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Metallic materials — Bend test

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS Z 2248** : 2014), which has been technically revised.

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Metallic materials — Bend test

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 7438** : 2020, Edition 4, with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the method of bend test for metallic materials [1].

Annex B shows the method of bend test at plane strain conditions by agreement between the purchaser and the supplier, for reference.

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 7438 : 2020 *Metallic materials — Bend test* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

Note [1] In **ISO 7438**, it is described as "a method for determining the ability of metallic materials to undergo plastic deformation in bending".

2 Normative reference

Part or all of the provisions of the following standard, through reference in this text, constitute provisions of this Standard. The most recent edition of the standard (including amendments) indicated below shall be applied.

JIS G 0202 *Glossary of terms used in iron and steel (Testing)*

3 Term and definition

For the purpose of this Standard, the following term and definition, and those given in **JIS G 0202** apply.

3.1

test force

force applied to test piece for the purpose of testing

4 Symbols and designations

The devices used in the bend test are as shown in Figure 1 to Figure 5, and the sym-

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bols and designations in Table 1. The devices of other types having an equivalent function are acceptable.

Table 1 Symbols and designations

Symbol	Designation	Unit
a	Thickness or diameter of test piece (or diameter of the inscribed circle for pieces of polygonal cross-section)	mm
b	Width of the test piece	mm
c	Distance between the plane including the horizontal axis of supports and the central axis of the rounded portion of the former before test	mm
D	Diameter of the former or the mould	mm
f	Displacement of the former from the position before test (see Annex A)	mm
θ	Load angle parameter, i.e. strain path direction (see Annex B)	—
L	Length of the test piece	mm
l	Distance between supports	mm
η	Triaxiality factor (see Annex B)	—
p	Distance between the vertical planes including the central axis of each support and the vertical plane including the central axis of the former (see Annex A)	mm
R	Radius of the supports (see Annex A)	mm
r [a)]	Internal radius	mm
α_B	Angle of bend	°
Note [a)] Equal to the tip radius of former or mould.		

5 Principle of testing

The bend test consists of submitting a test piece of round, square, rectangular or polygonal cross-section to plastic deformation by bending, without changing the direction of loading, until a specified angle of bend is reached, and is to examine for the cracks on the outer surface of curvature of the test piece. The axes of two legs of the test piece remain in a plane perpendicular to the axis of bending without torsion. In the case of 180° bending, the two lateral surfaces may, depending on the requirements of the relevant product standard, lie flat against each other or may be parallel at a specified distance, an insert being used to control this distance.

NOTE The test equipment (see Clause 6) and the test method (see Clause 8) are adequately selected according to the shape of test piece, angle of bend etc.

6 Test equipment

6.1 General

The bend test shall be carried out in testing machines or presses equipped with one of the following devices. The devices having an equivalent function are acceptable.

a) Bending device with two supports and a former (see Figure 1) (pressing bend method)

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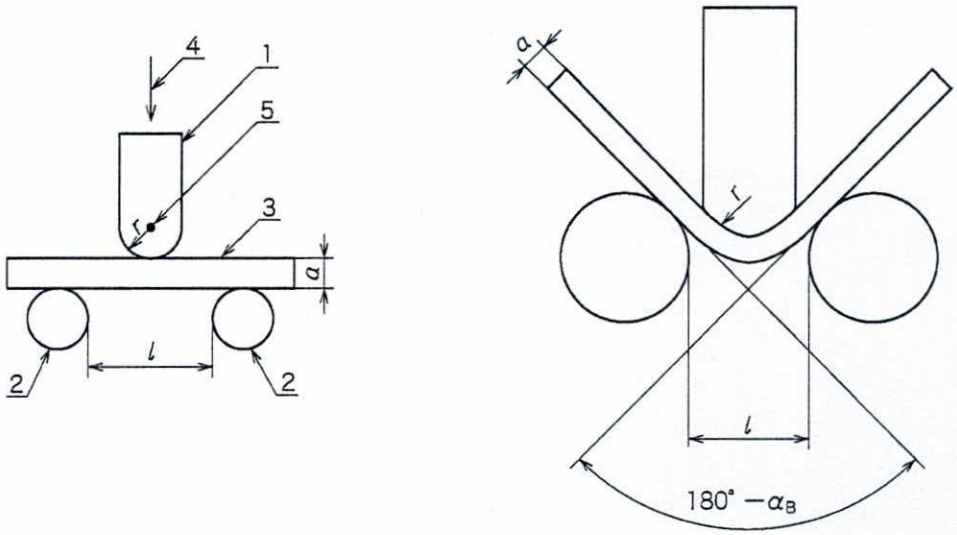
b) Bending device with a clamp (see Figure 2) or bending device with a mandrel or mould (see Figure 3) (winding bend method)

c) Bending device with a V-block and a former (see Figure 4) (V-block method)

d) Bending device capable of pushing in from legs of test piece (see Figure 5)



Key
1 : Former
2 : Support
3 : Test piece
4 : Direction of test force
5 : Centre of tip radius of former

Figure 1 Bending device with supports and former (pressing bend method)

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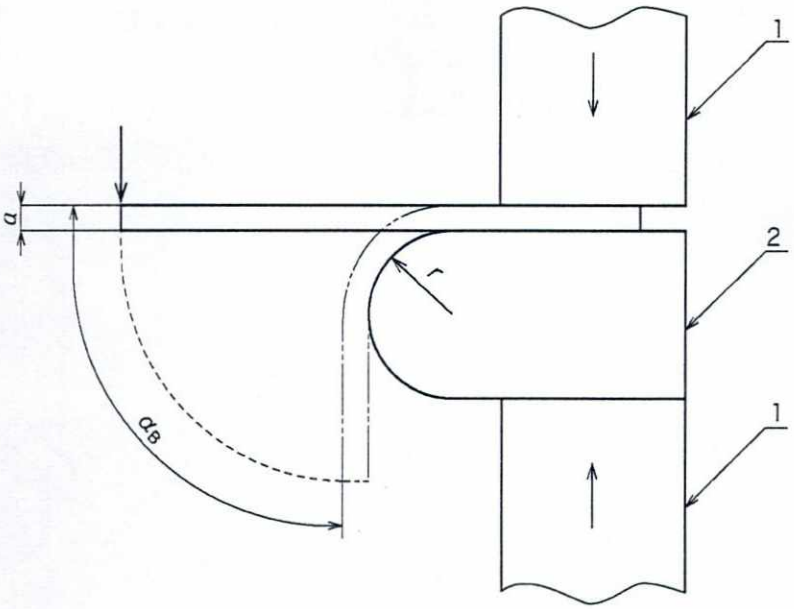

Key
1 : Clamp
2 : Mould

Figure 2 Bending device with clamp (winding bend method)

Key
1 : Test force
2 : Test piece
3 : Mandrel
4 : Mould

a) **Case of mandrel** b) **Case of mould**

Figure 3 Bending device with mandrel or mould (winding bend method)

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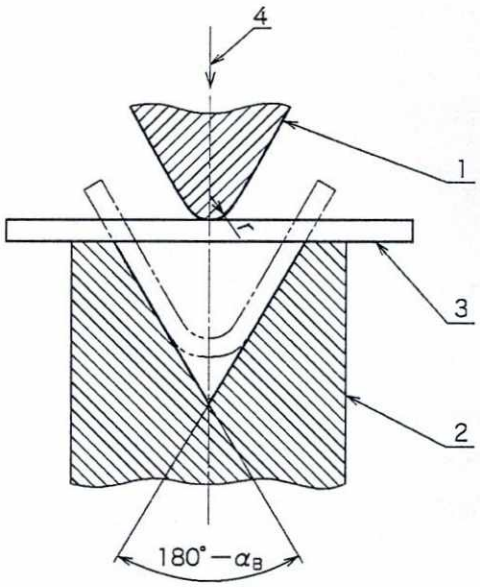

Key
1 : Former
2 : V-block
3 : Test piece
4 : Direction of test force

Figure 4 Bending device with V-block and former (V-block method)

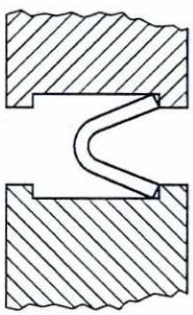

Figure 5 Bending device capable of pushing in from legs of test piece

6.2 Bending device with supports and former (pressing bend method)

6.2.1 The length of the supports and the width of the former shall be greater than the width or diameter of the test piece. The tip radius r of the former is determined by the relevant product standard (see Figure 1). Unless otherwise specified in the relevant product standard, the tip radius r of the former shall be not more than the specified inside radius for bending (see **8.2.1**). In the case of the especially small inside diameter, an adequate inside radius shall apply. The supports and the former shall be of sufficient hardness.

6.2.2 Unless otherwise specified, the distance between the supports, l, is obtained ac-

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cording to Formula (1), when a is over 10 mm. When a is not more than 10 mm, the distance is obtained according to Formula (2). l shall not change during the bend test.

$$a > 10 \text{ mm} \quad l = (D + 3a) \pm \frac{a}{2} \quad \cdots\cdots (1)$$

$$a \leq 10 \text{ mm} \quad l = (D + 3a) \pm 5 \quad \cdots\cdots (2)$$

NOTE When the distance between the supports, l, is specified as smaller than or equal to $D + 2a$, it can result in clamping during the test and stretch forming of the test piece.

6.2.3 The supports and the axis of former shall be parallel to each other.

6.2.4 The part of the support to be contact with the test piece shall have a cylindrical surface, and the radius shall be not less than 10 mm.

6.3 Bending device with clamp (winding bend method)

The device consists of a clamp and a mould of sufficient hardness. It may be equipped with a lever for applying force to the test piece.

Because the position of the left face of the clamp can influence the test results, the left face of the clamp should not reach up to or beyond the vertical line through the centre of the circular mould shape (see Figure 2).

6.4 Bending device with mandrel or mould (winding bend method)

One side of the test piece is pressed and other side is wound around a mandrel or a mould using a device to attain an appropriate middle part of the test piece as specified (see Figure 3).

6.5 Bending device with V-block and former (V-block method)

The tapered surfaces of the V-block shall form an angle of $180° - \alpha_B$ (see Figure 4). The angle α_B and the dimensions shall be as specified in the relevant product standard (see **8.2.4**).

The tip of the former shall have a radius between 1 and 10 times the thickness of the test piece and shall be of sufficient hardness.

7 Test piece

7.1 General

Round, square, rectangular or polygonal cross-section test pieces shall be used in the test. Any areas of the material affected by shearing, flame cutting or similar operations during the sampling of test pieces should be removed. However, testing a test piece, the affected parts of which have not been removed, is acceptable, provided that the result is satisfactory.

Test pieces are divided into Test piece No. 1, Test piece No. 2 and Test piece No. 3 according to their shapes, and their dimensions are as given in **7.3**. The sampling and preparation of test pieces shall be as specified in the product standard of relevant Japanese Industrial Standard. Unless otherwise specified, any unnecessary defor-

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mation or heating on the portion to be used as the test pieces shall be avoided.

By agreement between the purchaser and the supplier, the thickness and width of the test pieces may be larger than the values specified in 7.3 (see 7.5).

7.2 Edges and side faces of rectangular test pieces

The edges of rectangular test pieces shall be rounded to a radius not exceeding the following values.

— 3 mm, when the thickness of test piece is 50 mm or greater

— 1.5 mm, when the thickness of test piece is less than 50 mm and more than or equal to 15 mm

— 1/10 of thickness, when the thickness of test piece is less than 15 mm and more than or equal to 10 mm

— 1 mm, when the thickness of test piece is less than 10 mm

The rounding should be made so that no transverse burrs, scratches or marks are formed which can adversely affect the test results. However, testing a test piece, the edges of which have not been rounded, is acceptable, provided that the result is satisfactory.

The side face produced by cutting process shall be machined as necessary.

7.3 Shapes and dimensions of test pieces

7.3.1 Test piece No. 1

This type of test pieces is used mainly for the bend test of metal plate, bar and square material of the product thickness of not less than 3 mm. The dimensions of test piece are as shown in Figure 6. The thickness of test pieces from sheets and strips shall be equal to the thickness of the product to be tested. If the product thickness is greater than 25 mm, the test piece of which only one surface is machined to reduce the thickness may be used. In this case, the thickness of test piece shall be not less than 25 mm. During bending of such a test piece, the unmachined side shall be on the tension-side surface of the test piece. The width of test piece shall be 20 mm to 50 mm, if the product thickness is not less than 3 mm. The width of test piece shall be the same as the product width, if the product width is not more than 20 mm.

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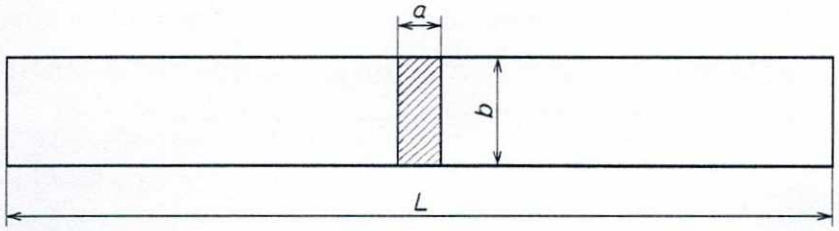
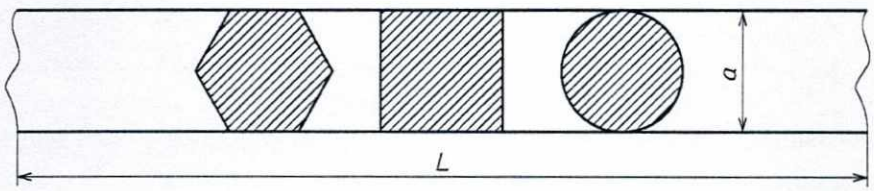


Key
a : thickness (thickness of product)
b : width, 20 mm to 50 mm (thickness of product, if the product thickness is not more than 20 mm)
L: length (according to the thickness of test piece and the test equipment used)

Figure 6 Test piece No. 1

7.3.2 Test piece No. 2

This type of test pieces is used mainly for the bend test of steel bar and non-ferrous material bar having round or polygonal cross-section. The test pieces of round or polygonal cross-section shall have a cross-section equal to that of the product, if the diameter (for a round cross-section) or inscribed circle diameter (for a polygonal cross-section) does not exceed 50 mm (see Figure 7). When the diameter or the inscribed circle diameter of the test piece exceeds 30 mm up to and including 50 mm, the test piece may be worked to reduce the diameter or inscribed circle diameter to not less than 25 mm. When the diameter or inscribed circle diameter exceeds 50 mm, the test piece shall be worked to reduce the diameter or inscribed circle diameter to not less than 25 mm (see Figure 8).



Key
a [a)] : diameter (for a round cross-section) or inscribed circle diameter (for a polygonal cross-section)
L : length (according to a of test piece and the test equipment used)
Note [a)] Product dimension.

Figure 7 Test piece No. 2

Unit: mm

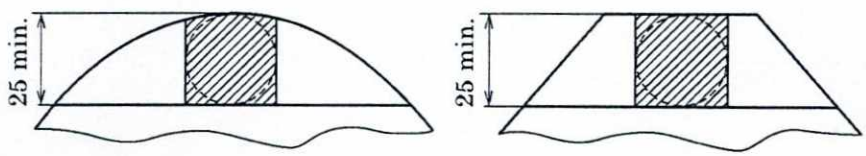


Figure 8 Test piece No. 2 (when diameter or inscribed circle diameter of test piece exceeds 30 mm)

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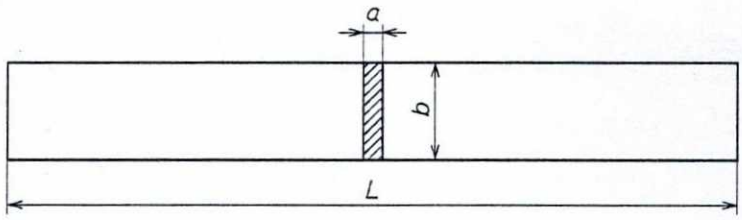
7.3.3 Test piece No. 3

This type of test pieces is used mainly for the bend test of metal plate having the product thickness of less than 3 mm. The dimensions of test piece are as shown in Figure 9. The width of test piece shall be 15 mm to 50 mm (see Figure 9). The thickness of test piece shall be equal to the thickness of the product to be tested.



Key
a : thickness (thickness of product)
b : width [15 mm to 50 mm [a)]]
L : length (according to the thickness of test piece and the test equipment used)
Note [a)] In **ISO 7438**, the upper limit of width of test piece is specified to be 25 mm.

Figure 9 Test piece No. 3

7.4 Test pieces taken from forgings, castings and semi-finished products

In the case of forgings, castings and semi-finished products, the shape of test piece and the sampling method shall be as defined in the relevant product standard, or by agreement between the purchaser and the supplier.

7.5 Agreement on wide and thick test pieces

By agreement between the purchaser and the supplier, test pieces of a greater width and thickness than those specified in **7.3** may be subjected to the bend test.

8 Test methods

WARNING During the test, adequate safety measures and guarding equipment shall be provided.

8.1 Test temperature

In general, tests are carried out at ambient temperature between 10 °C and 35 °C. Tests carried out under controlled conditions, where required, shall be made at a temperature of 23 °C ± 5 °C.

8.2 Test procedure

8.2.1 General

The bend test shall be carried out as follows.

In the test, the test force should be applied slowly so as to permit free plastic flow of the material.

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NOTE In **ISO 7438**, "In case of dispute, the rate of displacement of the former shall be (1 ± 0,2) mm/s." is described as the requirement.

The angle of bend specified in the relevant product standard shall always be used as the minimum limit, and bending shall be made by the angle not less than this. The inside radius of bending, if specified, shall be used as the maximum limit, and bending shall be made by the angle not more than this.

By agreement between the purchaser and the supplier, plane strain conditions (defined in Annex B) can be determined for the test pieces having the thickness of over 3 mm. In this case, the bend test should be carried out, referring to Annex B.

8.2.2 Pressing bend method

The pressing bend method shall be as follows.

In the bend test, using such a bending device with supports and a former (see Figure 1), the test piece shall be placed on the middle between supports and bent to a specified angle by applying an adequate force. The bend angle to be formed by the method shall be up to approximately 170°. The surfaces of former and supports which contact with the test piece may be coated with lubricant (oil etc.).

The angle of bend α_B can be calculated from the measurement of the displacement of the former as given in Annex A.

If it is difficult to bend the test piece to the specified angle by the method described above, the bend shall be completed by directly pushing in the legs of test piece (see Figure 5).

When the bend angle is 180°, the test piece shall be compressed, after being bent to approximately 170° by means of the method shown in Figure 1 etc. on legs towards one another by the method shown in Figure 10. The test piece may be placed between the parallel plates of a press by means of an insert having a thickness twice the specified inside radius.

Using a bending device with supports and a former (see Figure 1), when the distance between two supports is made as $l = D + 2a$ and the tolerance as shown in Table 2, the test piece may be deemed to have been bent to 180° when pushed until it passes through the clearance between the supports.

Table 2 Tolerances on distance between supports

Unit: mm

Thickness, diameter or diameter of inscribed circle of test piece a	Tolerance	
	+ side	− side
Over 10	$a/2$	0
Not more than 10	5	0

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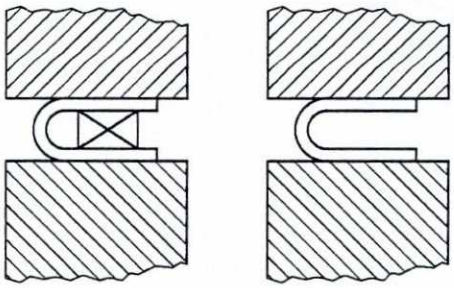

Figure 10 Legs of test piece parallel to each other

The test piece shall be bent to approximately 170° with a suitable inside radius at first, then bent up to when the legs of the test piece are in direct contact without an insert as shown in Figure 11.

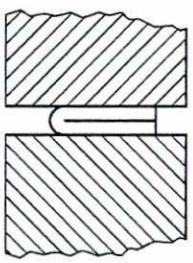

Figure 11 Legs of test piece in direct contact

8.2.3 Winding bend method

The winding bend method shall be as follows.

Using such a bending device with a mandrel or a mould (see Figure 3), one side of test piece is pressed and other side is wound around a mandrel or a mould by a specified angle to gain an appropriate middle shape of the test piece. The position to which the test force is applied is as shown in **a**) and **b**) of Figure 3.

8.2.4 V-block bend method

The test piece is placed on the V-block, and the test force is gradually applied to the middle with a former to gain an appropriate middle shape of the test piece (see Figure 4). The V-block method shall be carried out when specified by the relevant product standard.

9 Interpretation of results

The interpretation of the bend test shall be carried out according to the requirements of the relevant product standard. When these requirements are not specified, absence of cracks visible without the use of magnifying aids is considered as evidence that the test piece withstood the bend test.

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NOTE The existence of an oxide layer on the unmachined surface on the tension side of the bend test piece has an influence on the judgment of the results. This point can be considered by the relevant product standard or between the purchaser and the supplier.

10 Test report

When the test report is required, the information to be reported is selected from the following by agreement between the purchaser and the supplier.

a) Reference to this Standard

b) Identification of test piece (type of material, heat number, direction of test piece axis relative to a product etc.)

c) Shapes/dimensions of test piece

d) Test methods

e) Item as agreed between the purchaser and the supplier

f) Test results

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Annex A (informative)
Determination of the bend angle from the measurement of the displacement of the former

This Annex specifies the determination of the bend angle of a test piece under force. The direct measurement of this angle is complicated. For this reason, the method of calculation of this angle from the measurement of the displacement f of the former is proposed. The bend angle, α_B, of the test piece under force can be determined from the displacement of the former and the values shown in Figure A.1, according to the following formulae.

$$\sin\frac{\alpha_B}{2}=\frac{p\times c+W\times(f-c)}{p^2+(f-c)^2}$$

$$\cos\frac{\alpha_B}{2}=\frac{W\times p+c\times(f-c)}{p^2+(f-c)^2}$$

where, α_B : angle of bend of test piece

p : distance between the vertical planes including the central axis of each support and the vertical plane including the central axis of former

c : $c=R+a+r$

a : thickness of test piece

r : tip radius of former

R : radius of support

W: $\sqrt{p^2+(f-c)^2-c^2}$

f : displacement of former from the position before test

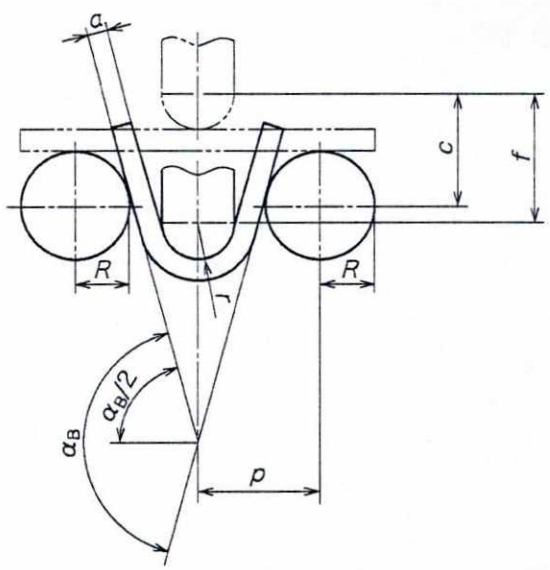

Figure A.1 Values for calculation of angle of bend α_B

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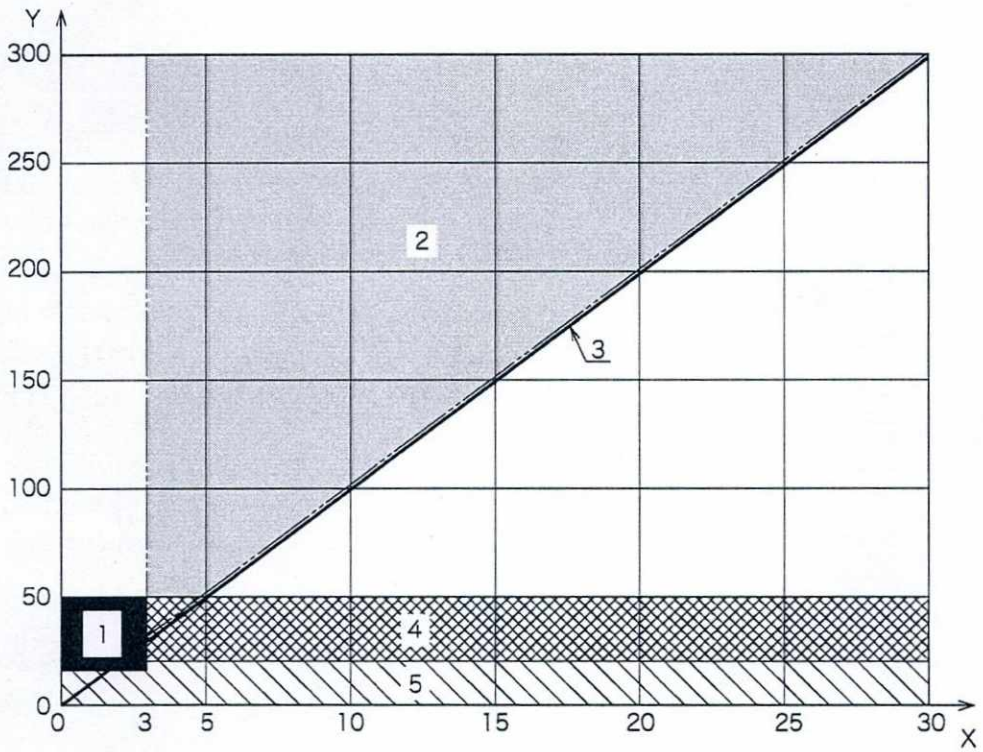
Annex B (informative)
Bend test at plane strain conditions

B.1 Overview

The use of this Annex shall be as agreed between the purchaser and the supplier.

The different combinations of thickness and width from those specified in 7.3.1 and 7.3.3 and the condition for plane strain are shown in Figure B.1 as a guide for selecting test piece width. The line in bold (Symbol 3 in Figure B.1) is separating plane strain from non-plane strain conditions.



Key
X : thickness a (mm)
Y : width b (mm)
1 : 15 mm ≤ b ≤ 50 mm, when a < 3 mm (see **7.3.3**)
2 : a > 3 mm and $b \geq 10 \cdot a$
3 : plane strain condition, $b \geq 10 \cdot a$
4 : 20 mm ≤ b ≤ 50 mm, when $a \geq 3$ mm (see **7.3.1**)
5 : $b \leq 20$ mm (see **7.3.1**)

Figure B.1 Combinations of thickness a and width b in relation to plane strain condition, for test pieces given in 7.3

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A bend test suitable for all applications and dimensions of a product should test the product in the most extreme state. The most extreme state of bending occurs when a plane strain condition is achieved. To attain plane strain conditions, a test piece width-to-thickness ratio (b/a) ≥ 10 should be employed. This critical state (plane strain) is not reached if the width of the test piece is too small.

The specifications given in this Annex can however lead to the following effects :

— reduced angles of approved bend, α_B, in comparison with test piece widths specified before in **7.3**;

— as a consequence, test pieces can fail;

— increase of the testing force;

— increase of the weight of the test piece;

— the bendability requirements in product standards may not be fulfilled.

Nevertheless, the results of tests carried out according to this Annex are more realistic for several applications (see **B.2**).

However, a test piece with a round or hexagonal cross-section (bar) is not an issue, since the most critical state (plane strain) is never attained.

B.2 General

Bendability of a sheet or a plate (rectangular shaped test piece) depends greatly on the width of the test piece. Different test piece widths promote different strain states. Bend tests carried out on a too short test piece width can promote a non-conservative result (higher ductility, i.e. less tendencies for failures). In Figure B.2, this is very clearly indicated. The same former diameter has been used but the bend results are very different depending on the width of the test piece used. The test piece to the left has a width, b, of four times the thickness, a. A too short width, b, in relation to the thickness, a, never attains the critical level of the triaxiality factor [$\eta(\bar{\theta} = 0) = +1/\sqrt{3} \approx 0.58$] representing plane strain condition (in tension) [1]. This value is obtained by the relation between triaxiality factor, η, and the Lode angle parameter, $\bar{\theta}$, ([2] to [4]) [see Formula (B.1)] calculating the roots setting the Lode angle parameter to $\bar{\theta} = 0$, i.e. representing plane strain path.

$$\cos\left[\frac{\pi}{2}(1-\bar{\theta})\right] = -\frac{27}{2}\eta\left(\eta^2 - \frac{1}{3}\right) \quad \text{(B.1)}$$

In Figure B.2 approximate values of the triaxiality factor are shown (based on finite element simulations), confirming a good correlation between areas exposing failures and reaching triaxiality factor above the limit for plane strain.

NOTE The lode angle parameter and triaxiality factor are used for information about the mechanical background of plane strain condition, but they are not directly used in the test. The plane strain conditions are achieved if the specifications of **B.3** are used.

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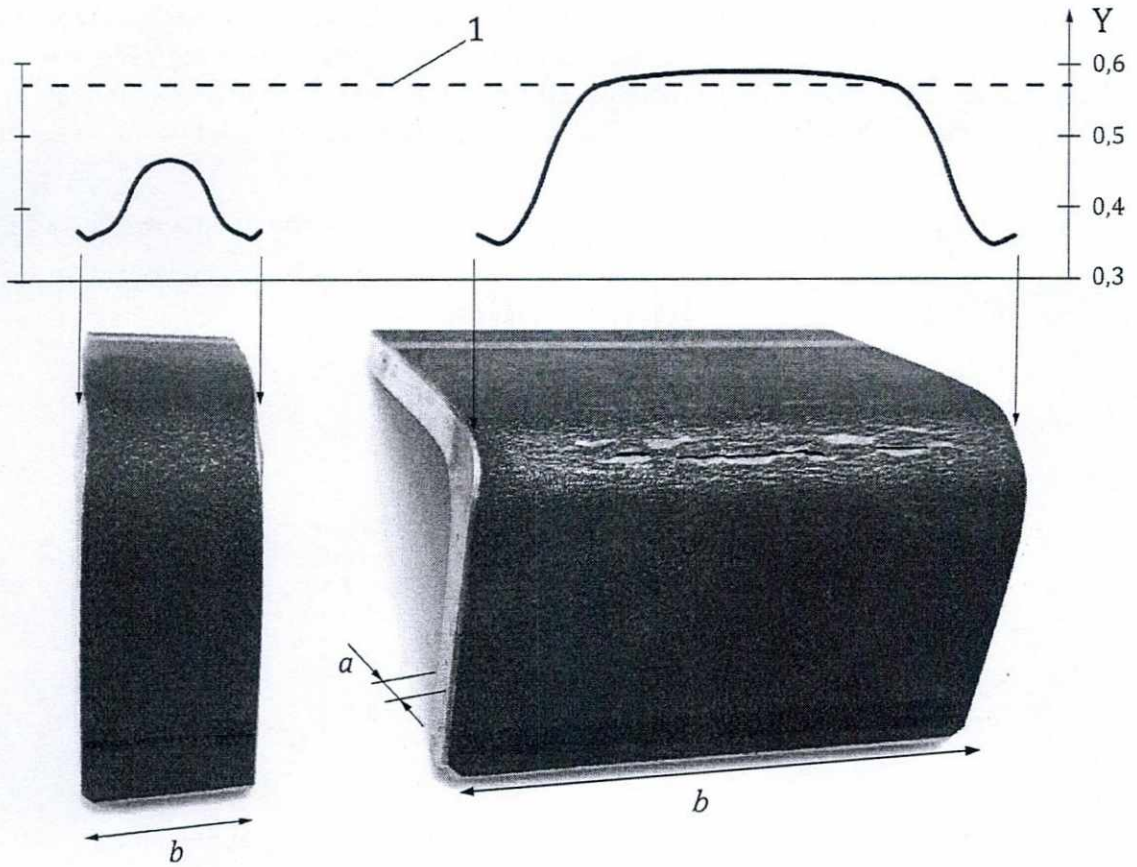

Key
Y : triaxiality factor
1 : critical value for plane strain condition

Figure B.2 Differences in bendability depending on width *b*

B.3 Test piece

To attain plane strain conditions, a test piece width-to-thickness ratio (b/a) ≥10 shall be used.

This requirement is however already fulfilled for some thinner test pieces in **7.3**, as shown in Figure B.1.

B.4 Assessment

For rectangular test pieces, cracks can originate from the edge, as a result of poor edge preparation. These edge cracks are not an indication that the test piece failed the bend test as defined in **7.1**. Therefore, cracks originating from the edge and extending no more than two thicknesses from the edge shall not be included in the test interpretation of **7.1**. However, if the cracks originating from the edge extend more than two times the thickness into the width, then that test piece shall be considered invalid.

NOTE For a test piece width of about 10 times the thickness, the plane strain

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region corresponds to about the centre 60 % of the total width. Since plane strain bending assessment is desired, crack assessment is only considered in this region, and cracks occurring from the edges that do not extend into this area are not taken into consideration for the interpretation of the test results.

B.5 Test report

In addition to the information required in Clause **10 a)** to **f)**, the report shall also contain information about the dimensions of the test piece used. Furthermore, a reference to this Annex shall be included.

Example **JIS Z 2248**, Annex B.

Bibliography

[1] Li Y., Wierzbicki T. "*Prediction of plane strain fracture of AHSS sheets with post-initiation softening*", Int. Journal of Solids and Structures 47, 2316-2327, (2010)

[2] Bai Y., Wierzbicki T., "*A new model of metal plasticity and fracture with pressure and Lode dependence*", Int. Journal of Plasticity 24, 1071-1096, (2008)

[3] Wierzbicki T., Xue L., "*On the Effect of the Third Invariant of the Stress Deviator on Ductile Fracture*". Technical Report", Impact and Crashworthiness Laboratory, Massachusetts Institute of Technology, Cambridge, MA. (2005)

[4] Bai Y., Wierzbicki T. "*Application of extended Mohr-Coulomb criterion on ductile fracture*", Int. Journal of Fracture 161, 1-20 (2010)

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Annex JA (informative)

Comparison table between JIS and corresponding International Standard

JIS Z 2248		**ISO 7438** : 2020, (MOD)		
a) No. of clause (**JIS**)	b) No. of clause (corresponding International Standard)	c) Classification by clause	d) Detail and justification of technical deviation	e) Future measures for the technical deviation
1	1	Addition	"a method for determining the ability of metallic materials to undergo plastic deformation in bending" described in the main body of **ISO** is described as Note 1) in **JIS**.	Addition in light of situations unique to Japan.
3	3	Addition	**JIS** adds the definition of the term "test force".	Technical deviation is slight.
4	4	Addition	**JIS** adds practical examples of the test equipment other than that specified in **ISO**.	Technical deviation is slight.
5	5	Addition	**JIS** adds the examination for the cracks and the torsion of the test piece.	Technical deviation is slight.
6.1	6.1	Addition	**JIS** adds names of test equipment used in Japan.	Addition in light of situations unique to Japan.
		Addition	**JIS** adds Figure 3.	Addition in light of situations unique to Japan.
6.2	6.2	Addition	**JIS** adds the requirement for the radius of cylindrical surface of former as "unless otherwise specified in the relevant product standard, the radius shall be not more than the specified inside radius for bending".	Technical deviation is slight.
		Alteration	**JIS** adds the requirement for the distance between the supports when *a* is not more than10 mm.	Proposal to **ISO** will be considered.
		Addition	**JIS** adds the requirement that the supports and the axis of former are required to be parallel to each other.	Technical deviation is slight.
		Addition	**JIS** adds the requirement that the radius of supports is not less than10 mm.	Proposal to **ISO** will be considered.

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a) No. of clause (**JIS**)	b) No. of clause (corresponding International Standard)	c) Classification by clause	d) Detail and justification of technical deviation	e) Future measures for the technical deviation
6.4	—	Addition	**JIS** adds the requirement for the bending device with mandrel or mould (winding bend method)	Addition in light of situations unique to Japan.
7.1	7.3, 7.4	Addition	**JIS** adds the requirements for Test piece No. 1 to Test piece No. 3, and specifies their dimensions in Figure 6 to Figure 9.	Addition in light of situations unique to Japan.
	7.1	Addition	**JIS** adds "The sampling and preparation of test pieces shall be as specified in the product standard of relevant Japanese Industrial Standard. Unless otherwise specified, any unnecessary deformation or heating on the portion to be used as the test pieces shall be avoided".	Addition in light of situations unique to Japan.
7.2	7.2	Alteration	**JIS** alters the ranges for the radius of edge for test pieces of thickness 10 mm to 50 mm by adopting new ranges separated at 15 mm.	Proposal to **ISO** will be considered.
	7.3	Alteration	**JIS** alters the width of test piece to 15 mm to 50 mm, having the product thickness of less than 3 mm.	The reason is explained. Technical deviation is slight.
8.2	7.3	Alteration	**JIS** alters the description in **ISO** to "the bend test should be carried out, referring to Annex B."	Alteration in light of situations unique to Japan.
	8.3	Deletion	**JIS** deletes the requirement for the rate of displacement of the former in case of dispute.	The statement is deleted because there is no testing machine capable of measuring the displacement speed in Japan. Practical influence is small.
	8.3	Addition	**JIS** adds the requirement that the bend angle to be formed by the method shall be up to approximately 170°.	The angle over 170° is deemed as 180° practically. Technical deviation is slight.
	8.2	Alteration	**JIS** specifies the test procedure according to the test method (test equipment).	Technical deviation is slight.
	9.2	Addition	**JIS** moves the description to **8.2.1**.	Technical deviation is slight.
Annex B	Annex B	Alteration	**JIS** alters this Annex as informative.	No cases in Japan.

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NOTE 1	Symbols in sub-columns of classification by clause in the above table indicate as follows : — Deletion : Delete the specification item(s) or content(s) of International Standard(s). — Addition : Add the specification item(s) or content(s) which are not included in International Standard(s). — Alteration : Alter the specification content(s) or structure of International Standard(s).
NOTE 2	Symbol of overall degree of correspondence between **JIS** and International Standard(s) in the above table indicates as follows : — MOD : Modify International Standard(s).

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Errata for **JIS** (English edition) can be downloaded in PDF format at Webdesk (purchase information page) of our website (https://www.jsa.or.jp/).

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