SLOVENSKI STANDARD
SIST EN ISO 643:2024

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Nadomešča:
SIST EN ISO 643:2020

Jekla - Mikrografsko določevanje navidezne velikosti kristalnih zrn (ISO 643:2024)

Steels - Micrographic determination of the apparent grain size (ISO 643:2024)

Stahl - Mikrophotographische Bestimmung der erkennbaren Korngröße (ISO 643:2024)

Aciers - Détermination micrographique de la grosseur de grain apparente (ISO 643:2024)

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ICS:

77.040.99	Druge metode za preskušanje kovin	Other methods of testing of metals
77.080.20	Jekla	Steels

SIST EN ISO 643:2024 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 643

September 2024

ICS 77.040.99

Supersedes EN ISO 643:2020

English Version

Steels - Micrographic determination of the apparent grain size (ISO 643:2024)

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European foreword

This document (EN ISO 643:2024) has been prepared by Technical Committee ISO/TC 17 "Steel" in collaboration with Technical Committee CEN/TC 459/SC 1 “Test methods for steel (other than chemical analysis)” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2025, and conflicting national standards shall be withdrawn at the latest by March 2025.

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Endorsement notice

The text of ISO 643:2024 has been approved by CEN as EN ISO 643:2024 without any modification.

International Standard

ISO 643

Steels — Micrographic determination of the apparent grain size

Aciers — Détermination micrographique de la grosseur de grain apparente

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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.

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 document 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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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 ISO/TC 17, *Steel*, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 459, *ECISS - European Committee for Iron and Steel Standardization,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fifth edition cancels and replaces the fourth edition (ISO 643:2019), which has been technically revised.

The main changes are as follows:

— the test temperature of McQuaid-Ehn method has been modified for case hardening steels to 950 °C (see A.4);

— subclause 7.2 has been modified with reference to new Annex B and amended Table 2;

— Annex B from the third edition (ISO 643:2012) has been reinstated, now with new ISO grain size charts instead of ASTM charts;

— parts of the old Annex B (evaluation method) have been revised and moved to the main body of the standard (subclause 7.3) and the remainder of the annex has been renumbered as Annex C;

— new Annexes D and E have been added.

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.

Steels — Micrographic determination of the apparent grain size

WARNING — This document calls for the use of substances and/or procedures that may be injurious to health if adequate safety measures are not taken. This document does not address any health hazards, safety or environmental matters associated with its use. It is the responsibility of the user of this document to establish appropriate health, safety and environmentally acceptable practices.

1 Scope

This document specifies micrographic methods of determining apparent ferritic or austenitic grain size in steels. It describes the methods of revealing grain boundaries and of estimating the mean grain size of specimens with unimodal size distribution. Although grains are three-dimensional in shape, the metallographic sectioning plane can cut through a grain at any point from a grain corner, to the maximum diameter of the grain, thus producing a range of apparent grain sizes on the two-dimensional plane, even in a sample with a perfectly consistent grain size.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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 Grains

3.1.1
grain
closed polygonal shape with more or less curved sides, which can be revealed on a flat section through the sample, polished and prepared for micrographic examination

Note 1 to entry: In ISO 4885[1] grain is defined as “space lattice formed by atoms with regular interstices".

Note 2 to entry: If any other constituent (e.g. pearlite) of similar dimensions to the grains of interest is present, that constituent can be counted as grains of interest.

3.1.2
austenitic grain
crystal with a face-centred cubic crystal structure which may, or may not, contain annealing twins

3.1.3
ferritic grain
crystal with a body-centred cubic crystal structure which never contains annealing twins

3.2 General

3.2.1
index
positive, zero or possibly negative number G which is derived from the mean number m of *grains* (3.1.1) counted in an area of 1 mm^2 of the section of the specimen

Note 1 to entry: By definition, $G = 1$ where $m = 16$; the other indices are obtained by Formula (1).

3.2.2
intercept
N
number of *grains* (3.1.1) intercepted by a test line, either straight or curved

Note 1 to entry: See Figure 1.

Note 2 to entry: Straight test lines will normally end within a grain. These end segments are counted as 1/2 an intercept. $\bar{N}$ is the average of a number of counts of the number of grains intercepted by the test line applied randomly at various locations. $\bar{N}$ is divided by the true line length, L_T usually measured in millimetres, in order to obtain the number of grains intercepted per unit length, $\bar{N}_L$.

3.2.3
intersection
P
number of intersection points between *grain* (3.1.1) boundaries and a test line, either straight or curved

Note 1 to entry: See Figure 2.

Note 2 to entry: $\bar{P}$ is the average of a number of counts of the number of grain boundaries intersected by the test line applied randomly at various locations. $\bar{P}$ is divided by the true line length, L_T usually measured in millimetres, in order to obtain the number of grain boundary intersections per unit length, $\bar{P}_L$.

4 Symbols

The symbols used are given in Table 1.

Table 1 — Symbols

Symbols	Definition	Value
$\bar{a}$	Mean area of grain in square millimetres	$\bar{a} = \frac{1}{m}$
A_B	True area of the test box	mm^2
A_C	True area of the test circle	mm^2
A_F	Apparent area of the test figure in square millimetres	—
$\bar{d}$	Mean grain diameter in millimetres	$\bar{d} = \frac{1}{\sqrt{m}}$
D	Diameter of the circle on the ground glass screen of the microscope or on a photomicrograph enclosing the image of the reference surface of the specimen	79,8 mm (area = 5 000 mm^2)
g	Linear magnification (to be noted as a reference) of the microscopic image	In principle 100
G	Equivalent index of grain size	$G = \log_2 m - 3$
l	Mean lineal intercept length, generally expressed in millimetres	$l = 1 / \bar{N}_L = 1 / \bar{P}_L$
l_0	Mean lineal intercept length for $G = 0$, in millimetres	0,32
L_T	True length of the test line divided by the magnification, in millimetres	—
[a] The method for designating the direction conforms to ISO 3785[2].		

Table 1 *(continued)*

Symbols	Definition	Value
m	Number of grains per square millimetre of specimen surface in the area examined	$m = n_t/A_C$ $m = n_t/A_B$
M	Number of the closest standard chart picture where g is not 100	—
n_e	Number of grains completely inside the circle of diameter D	—
n_i	Number of grains intersected by the circle of diameter D	—
n_t	Total equivalent number of grains examined on the image of diameter D	—
$\bar{N}$	Mean number of grains intercepted per unit length L	—
$\bar{N}_L$	Mean number of grains intercepted per unit length of the line	$\overline{N_L} = \bar{N} / L_T$
N_x	Number of intercepts per millimetre in the longitudinal direction[a]	—
N_y	Number of intercepts per millimetre in the transverse direction[a]	—
N_z	Number of intercepts per millimetre in the perpendicular direction[a]	—
$\bar{P}$	Mean number of counts of the number of grain boundaries intersected by the test line applied randomly at various locations	—
$\bar{P}_L$	Mean number of grain boundary intersections per unit length of test line	$\overline{P_L} = \bar{P} / L_T$
Q	Correction factor for non-standard magnification	$Q = 2log_2\left(\frac{g}{100}\right)$

[a] The method for designating the direction conforms to ISO 3785[2].

5 Principle

This document is applicable to grain structures that have a unimodal size distribution. The apparent grain size is determined by micrographic examination of appropriately prepared sections of the specimen.

The following principal methods are available to obtain an index representing the mean value of the grain size:

a) comparison method using standard charts (see 7.2);

b) planimetric method counting grains to determine the mean number of grains per unit area, (see 7.3);

c) intercept method counting the number of grains or grain boundaries along a line of a known length (see 7.4).

All methods give comparable results.

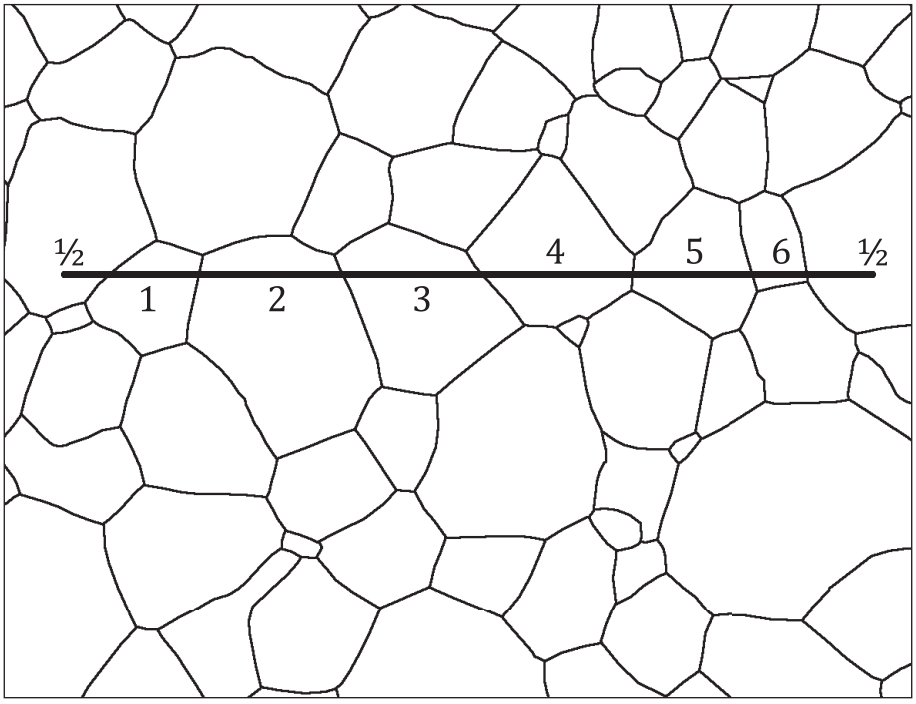

Figure 1 — Example of intercept, *N*

Intercept, *N*, grain counts for a straight line on a single-phase grain structure. Six intercepts and two line segments ending within a grain equals 2 × 1/2 + 6 = 7.

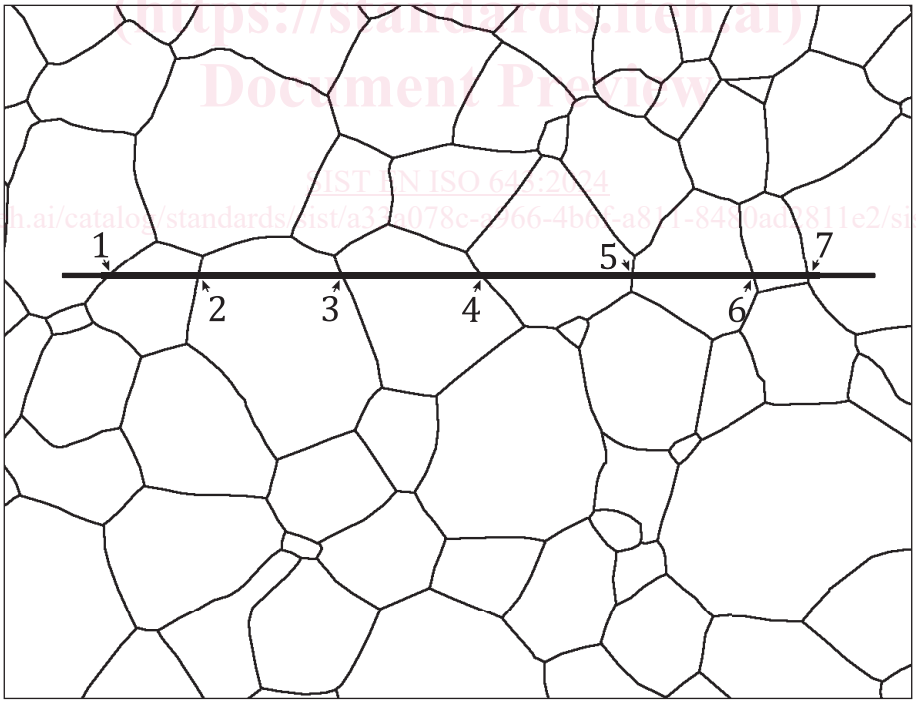

Figure 2 — Example of intersection, *P*

Intersection, *P*, counts for a straight test line placed over a single-phase grain structure where the arrows point to 7 intersection points and *P* = 7.