SLOVENSKI STANDARD
SIST ISO 10113:1998

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Kovinski materiali - Tanka pločevina in trakovi - Ugotavljanje količnika plastične anizotropije

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

Matériaux métalliques -- Tôles et bandes -- Détermination du coefficient d'anisotropie plastique

Ta slovenski standard je istoveten z: **ISO 10113:1991**

ICS:

77.040.10	Mehansko preskušanje kovin	Mechanical testing of metals
77.140.50	Ploščati jekleni izdelki in polizdelki	Flat steel products and semi-products

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INTERNATIONAL STANDARD

ISO 10113

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

Matériaux métalliques — Tôles et bandes — Détermination du coefficient d'anisotropie plastique

Reference number
ISO 10113:1991(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10113 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*.

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

1 Scope

This International Standard specifies a method for determining the plastic strain ratio of flat products (sheet and strip) made of metallic materials.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6892:1984, *Metallic materials — Tensile testing.*

ISO 7500-1:1986, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tensile testing machines.*

ISO 9513:1989, *Metallic materials — Verification of extensometers used in uniaxial testing.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 plastic strain ratio, r: The ratio of the true width strain and true thickness strain in a test piece that has been submitted to uniaxial tensile stress:

$$r = \frac{\varepsilon_b}{\varepsilon_a}$$

where

ε_a is the true thickness strain;

ε_b is the true width strain.

The above expression is only valid in the region where the plastic strain is homogeneous.

Since it is easier to measure changes in length than changes in thickness, the following relationship derived from the law of constancy of volume before and after plastic strain is used to calculate the plastic strain ratio r:

$$r = \frac{\ln\left(\frac{b_0}{b}\right)}{\ln\left(\frac{Lb}{L_0 b_0}\right)}$$

In addition to the calculated value of r, the orientation of the test piece relative to the rolling direction, as well as the strain level, shall be stated. For example: $r_{45/20}$ (see table 1).

For some materials exhibiting a phase change during plastic deformation, the volume of the measured section cannot always be assumed constant. In such cases, the formula to be applied shall be agreed, prior to testing, between the interested parties and shall be stated in the test report.

3.2 weighted average plastic strain ratio, $\bar{r}$: The weighted average of the $r_{x/y}$ values for different test piece orientations, calculated using the formula

$$\bar{r} = \frac{r_0 + r_{90} + 2r_{45}}{4}$$

3.3 degree of planar anisotropy, Δr: A coefficient calculated using the formula

$$\Delta r = \frac{1}{2}(r_0 + r_{90} - 2r_{45})$$

For some materials, other test piece orientations may be chosen, in which case formulae other than those given in 3.2 and 3.3 will have to be used. These formulae shall be given in the test report.

4 Symbols

The meanings of the symbols used in this International Standard are given in table 1.

Table 1

Symbol	Meaning	Unit
b_0	Original gauge width of the test piece	mm
b	Gauge width of the test piece after straining to a specified elongation	mm
L_0	Original gauge length	mm
L	Gauge length after straining to a specified elongation	mm
r	Plastic strain ratio	—
$r_{x/y}$	Plastic strain ratio in x-direction (in degrees) relative to the rolling direction at a strain level of y %	—
$\bar{r}$ 1)	Weighted average of $r_{x/y}$ values	—
Δr	Degree of planar anisotropy	—
ε_a	True thickness strain	—
ε_b	True width strain	—

1) In some countries r_m is used instead of $\bar{r}$.

5 Principle

A test piece is subjected to a tensile test to a specified strain level and the plastic strain ratio r calculated from measurements of the changes in length and width. The orientation of the test piece relative to the rolling direction, and the strain level for which the values of r are determined, are as specified in the relevant product standard.

6 Test equipment

The tensile testing machine used shall comply with the requirements of ISO 6892 and ISO 7500-1.

The device(s) used for determining the changes in gauge length and gauge width shall be capable of measuring to within $\pm$ 0,01 mm and $\pm$ 0,005 mm, respectively.

Where extensometers are used, they shall be class 1, as defined in ISO 9513, or better.

The method of gripping the test piece shall be as specified in ISO 6892.

7 Test piece

7.1 The test piece shall be obtained in accordance with the requirements of the relevant product standard or, if not specified therein, as agreed between the interested parties.

The type of test piece and its preparation, including the machining tolerances, the tolerances on shape and the marking of the original gauge length, shall be as defined in ISO 6892, but within the gauge length the edges shall be sufficiently close to parallel for no two width measurements to differ by more than 0,1 % of the mean of all the width measurements.

7.2 The test piece thickness shall be the full sheet thickness unless otherwise specified.

7.3 The surface of the test piece shall not be damaged by scratches, etc.

8 Procedure

8.1 The test is normally carried out at ambient temperature between 10 °C and 35 °C. Tests carried out under controlled conditions shall be made at a temperature of 23 °C $\pm$ 5 °C.

8.2 If the strain measurements are made manually, the original width of the test piece shall be measured at least at three points evenly distributed along the gauge length, including one measurement at each end of the gauge length. The mean value of these width measurements shall be used in calculating the plastic strain ratio.

8.3 If the measurements are made automatically, the original gauge length and the width at least at one measurement point shall be measured using an extensometer of class 1, as defined in ISO 9513, or better.

8.4 The test speed, i.e. the speed of separation of the crossheads of the machine, shall not exceed

50 % of L_c per minute

where L_c is the length of the parallel-sided portion of the test piece.

8.5 Mount the test piece in the grips of the testing machine and, keeping the test speed within the limit specified in 8.4,

a) either apply the force required to achieve the strain level specified in the relevant product standard (manual determination),

b) or apply the force required to determine width values at the strain level specified in the relevant product standard (automatic determination).

8.6 In the case of manual determination, after removing the force measure the gauge length L and gauge width b in the same manner and to the same tolerances as for the original gauge length and original gauge width.

8.7 In the case of automatic determination, the measurements of length and width at the specified strain level shall be made using an extensometer as specified in clause 6.

8.8 If the test piece shows any transverse bow (see figure 1), which could influence the test results, the test shall be considered invalid and a new test shall be carried out.

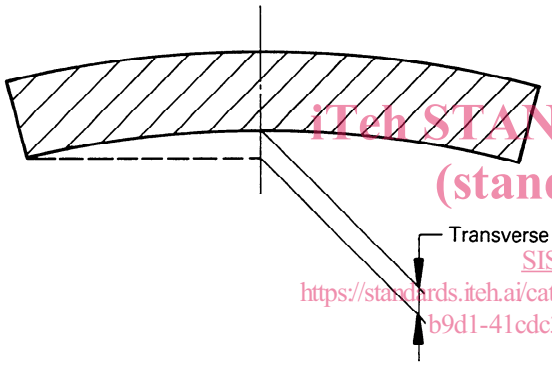

Figure 1 — Transverse bow in a test piece

8.9 If the plastic strain is not homogeneous, the test results shall be considered invalid and a new test shall be carried out.

9 Expression of results

9.1 For a manual determination, calculate the plastic strain ratio, the weighted average of the plastic strain ratio for different test piece orientations, and the degree of planar anisotropy using the formulae given in 3.1, 3.2 and 3.3.

9.2 For an automatic determination, the automatic tensile testing machine and data processing programme give the plastic strain ratio, the weighted average of the plastic strain ratio for different test piece orientations, and the degree of planar anisotropy directly.

9.3 The calculated values of the plastic strain ratio shall be reported to the nearest 0,05.

9.4 Manual and automatic determinations may give different results. In the case of significant differences, the manual determination shall be considered the reference method.

10 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) identification of material tested;

c) the method used (manual or automatic);

d) the type of test piece used;

e) the orientation of the test piece relative to the rolling direction;

f) the strain level at which the measurements were made;

g) the test results;

h) the formulae used to calculate $\bar{r}$ and Δr if different from the formulae given in 3.2 and 3.3.