

$\theta = 86° \sim 88°$

$\Phi = 80° \sim 86°$

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

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

R: 3 mm ~ 8 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.

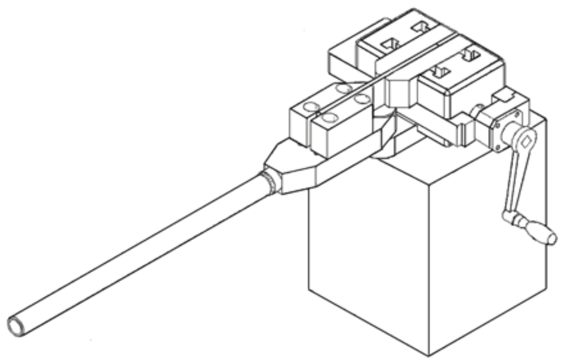
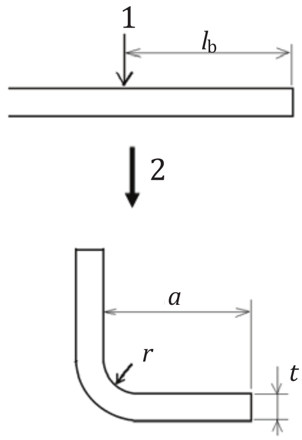


Figure C.3 — Example of another bending tool like the pipe bender to make bent test specimens

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

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

Where the value of parameter, α, is given in Table D.1.

Table D.1 — Value of parameter α

$\frac{r}{t}$	$\frac{r}{t}=0$	$0<\frac{r}{t}\le 2$	$2<\frac{r}{t}\le 5$	$5<\frac{r}{t}$
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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