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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 5027-2025

Replacing GB/T 5027-2016

**Metallic materials - Sheet and strip - Determination of plastic
strain ratio (r)**

金属材料 薄板和薄带 塑性应变比 (r值) 的测定

(English Translation)

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Foreword

This document was drafted in accordance with the rules given in GB/T 1.1-2020, Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents.

This document replaces GB/T 5027-2016, Metallic materials - Sheet and strip - Determination of plastic strain ratio. Compared with GB/T 5027-2016, in addition to structural adjustments and editorial changes, the main technical changes of this document are as follows.

- Modify some symbols and descriptions in Table 1 (see Chapter 4; Chapter 4 of the 2016 edition);
- Change the test procedure by re-classifying the three methods used for the determination of r (manual, semi-automatic and automatic) (see Chapter 8; Chapter 8 of the 2016 edition);
- Combine the provisions for the calculation of r into Chapter 8, and the clearly divide data evaluation methods for r into single-point method A (deducting elastic strain), single-point method B (without deducting elastic strain), and interval regression method (see Chapter 8; Chapter 9 of the 2016 edition);
- Change the terms of weighted average value and anisotropy to additional test results

(see Chapter 9; Chapter 9 of the 2016 edition);

This document adopts ISO 10113:2020, Metallic materials - Sheet and strip - Determination of plastic strain ratio (r) by modification.

Compared with ISO 10113:2020, this document makes the following structural adjustments.

-- 8.4.3.4 corresponds to 8.4.3.3 of ISO 10113:2020, and Formula (17) corresponds to Formula (14) of ISO 10113:2020;

-- Appendix B corresponds to Appendix A of ISO 10113:2020.

This document contains many technical differences compared to ISO 10113:2020, which are indicated by a single vertical line (|) in the outer margin of the clauses involved. A list of these technical differences and their reasons is given in Appendix A. This document also makes the following editorial modifications.

-- Delete Note 1 in Table 1 of Chapter 4 of the international standard;

-- Delete the informative Appendix B "Symbol Comparison Table" of the international standard;

-- Add Chinese literatures in the Bibliography.

1 Scope

This document specifies the principle, test apparatus, test samples, test procedures, additional test results and test report for the determination of plastic strain ratio of metal sheet and strip.

This document applies to the determination of plastic strain ratio of metal sheet and strip.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 228.1-2021, Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1:2019, MOD)

GB/T 8170, Rules of rounding off for numerical values & expression and judgment of limiting values

GB/T 12160, Metallic materials - Calibration of extensometers systems used in uniaxial testing (GB/T 12160-2019, ISO 9513:2012, IDT)

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in GB/T 228.1, apply.

3.1 Plastic strain ratio

Under uniaxial tensile stress, the ratio of the true plastic strain in the width direction of the sample to the true plastic strain in the thickness direction, as shown in Formula (1).

Note: For some materials, other sampling directions may be used, in which case a calculation formula different from Formula (3) shall be used.

3.3 Degree of planar anisotropy

Δr The value obtained by substituting the $r_{x/y}$ values of the samples in different sampling directions into Formula (4). The values of r in different directions are measured using the same determination method and the same (engineering) plastic strain γ or (engineering) plastic strain range α - β .

Note: For some materials, other sampling directions may be used, in which case a calculation formula different from Formula (4) shall be used.

3.4 Poisson's ratio

The ratio of the elastic strain in the width direction of the sample to the elastic strain in the length direction.

4 Symbols and their meanings

The symbols used in this document and their meanings are shown in Table 1.

5 Principle

Plastic strain ratio (r) is usually used to characterize and evaluate materials, and is also used for numerical simulation of forming processes.

Stretch the sample to a specified (engineering) plastic strain level, and calculate r based on the change in sample width and thickness after unloading or after deducting the elastic strain, or calculate r based on the principle of volume invariance, using the changes in sample length and width, see formula (5). Where. ϵ_{p_a} - true plastic strain in the thickness direction, $\epsilon_{p_a} = \ln$;

ϵ_{p_b} - true plastic strain in the width direction, $\epsilon_{p_b} = \ln$;

ϵ_{p_l} - true plastic strain in the length direction, $\epsilon_{p_l} = \ln$.

The volume invariance principle only applies to the situation before the maximum plastic elongation A_g , because after this point the sample will undergo local necking and this principle is no longer valid.

Some materials will show a slight local necking before A_g , which may cause the instantaneous reduction of the sample in the width direction to be too large, resulting in an overestimation of r . This deviation is especially obvious when the transverse extensometer is only clamped in the middle area of the original gauge length of the sample. At this time, the following two processing methods are recommended.

- a) The transverse extensometer should be able to measure the instantaneous reduction in the width direction of the sample at multiple locations, and the measurement points should cover the entire (longitudinal) gauge length;
- b) The length of the parallel section of the sample should be at least six times the original width b_0 of the sample gauge length.

The sampling direction of the sample relative to the rolling direction and the (engineering) plastic strain level for determining r are specified by the relevant product standard.

When $r > 1$, the deformation characteristic of the material is that the deformation in the width direction is greater than that in the thickness direction ($\epsilon_{p_b} > \epsilon_{p_a}$, as shown in Figure 1); when $r < 1$, the deformation in the thickness direction is greater than that in the width direction ($\epsilon_{p_b} < \epsilon_{p_a}$, as shown in Figure 1); when $r = 1$, the deformation behavior of the material in the thickness direction and the width direction is isotropic ($\epsilon_{p_b} = \epsilon_{p_a}$, as shown in Figure 1). Key.

- 1 - original cross section of the parallel section of the sample;
- 2 - significant deformation of the material in the width direction;
- 3 - isotropic material (deformation is uniform across the width and thickness 4 - significant deformation of the material in the thickness direction; a Increase with the plastic extension.

6 Test apparatus

6.1

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

6.2

For the manual measurement method (see 8.2), the device used to measure the original gauge length of the sample and the gauge length after plastic deformation occurs and is unloaded shall have an accuracy of $\pm 0.2\%$ or better. The device used to measure the original width of the sample and the width of the sample after plastic deformation occurs and is unloaded shall have an accuracy of ± 0.005 mm or better.