INTERNATIONAL STANDARD

ISO 14250

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Steel — Metallographic characterization of duplex grain size and distributions

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

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14250 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*.

Annex A forms a normative part of this International Standard.

Steel — Metallographic characterization of duplex grain size and distributions

1 Scope

This International Standard specifies a micrographic method of determining the duplex grain size of rolled or forged steel products using standard diagrams or by the point count procedure.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 643, *Steels — Micrographic determination of the ferritic or austenitic grain size*.

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

3 Term and definition

For the purposes of this International Standard, the following term and definition applies.

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

NOTE Various types of duplex grain sizes are described in 8.1.

4 Abbreviated terms

ALA	As Large As
AGS	Average Grain Size
BD	Banding
BM	Bi Modal
CS	Cross Section
Long.	Longitudinal
NL:	Necklace
OCC	Occasional
Trans.	Transverse
WR	Wide Range

5 Principle

5.1 Duplex grain size is classified into two classes specifying subcategories within these types and estimating area fractions occupied by the distinct grain size types.

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

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

6 Apparatus

6.1 General

The apparatus used depends 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 requires the use of a comparison chart to improve the accuracy of visual estimates of area fractions occupied by a distinct grain size. This comparison chart is given in annex A and shows different area percentages of light grains among dark grains.

6.3 Point count procedure for estimation of area fractions

This procedure requires 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.

7 Sampling and preparation of test specimens

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, these are left to the discretion of the producer.

A flat surface of the test specimen shall be polished for micrographic examination and 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

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 specimen. If they comprise more than 5 % of that area, treat the specimen as described in 8.1.1.4.

An example of a photomicrograph of the ALA condition appears in Figure 1.

8.1.1.3 Wide range grains

This is the presence of an unusually wide range of grain sizes, randomly distributed, with the largest size differing from the smallest size by five or more ISO size numbers.

An example of a photomicrograph of the wide-range condition appears in Figure 2.

8.1.1.4 Bimodal grains

This is the presence of two distinct grain sizes, randomly distributed such that the sizes differ by more than four ISO grain size numbers, and such that the two sizes together comprise 75 % or more of the total area of the specimen.

An example of a photomicrograph of the bimodal condition appears in Figure 3.

8.1.2 Topological duplex grain size

8.1.2.1 General

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

8.1.2.2 Cross-section variations of grains

This is the presence of a systematic variation in grain size across the section of the product, such that the average grain size differs from one area to another by three or more ISO grain size numbers; or the presence of different grain sizes in specific areas of a product cross-section (e.g., coarse grains resulting from germinative grain growth at areas of critical strain), such that the grain size in those specific areas differs from the grain size in the bulk of the cross-section by three or more ISO grain size numbers.

An example of a photomicrograph of the cross-section condition appears in Figure 4.

8.1.2.3 Necklace grains

This is the presence of individual coarse grains, each surrounded by rings of finer grains, the coarse and fine grains differing in size by three or more ISO grain size numbers.

An example of a photomicrograph of the necklace condition appears in Figure 5.

8.1.2.4 Grains in bands

This is the presence of bands of distinct grain sizes, such that the sizes differ by three or more ISO grain size numbers.

An example of a photomicrograph of the banding condition appears in Figure 6.

Figure 1 — ALA Condition

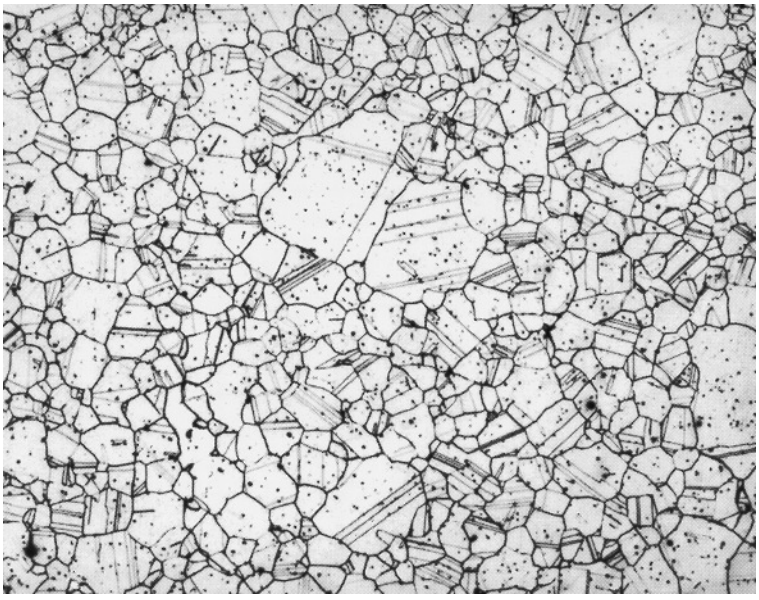

Figure 2 — WR Condition

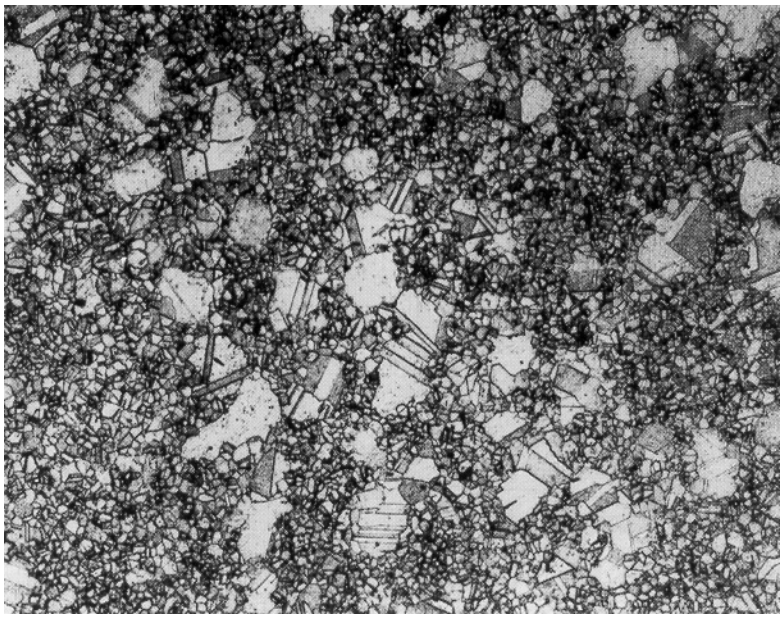

Figure 3 — BM Condition

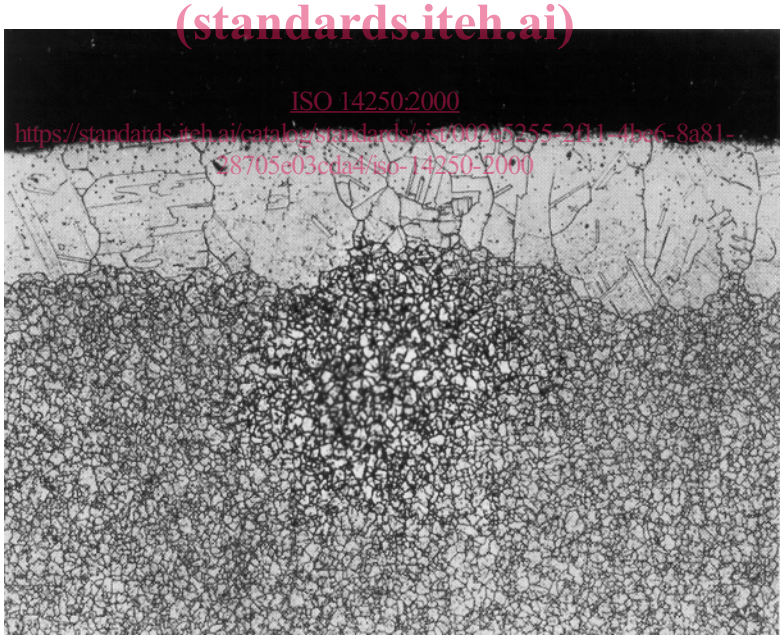

Figure 4 — CS Condition