



**International
Standard**

ISO 9042

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

*Aciers — Méthode d'estimation statistique de la fraction
volumique d'un constituant à l'aide de grilles de points*

**Second edition
2024-04**

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	1
5 Principle	2
6 Apparatus	2
6.1 Grid.....	2
6.2 Means of observation.....	3
7 Sample	3
7.1 Sampling and number of samples.....	3
7.2 Preparation of samples.....	3
8 Procedure	4
8.1 Selection of the grid.....	4
8.2 Magnification selection.....	4
8.3 Selection of the number of observed fields.....	4
8.4 Array of the fields.....	5
8.5 Examination and estimation of the fields.....	5
8.6 Calculation of the volume fraction V_v	6
9 Test report	7
Bibliography	8

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

This second edition cancels and replaces the first edition (ISO 9042:1988) which has been technically revised.

The main changes are as follows:

- clearer definition of t multiplier and corrected values in [Table 4](#) (formerly Table 3);
- additional grid examples;
- application to digital images;
- change of terminology: Error % is now E_{rel} ;
- editorial changes.

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 — Point counting method for statistically estimating the volume fraction of a constituent with a point grid

1 Scope

This document specifies a point counting method for statistically estimating the volume fraction of a constituent through the microstructure of a steel by means of a point grid.

It applies to constituents which are clearly identifiable.

By default, counting is performed manually, but can be computer assisted or substituted by validated computer algorithms.

NOTE In this document, the word "constituent" can designate a phase as well as a micrographic constituent composed of two or more phases.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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/>

4 Symbols and abbreviated terms

The symbols used are given in [Table 1](#).

Table 1 — Symbols

Symbols	Definition	Value
n	Number of fields observed	—
P_T	Total number of points in the grid	—
P_i	Point count on the i^{th} field	—
$P_p(i)$	Proportion of grid points in the constituent on the i^{th} observed field, expressed as a percentage of the total number of points in the grid.	See Formula (2)
$\overline{P_p}$	Arithmetic mean of $P_p(i)$	See Formula (3)
\hat{s}	Estimate of the standard deviation σ of the mean	See Formula (4)
CI	95 % confidence interval	See Formula (5)
$t_{0,05;n-1}$	Student's t-distribution for a two-sided confidence level of 95 % and n observed fields	See Table 4 for values

Table 1 (continued)

Symbols	Definition	Value
V_V	Volume fraction of the constituent expressed as a percentage	See Formula (6)
$A_{A,est}$	Estimated area fraction of the constituent expressed as a percentage	—
E_{rel}	Relative error, a measure of the statistical precision, expressed as a percentage; a lower E_{rel} corresponds to a lower error and thus a higher accuracy	See Formula (7)

5 Principle

The basic principle is that a grid with a number of regularly arrayed points, when systematically placed over an image of a micrographic section, can provide, after a representative number of placements on different fields, an unbiased estimation of the volume fraction of the constituent.

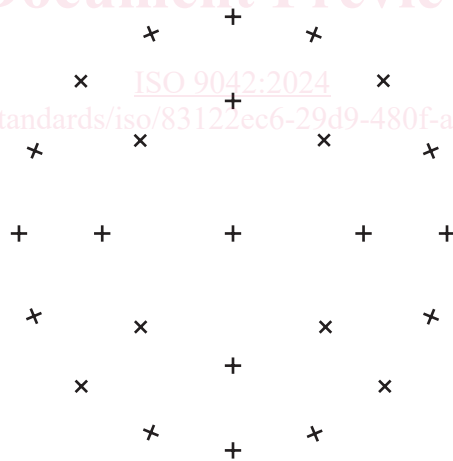
The method consists in superimposing the point grid on a given number of fields of the observed surface and in counting the number of points of the grid included in the constituent and then calculating its volume fraction.

6 Apparatus

6.1 Grid

The grid consists of a specified number of regularly spaced and unambiguously defined points. The grids shown in [Figures 1](#) to [3](#) are given as examples. Alternately, a grid of randomly distributed points may be used.

The grid can be applied via a reticle placed in the eyepiece of the microscope, a graphical overlay on a digital image, the pixel array of a digital image, or other image analysis procedures. It can also be reproduced on a transparency which is placed on the viewing screen of the microscope or on micrographs.



NOTE It is possible to use all 25 points, the outer points, or the 9 inner points.

Figure 1 — Circular grid