International Standard

ISO 14250

Steel — Metallographic characterization of duplex grain size and distributions

Aciers — Caractérisation métallographique de la grosseur et de la distribution de grain duplex

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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).

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This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*.

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This second edition cancels and replaces the first edition (ISO 14250:2000), which has been technically revised.

The main changes are as follows:

— adding terms and definitions (Clause 3), principles (Clause 5) and procedure (Clause 8), and renumbering the subsequent clauses;

— clarifying the specific method for determining grain size using ISO 643;

— modifying all of the figures;

— clarifying the planimetric procedure of estimation of area fraction;

— clarifying the determination of isolated coarse grain size;

— clarifying the determination of apparent grain size other than ALA grains;

— clarifying the characterization of duplex grain size and distributions;

— modifying the charts for estimation of area fractions in Annex A;

— adding the classification procedure for grain size distributions in Annex B.

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.

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Steel — Metallographic characterization of duplex grain size and distributions

1 Scope

This document specifies a micrographic method of determining the duplex grain size including the area fraction, of rolled or forged steel products.

Additionally, this document provides detailed description methods for each specific type of duplex grain size.

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 643, *Steels — Micrographic determination of the apparent grain size*

ISO 9042, *Steels — Point counting method for statistically estimating the volume fraction of a constituent with a point grid*

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3 Terms and definitions

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

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

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

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

3.1
duplex grain size
condition existent when the distribution of grain intercept lengths, diameters or areas deviates from a single lognormal distribution

Note 1 to entry: Various types of duplex grain sizes are described in 8.1.

3.2
equivalent diameter
diameter of a circle with an area equivalent to that of the grain

Note 1 to entry: The area is calculated as the geometric mean of the long axis (the maximum chord length) and the short axis (the maximum chord length perpendicular to the long axis), obtained by multiplying the two axes and taking the square root of the product.

3.3
random duplex grain size
grains of two or more significantly different sizes that are randomly distributed

Note 1 to entry: See 5.1 for further explanations.

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3.4
topological duplex grain size
grains of two or more significantly different sizes that vary in a non-random, definable pattern

Note 1 to entry: See 5.1 for further explanations.

4 Abbreviated terms

The abbreviated terms used are given in Table 1

Table 1 — Abbreviated terms

Abbreviated term	Definition
ALA	As large as
AGS	Apparent grain size
BD	Banding
BM	Bimodal
CS	Cross section
DG	Duplex grain
L	Longitudinal
NL	Necklace
T	Transverse
WR	Wide range
G_{ALA}	ALA grain size
G	AGS grain size

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5 Principle

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5.1 Duplex grain size is classified into two main categories: random duplex grain size and topological duplex grain size, each with specified subcategories. Random duplex grain size includes: Individual coarse grains (ALA), Wide range grains (WR) and Bimodal grains (BM). Topological duplex grain size includes: Cross-section variations of grains (CS), Necklace grains (NL) and Grains in bands (BD). This pattern may be related to the shape of the product being examined or the factors influencing grain formation. The document specifies methods for analysing the distribution type, rating the grain size, and estimating the area fractions occupied by each distinct grain size type. See Figure B.1 in Annex B for the classification procedure for grain size distribution.

5.2 This document outlines methods for identifying the presence of duplex grain size and characterizing the features of specific types of duplex grain sizes. It includes procedures for estimating the area fractions occupied by distinct grain sizes. The document establishes test methods for determining ALA grain size and provides guidelines for applying ISO 643 to determine grain size in specific designated areas. Additionally, it offers methods for reporting detailed and distinctive information for each type of duplex grain size. Furthermore, the test methods provide a statistical procedure for determining the actual distribution of all grain sizes present in a duplex grain size specimen.

5.3 The method may be applied to specimens or products containing grains of two or more significantly different sizes, but distributes at random or in topologically varying patterns.

5.4 The total specimen surface shall be evaluated when the test method describes deviations from a single, log-normal distribution of grain sizes and characterizes pattern of variations in grain size.

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6 Apparatus

6.1 General

The apparatus used shall depend on the nature of the test method as described in 6.2 to 6.4.

6.2 Comparison procedure for estimation of area fractions

This procedure shall require the use of comparison charts presented in Annex A, Figure A.1 to improve the accuracy of visual estimates of area fractions occupied by a distinct grain size. These comparison charts show different area percentages of light grains among dark grains.

6.3 Point count procedure for estimation of area fractions

This procedure shall require the use of a test grid on a transparent overlay, or on a reticle, as specified in ISO 9042.

6.4 Determination of grain size

The devices specified in ISO 643 shall be used. For specimens exhibiting different grain size distributions, the test methods outlined in ISO 643 — such as the rating chart method, planimetric method, or intercept method — shall be employed to rate the distinct grain sizes. Additionally, the intercept length method described in ISO 643:2024, Annex E, may also be utilized for this purpose. When rating individual ALA grains, the assessment shall be based on the equivalent diameter or the area of the maximum grain.

7 Sampling and preparation of test specimens

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In order to characterize patterns of duplex grain size, the entire cross section of the specimen from the product shall be evaluated. The examined surface shall be along the longitudinal direction in a plane parallel to the direction of maximum product deformation except in the case of bars and tubes where the examined surface shall be perpendicular to the direction of the maximum deformation. The number of test specimens and their location shall be specified in the relevant product standard. When it is not the case, they are left at the producer's discretion.

A flat surface of the test specimen shall be polished for micrographic examination and shall be etched for an adequate period of time by means of the appropriate etching. The etch shall be such that all, or nearly all, of the grain boundaries are visible.

8 Procedure

8.1 Recognizing and classifying duplex grain size

8.1.1 Random duplex grain size

8.1.1.1 General

A random duplex grain size is defined as any of the following.

8.1.1.2 Random coarse grains (ALA)

This is the presence of randomly distributed individual coarse grains, differing in size by three or more ISO grain size numbers from the average size of the balance of the grains.

These individual coarse grains shall comprise 5 % or less of the area of the specimens. If they comprise more than 5 % of that area, treat the specimen as described in 8.1.1.4.

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