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Metallic Materials – Bend Test

金属材料 弯曲试验方法

Replaced

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Metallic Materials - Bend Test

1 Scope

This Standard specifies the principle for bend test method, symbols, test devices, specimen, test procedures, assessment of test results, and test report.

This Standard is applicable to the bend test for specimen that is specified by the relevant product standards of the metallic materials; and determine its bending plastic deformation. However, it is not applicable to the bend tests for metallic tubes and metallic welded joints.

2 Normative References¹⁾

The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. At the time of publication, the editions indicated are valid. All standards are subject to revision. The parties who are using this Standard shall explore the possibility of using the latest version of the following standards.

GB/T 2975-1998 Steel and Steel Products - Location and Preparation of Test Pieces for Mechanical Testing

3 Principle

The bend test consists of submitting a specimen 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.

During the bend test, the axes of two arms of the specimen remain in a plane perpendicular to the axis of bending. In the case of a 180° bend test, according to the requirements of relevant product standard, the specimen shall be bent till the two arms are at a specified distance, parallel to each other; or the two arms come into contact directly.

¹⁾ The contents of this Clause are not specified in ISO 7438:1985. The quoted national standard GB/T 2975-1998 is equivalent to the international standard ISO 377:1997 *Steel and Steel Products - Location and Preparation of Test Pieces for Mechanical Testing*.

one of the following bending devices:

- a) Bending device with roller as shown in Figure 1;
- b) Bending device with a V-block as shown in Figure 2;
- c) Bending device with a clamp as shown in Figure 3;
- d) Bending device with turning plate as shown in Figure 4.

5.1 Bending device with roller

5.1.1 The length of the roller shall be greater than the width or diameter of the specimen. The radius of the roller shall be 1~10 times thickness of the specimen. The roller shall be of sufficient hardness.

5.1.2 Unless otherwise specified, the distance between the rollers (see Figure 1) shall be determined as per the Formula (1):

$$l = (d + 3a) \pm 0.5a \quad \dots\dots\dots (1)$$

Such distance shall remain unchanged during the test.

5.1.3 The diameter of the bending head shall be specified in the relevant product standard. The width of the bending head shall be greater than the width or diameter of the specimen. The bending head shall be of sufficient hardness.

5.2 Bending device with a V-block

The angle of the V-block shall be $180^\circ - \alpha$ (see Figure 2). The bending angle shall be specified in the relevant product standard. The corner radius of the bending head is $d/2$.

The supporting edges of the V-block shall be rounded; and its rounding radius shall be 1 ~ 10 times thickness of the specimen. The width of the mold and bending head shall be greater than the width or diameter of the specimen. The bending head shall be of sufficient hardness.

5.3 Bending device with a clamp

The device consists of a clamp and a bending center of sufficient hardness (see Figure 3). It may be equipped with a lever for applying force. The diameter of the bending center shall be as specified in relevant product standard; the width of the bending center shall be greater than the width or diameter of the specimen.

- a) When the width of product is no greater than 20mm, the width of the specimen shall be that of the original product;
- b) When the width of a product is greater than 20 mm, and the thickness is less than 3mm, the width of the specimen shall be (20 ± 5) mm. When the thickness is no less than 3mm, the width of the specimen shall be 20~50mm.

6.4 The thickness or diameter of the specimen shall meet the requirements of relevant product standard. If not specified, it shall be as follows:

6.4.1 For the sheets, strips and sections, when the thickness of the product is no greater than 25mm, the thickness of the specimen shall be that of the original product. When the thickness of the product is greater than 25mm, the thickness of the specimen may be reduced by machining to no less than 25mm, and one-side shall be retained unmachined. The unmachined side of the specimen during the bend test shall be on the tension-side.

5.4.2 For products with a diameter or polygonal cross-section whose inscribed circle diameter is no greater than 50mm, the cross-section of the specimen shall be that of the product. If the capacity of the test equipment is insufficient, for products with a diameter or polygonal cross-section whose inscribed circle diameter exceeds 30~50 mm, it may be machined into a specimen with a cross-section whose inscribed circle diameter is no less than 25 mm according to Figure 5. For products with a diameter or a polygonal cross section whose inscribed circle diameter is greater than 50 mm, it may be machined into a specimen with a cross-section whose inscribed circle diameter is no less than 25 mm according to Figure 5. During the test, the unmachined original surface of the specimen shall be on the tensile deformation side. Unless otherwise specified, steel-reinforced products are tested by their total cross-section.

6.5 In the case of forgings, castings and semi-finished products, the dimensions of the specimen shall be as defined in the general delivery requirements, or by agreement.

6.6 For non-arbitration test, the test may be carried out by specimens with width and thickness larger than that specified in 6.3 and 6.4.

6.7 The length of the specimen depends on the thickness of the specimen and the used test equipment. When the method in Figures 1 and 4 are used, it may be determined by Formula (3):

$$L = 0.5\pi(d + a) + 140 \text{ mm} \quad \dots\dots\dots (3)$$

Where:

π is circumference ratio, taking the value of 3.1.

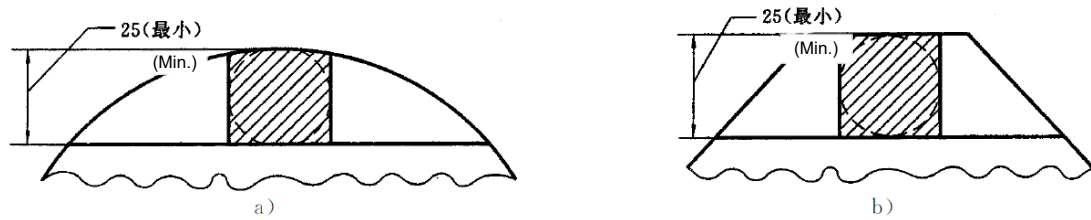


Figure 5 – Shape and Dimension of Cross-Section of Thinning Specimen

7 Test Procedures

7.1 In general, the test shall be carried out at ambient temperature between 10 °C and 35 °C. For the test with strict requirements for the temperature, the test temperature shall be at (23 ± 5) °C.

7.2 As specified by the relevant product standard, the test shall be finished by one of the following methods.

- a) The specimen is bent to a specified angle of bend under the conditions and force g given in Figures 1, 2, 3 or 4;
- b) The specimen is bent under the force till a specified distance between the two arms and parallel to each other [see Figure 4c) and Figure 7];
- c) The specimen is bent under force till the two arms are in direct contact (see Figure 8).

7.3 For the test when the specimen is bent to the specified bending angle, the specimen shall be placed on two rollers [see Figure 1a] or V-block (see Figure 2) or two horizontal turning plates [see Figure 4a)]; the axis of the specimen shall be perpendicular to the axis of the bending head; and the bending head shall continuously apply force to the specimen at the midpoint between the two supports to bend it until it reaches the specified bending angle.

If the specified bending angle cannot be reached directly, the specimen shall be placed between two parallel pressing plates (see Figure 6); and apply continuous pressure to both ends to further bend it until the specified bending angle is reached.

7.4 When the specimen is bent to a 180° angle, the two arms are spaced apart at a specified distance and are parallel to each other, and the method shown in Figure 1 is adopted, the specimen is bent initially (the bending angle shall be as large as possible); and then place the specimen between two parallel pressing plates (see Figure 6) to apply continuous pressure to both ends to further bend it till the two arms are parallel (see Figure 7). The cushion block may or may not be added. Unless otherwise specified in the product standard, the thickness of the cushion block is equal to the

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