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Metallic materials - Sheet and strip - Determination of plastic strain ratio

金属材料 薄板和薄带 塑性应变比(r 值)的测定

(ISO 10113:2006, MOD)

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Metallic materials - Sheet and strip - Determination of plastic strain ratio

1 Scope

This Standard specifies the method for determining the plastic strain ratio of metal sheets and strips.

This Standard applies to materials that are uniformly plastically deformed (that is, the part of the stress-strain curve in the range of plastic deformation that increases monotonically and continuously). It is also not applicable to the materials with non-uniform plastic deformation (that is, the part of the stress-strain curve in the range of plastic deformation that has a discontinuous shape such as sawtooth).

2 Normative references

The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 228.1-2010, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature* (ISO 6892-1:2009, MOD)

GB/T 12160-2002, *Calibration of extensometers used in uniaxial testing* (ISO 9513:1999, IDT)

3 Terms and definitions

For the purposes of this Standard, the following terms and definitions apply.

3.1 plastic strain ratio; r

Under the action of uniaxial tensile stress, the ratio of the true plastic strain in the width direction and the true plastic strain in the thickness direction of the specimen is shown in formula (1):

$$r = \frac{\varepsilon_b}{\varepsilon_a} \qquad \cdots\cdots (1)$$

Where,

5 Principle

Conduct the tensile test on the specimen. Test for changes in length and width at specified plastic strain levels. Calculate the plastic strain ratio value r. The sampling direction of the specimen relative to the rolling direction and the level of plastic (engineering) strain for testing the r value are specified by the relevant product standard. As a guideline, the strain level shall be above the yield extension stage and below the amount of plastic (engineering) strain at the maximum force.

6 Test equipment

6.1 The tensile testing machine shall meet the requirements of GB/T 228.1-2010 for equipment.

6.2 The resolution of the device for measuring the gauge length of the sample shall be better than 0.01mm. For manual measurement, the resolution of the device for measuring the width shall be better than 0.005mm.

6.3 Use automatic measurement methods. The extensometer shall meet the requirements for Grade 1 in GB/T 12160-2002 or be better than Grade 1.

NOTE: When using long gauge lengths and large elongations, the length error measured by a Grade 1 extensometer may exceed ±0.01mm.

6.4 The clamping method of the specimen shall be in accordance with the provisions of GB/T 228.1-2010.

7 Specimen

7.1 Sampling shall be in accordance with relevant product standards. If the product standard is not specified, sampling is according to the agreement of the parties concerned.

7.2 Specimen type and specimen preparation, including dimensional tolerances, shape tolerances, and original gauge length markings, shall comply with the provisions of Annex B of GB/T 228.1-2010. In addition, it is also required that the two sides of the specimen shall be sufficiently parallel within the gauge length range, so as to ensure that the difference between any two width measurements is less than 0.1% of the average width measurement.

7.3 Except for special requirements, the thickness of the specimen is the thickness of the test plate.

7.4 There shall be no damage such as scratches on the surface of the specimen.

8 Test procedures

8.1 The test is generally carried out at room temperature of 10℃~35℃. When it is required to conduct the test under controlled temperature conditions, the temperature shall be controlled at (23±5)℃.

8.2 If manual measurement is used, the original width of at least 3 points must be measured at equal intervals within the gauge length of a specimen, including one measurement at each end of the gauge length. The average of these widths is used to calculate the plastic strain ratio.

8.3 If automatic measurement is used, the length extension and the width change at the at least one point shall be measured using an extensometer that conforms to the provisions of Clause 6.

8.4 During the plastic deformation stage, the strain rate shall not exceed 0.008/s.

8.5 Clamp the specimen in the tester chuck. Keep the test speed within the speed range specified in 8.4. Make the desired transformation:

a) Meet the plastic (engineering) strain levels specified in the relevant product standards;

b) Measure the length and width within the gauge length of the specimen or within the gauge length of the extensometer at the level of plastic (engineering) strain specified in the relevant product standard.

8.6 The test is invalid if the specimen exhibits transverse bending that affects the test results (see Figure 1). The test shall be reconducted.

8.7 If the plastic strain is not uniform, manual determination of the r value cannot be performed. Use the continuously measured length extension and corresponding width change data. Apply the statistical methods specified in 9.2. Reproducible r values can be calculated.

8.8 Coated materials (such as galvanized or organic coatings) may have different r values than uncoated base materials.

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