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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

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 2, *Ductility testing*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 459/SC 1, *Test methods for steel (other than chemical analysis)*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 10113:2006), which has been technically revised. The main changes compared to the previous edition are as follows:

— a new structure;

— the addition of the semi-automatic method (see 8.3);

— a clear differentiation between the manual, the semi-automatic and the automatic methods (see 8.2, 8.3 and 8.4);

— the addition of the methods of investigating sources of errors in *r*-value determination (see Annex A).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This corrected version of ISO 10113:2020 incorporates the following corrections:

— Correction of the description of the test in the fourth paragraph of 8.4.2.

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

1 Scope

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892-1:2019, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

ISO 80000-1, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6892-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
plastic strain ratio
r
ratio of the true plastic width strain to the true plastic thickness strain in a test piece that has been subjected to uniaxial tensile stress calculated using Formula (1)

$$r = \frac{\varepsilon_{p\_b}}{\varepsilon_{p\_a}} \tag{1}$$

where

ε_{p_a} is the true plastic thickness strain;

ε_{p_b} is the true plastic width strain.

Note 1 to entry: The above expression using a single point is only valid in the region where the plastic strain is homogeneous.

Note 2 to entry: Since it is easier and more precise to measure changes in length than in thickness, the following relationship derived from the law of constancy of volume is used up to the percentage plastic extension at maximum force, A_g, to calculate the plastic strain ratio, r [see Formula (2)].

$$r = \frac{\ln\left(\frac{b_1}{b_o}\right)}{\ln\left(\frac{L_o b_o}{L_1 b_1}\right)} \quad (2)$$

Note 3 to entry: For some materials exhibiting a phase change during plastic deformation, the volume of the measured section cannot always be assumed to be constant. In such cases, the procedure shall be defined and agreed between the parties involved.

Note 4 to entry: As the value r depends on the orientation of the test piece relative to the rolling direction, as well as on the strain, the symbol r can be supplemented by the angle which characterises this orientation and the plastic (engineering) strain. For example $r_{45/20}$ (see Table 1).

3.2
weighted average plastic strain ratio
$\bar{r}$
weighted average as calculated using Formula (3) of the $r_{x/y}$ values for different test piece orientations, x, where $r_{x/y}$ are determined using the same selected test method and at the same plastic (engineering) strain, y, or plastic (engineering) strain range, α - β

$$\bar{r} = \frac{r_{0/y} + r_{90/y} + 2r_{45/y}}{4} \quad (3)$$

Note 1 to entry: For some materials, other test piece orientations may be chosen, in which case formulas other than Formula (3) shall be used.

3.3
degree of planar anisotropy
Δr
value calculated using Formula (4) where $r_{x/y}$ values for different test piece orientations, x, are determined using the same selected test method and at the same plastic (engineering) strain, y, or plastic (engineering) strain range, α - β

$$\Delta r = \frac{\left(r_{0/y} + r_{90/y} - 2r_{45/y}\right)}{2} \quad (4)$$

Note 1 to entry: For some materials, other test piece orientations may be chosen, in which case formulas other than Formula (4) shall be used.

3.4
Poisson´s ratio
ν
ratio of the elastic width strain to the elastic length strain of the material

4 Symbols

The designations of the symbols used in this document are given in Table 1.