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Geometrical Product Specifications (GPS) — Surface texture: Profile method — Metrological characteristics of phase correct filters

Spécification géométrique des produits (GPS) — État de surface: Méthode du profil — Caractéristiques métrologiques des filtres à phase correcte

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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.

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.

International Standard ISO 11562 was prepared jointly by Technical Committees ISO/TC 57, *Metrology and properties of surfaces*, Subcommittee SC 1, *Geometrical parameters — Instruments and procedures for measurement of surface roughness and waviness*, ISO/TC 3, *Limits and fits*, and ISO/TC 10, *Technical drawings, product definition and related documentation*, Subcommittee SC 5, *Dimensioning and tolerancing*.

Annexes A, B and C of this International Standard are for information only.

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Introduction

This International Standard is a Geometrical Product Specification (GPS) standard and is to be regarded as a *General GPS standard* (see ISO/TR 14638). It influences chain links 2 and 3 of the chains of standards for roughness profile and waviness profile and chain link 2 of the chain of standards for primary profile and is envisaged also to cover roundness and other form characteristics.

For more detailed information of the relation of this standard to other standards and the GPS matrix model, see annex B.

For digital instruments, the appropriate filter for surface profile information is a phase correct filter. The chosen weighting function, for the phase correct filter, is Gaussian with a 50 % transmission at the cut-off wavelength. This provides a transmission characteristic with a relatively sharp cut-off.

It is of importance that the transmission for the cut-off wavelength is 50 % since the short wave and long wave portions of the surface profile are separated and can be recombined without altering the surface profile.

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Geometrical Product Specifications (GPS) — Surface texture: Profile method — Metrological characteristics of phase correct filters

1 Scope

This International Standard specifies the metrological characteristics of phase correct filters for the measurement of surface pofiles.

In particular it specifies how to separate the long and short wave content of a surface profile.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 profile filter: Filter which serapates profiles into longwave and shortwave components.

2.1.1 phase correct profile filter: Profile filter which does not cause phase shifts which lead to asymmetrical profile distortions.

2.2 phase correct filter mean line (mean line): Long wave profile component which is determined for any point of the profile by a weighted mean value derived from adjacent points.

2.3 transmission characteristic of a filter: Characteristic which indicates the amount by which the amplitude of a sinusoidal profile is attenuated as a function of its wavelength.

2.4 weighting function: Function for calculating the mean line which indicates for each point the weight attached by the profile in the neighbourhood of that point.

NOTE — The transmission characteristic of the mean line is the Fourier transformation of the weighting function.

2.5 cut-off wavelength of the phase correct filter: Wavelength of a sinusoidal profile of which 50 % of the amplitude is transmitted by the profile filter.

NOTE — Profile filters are identified by their cut-off wavelength value.

2.6 transmission band for profiles: Band of sinusoidal profile wavelengths which are transmitted at more than 50 % when two phase correct filters of different cut-off wavelengths are applied to the profile.

NOTE — The profile filter with the shorter cut-off wavelength retains the long wave profile component and the profile filter with the longer cut-off wavelength retains the short wave profile component.

2.7 cut-off ratio: Ratio of the long wavelength characteristic cut-off to the short wavelength characteristic cut-off of a given transmission band.

3 Characteristics of phase correct profile filters

3.1 Weighting function for the phase correct profile filter

The weighting function of the phase correct filter (see figure 1) corresponds to the equation of the Gaussian density function. With the cut-off wavelength λco (where co = cut-off), the equation is as follows:

$$s(x) = \frac{1}{\alpha \lambda co} e^{-\pi \left(\frac{x}{\alpha \lambda co} \right)^2} \quad \ldots (1)$$

where

x is the position in relation to the centre of the weighting function;

λco is the cut-off wavelength of the profile filter;

$$\alpha = \sqrt{\frac{\ln 2}{\pi}} = 0{,}469\,7 \quad \ldots (2)$$

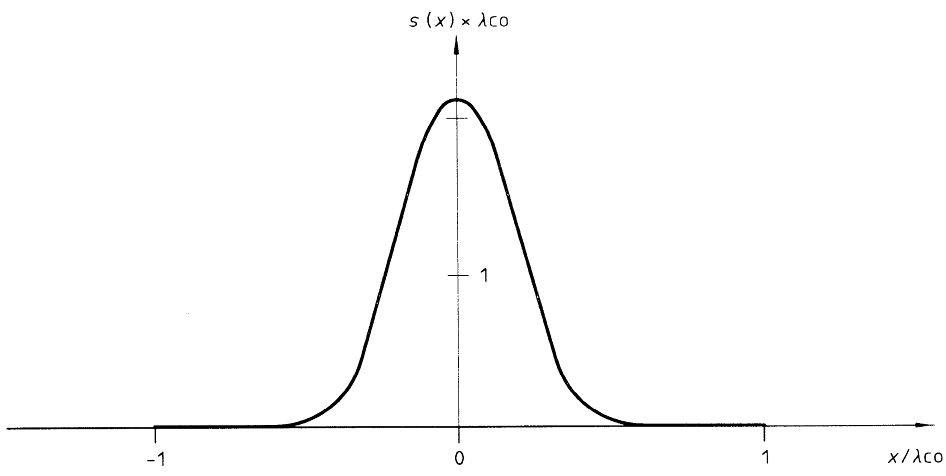

Figure 1 — Weighting function of the profile filter

3.2 Transmission characteristic

3.2.1 Transmission characteristic of the long wave profile component (mean line)

The filter characteristic (see figure 2) is determined from the weighting function by means of the Fourier transformation. The filter characteristic for the mean line corresponds to the following equation:

$$\frac{a_1}{a_0} = e^{-\pi\left(\frac{\alpha\,\lambda co}{\lambda}\right)^2} \qquad \ldots (3)$$

where

a_0 is the amplitude of sine wave roughness profile before filtering;

a_1 is the amplitude of this sine profile in the mean line;

λco is the limiting wavelength of the profile filter;

λ is the wavelength of the sine profile.

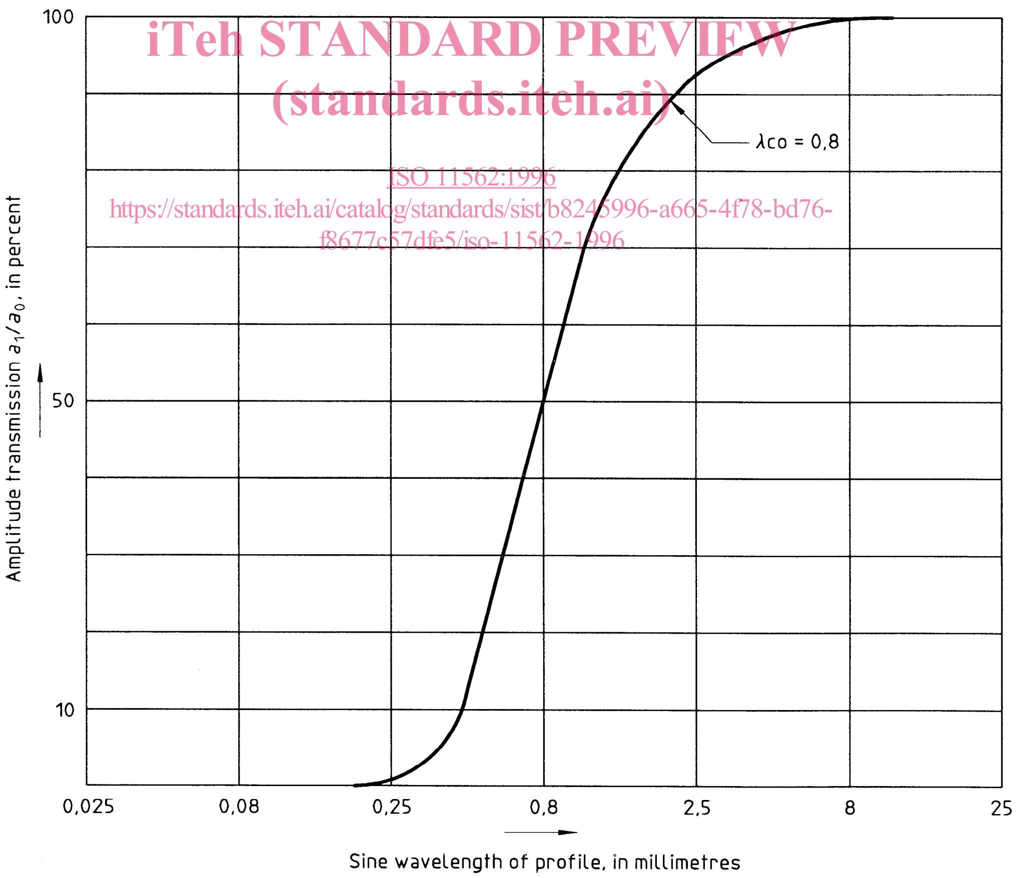

Figure 2 — Transmission characteristic of the long wave profile component

3.2.2 Transmission characteristic of the short wave profile component

The transmission characteristic of the short wave profile component is complementary to the transmission characteristic of the long wave profile component.

The short wave profile component is the difference between the surface profile and the long wave profile component. The equation as a function of the limiting wavelength λco is:

$$\frac{a_2}{a_0} = 1 - e^{-\pi\left(\frac{\alpha\,\lambda co}{\lambda}\right)^2} \quad ; \quad \frac{a_2}{a_0} = 1 - \frac{a_1}{a_0} \qquad \ldots (4)$$

where a_2 is the amplitude of the sine wave roughness profile.

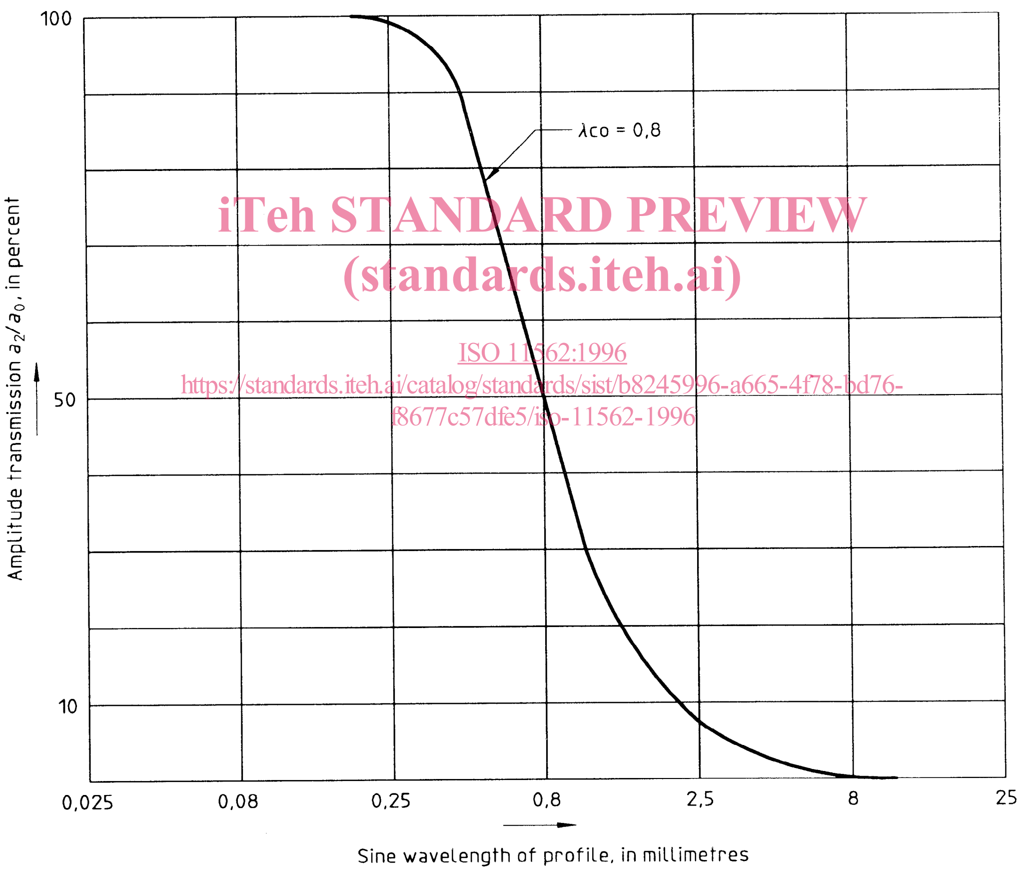

Figure 3 — Transmission characteristic for the short wave profile component

4 Limits of error of phase correct filters

For phase correct filters no tolerance values are given.

Instead of tolerances, a graphical representation of the deviations of the realized phase correct filter from the Gaussian filter shall be given as a percentage value over the wavelength range 0,01 λco to 100 λco. An example of a deviation curve is given in figure 4.

Figure 4 — Example of a deviation curve of a realized phase correct filter from the Gaussian filter