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Metallic Materials - Sheet and Strip - Erichsen Cupping Test

(ISO 20482:2013, IDT)

金属材料 薄板和薄带 埃里克森杯突试验

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Metallic Materials - Sheet and Strip - Erichsen Cupping Test

1 Scope

This Standard specifies the method for determining the ability of metal sheets and strips to withstand plastic deformation during drawing forming by the Erichsen Cupping Test.

This Standard is applicable to the determination of metal sheets and strips with a thickness of 0.1mm~2.0mm and a width of no less than 90mm. For thicker sheets and strips or those that only the narrower specimen may be taken, then use the mold with specified size; and the subscript shall be used when indicating the results. See Table 1.

2 Normative References

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this document.

ISO 4287 Geometrical Product Specifications (GPS) - Surface Texture: Profile Method - Terms, Definitions and Surface Texture Parameters

3 Terms and Definitions

For the purpose of this document, the following terms and definitions apply.

3.1 Through crack

The crack penetrates the entire thickness of the sample, and the width of the crack is just enough to allow light to pass through the crack.

4 Symbols and Instructions

The symbols, instructions and units used in this Standard are given in Figure 1 and

5 Test Principle

A punch with a spherical end is pressed against a specimen clamped between the die mold and the die cushion to form a dent until a through crack appears. The depth of the dent measured based on the displacement of the punch is the test result.

6 Test Equipment

6.1 The test shall be carried out on a device equipped with a die mold, punch and die cushion. The dimensions and tolerances of the die mold, punch and die cushion are shown in Table 1.

6.2 The structure of the test equipment shall ensure that the outer surface of the specimen may be observed during the test, and may determine the instant when the through crack occurs.

NOTE: Usually when the crack occurs, the specimen's ability to withstand the force decreases, and sometimes it also emits a noticeable sound.

6.3 The equipment shall be equipped with a measuring tool for measuring the movement of the punch with a resolution of at least 0.1mm.

6.4 The die mold, die cushion and punch shall have sufficient rigidity and shall not deform during the test. The Vickers hardness of the working surface of the die mold, die cushion and punch is at least 750HV30. And shall meet the following requirements:

a) The punch shall not rotate during the test;

b) The working surface of the punch shall be spherical and polished; and the average roughness R_a defined by ISO 4287 shall be no greater than 0.4μm.

6.5 The distance of the die mold axis relative to the spherical center of the punch shall be less than 0.1mm within the range of stamping stroke.

6.6 The contact surface BETWEEN the die cushion, die mold AND the specimen shall be flat and perpendicular to the movement axis of the punch. The forming die mold shall be able to self-adjust with respect to the die cushion (fixed).

6.7 The test equipment shall have a constant clamping force of about 10kN to ensure that the specimen is clamped.

6.8 The test equipment shall be able to measure the displacement of the punch from the beginning of contact with the surface of the specimen.

6.9 Hardened steel balls may also be used to replace the punches specified in 6.1, 6.4,

9.5 Pressing-in and molding smoothly. For standard tests, the rate shall be controlled between 5mm/min~20mm/min. For specimens with width or diameter b<90mm, the rate shall be controlled between 5mm/min~10mm/min.

NOTE 1: For manually-operated test equipment, when the operation is near the end, the rate shall be reduced to close to the lower limit; so as to be able to accurately determine the instant of the occurrence of trough cracks.

NOTE 2: When using computer-controlled test equipment, because the test results are directly given by the force-punch displacement diagram, so there is no need to reduce the rate later in the test.

9.6 When a through crack occurs, the movement of the punch shall be stopped immediately.

NOTE: Generally, when a through crack occurs, there will be a force attenuation in the force-punch displacement diagram. This force attenuation may be used as a basis for determining the stop of the punch movement.

9.7 Measure the indentation depth of the punch, as shown, h, in Figure 1; accurate to 0.1mm.

9.8 Unless otherwise specified in the product standard, at least three tests shall be carried out; the Erichsen Cupping value *IE* shall be the average of all measured values of h readings, in millimeters (mm).

10 Test Report

The test report shall include at least the following:

a) Number of this standard;

b) Identification of the specimen (sampling position);

c) The thickness of the specimen;

d) The type of used lubricant;

e) If required, provide the specimen morphology after rupture;

f) Erichsen Cupping Value *IE* (if required, provide a single measurement value).

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