### INTERNATIONAL STANDARD



INTERNATIONAL ORGANIZATION FOR STANDARDIZATION ORGANISATION INTERNATIONALE DE NORMALISATION МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

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

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



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

### 1 Scope

This International Standard specifies a manual 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.

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

### 2 Principle

**2.1** 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.

**2.2** 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.

### 3 Symbols and definitions

For the purpose of this International Standard, the following symbols are used.

n = number of fields observed

 $P_{\rm T}$  = total number of points in the grid

 $P_i$  = point count on the *i*th field

 $P_{\rm P}(i)$  = 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

$$P_{\rm P}(i) = \frac{P_i}{P_{\rm T}} \times 100$$

 $\overline{P}_{P}$  = arithmetic average of  $P_{P}(i)$ 

$$\overline{P}_{\mathsf{P}} = \frac{1}{n} \sum_{i=1}^{n} P_{\mathsf{P}}(i)$$

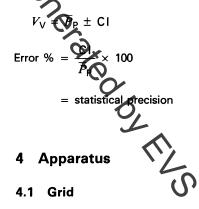
 $\hat{s}$  = estimate of the standard deviation ( $\sigma$ )

$$\hat{s} = \left\{ \frac{1}{n-1} \sum_{i=1}^{n} \left[ P_{P}(i) - \overline{P}_{P} \right]^{2} \right\}^{1/2}$$

CI = 95 % confidence interval

$$CI = \pm 2 \frac{\hat{s}}{\sqrt{n}}$$

volume fraction of the constituent expressed as a percentage



The grid consists of a specified number of equally spaced points formed by the intersections of very thin lines. The two types of grid (circular or square array) shown in figure 1 are given as examples that can be used.

The grid can be constituted by a reticle placed in the eyepiece of the microscope or reproduced on a transparency which is placed on the viewing screen of the microscope or on micrographs<sup>1)</sup>.

<sup>1)</sup> Since the use of micrographs is time-consuming and more costly, it should be avoided if possible.