# SLOVENSKI STANDARD
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**Geometrične specifikacije izdelkov - Filtriranje - 21. del: Filtri linearnih profilov: Gaussovi filtri (ISO/DIS 16610-21:2023)**

Geometrical product specifications (GPS) - Filtration - Part 21: Linear profile filters: Gaussian filters (ISO/DIS 16610-21:2023)

Geometrische Produktspezifikation (GPS) - Filterung - Teil 21: Lineare Profilfilter: Gauß-Filter (ISO/DIS 16610-21:2023)

Spécification géométrique des produits (GPS) - Filtrage - Partie 21: Filtres de profil linéaires: Filtres gaussiens (ISO/DIS 16610-21:2023)



**Ta slovenski standard je istoveten z:** **prEN ISO 16610-21**



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| 17.040.20 | Lastnosti površin | Properties of surfaces |
| 17.040.40 | Specifikacija geometrijskih veličin izdelka (GPS) | Geometrical Product Specification (GPS) |

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# Geometrical product specifications (GPS) — Filtration —

## Part 21:
## Linear profile filters: Gaussian filters

*Spécification géométrique des produits (GPS) — Filtrage —*

*Partie 21: Filtres de profil linéaires: Filtres gaussiens*

ICS: 17.040.20; 17.040.40



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**ISO/CEN PARALLEL PROCESSING**



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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 290, *Dimensional and geometrical product specification and verification*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This edition of ISO 16610-21 cancels and replaces edition ISO 16610-21:2011, which has been technically revised.



The main changes are as follows.

— This document defines ideal continuous Gaussian filters for unbounded open profiles of infinite length and for closed profiles, exemplary applied to roundness profiles.

— Implementation details for open and closed profiles including the treatment of end effects are given in Annex A and Annex B, respectively.

A list of all parts in the ISO 16610 series can be found on the ISO website.

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.

# Introduction

This document is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences chain link C of all chains of standards.

The ISO GPS matrix model given in ISO 14638 gives an overview of the ISO GPS system of which this document is a part. The fundamental rules of ISO GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to the specifications made in accordance with this document, unless otherwise indicated.

For more information on the relationship of this document to filtration matrix model, see Annex C.

For more detailed information of the relation of this document to other standards and the GPS matrix model, see Annex D.

This document develops the terminology and a concept of linear Gaussian filters for profiles. The linear Gaussian filter for profiles has a transmission of 50 % for sinusoidal surface profiles with a wavelength equal to the cut-off wavelength. It separates the large and small lateral scale components of a surface profile in such a way that the surface profile can be reconstructed without altering.

# Geometrical product specifications (GPS) — Filtration —

# Part 21:
# Linear profile filters: Gaussian filters

## 1 Scope

This document specifies Gaussian filters for the filtration of surface profiles. It defines, in particular, how to separate large and small lateral scale components of a surface profile.

The concepts presented for closed profiles are applicable to the case of roundness filtering. Where appropriate, these concepts can be extended to generalized closed profiles, especially for profiles with re-entrant features.

Implementation details are given in Annex A for open profiles and Annex B for closed profiles.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16610-1:2015, *Geometrical product specifications (GPS) — Filtration — Part 1: Overview and basic concepts*

ISO 16610-20:2015, *Geometrical product specifications (GPS) — Filtration — Part 20: Linear profile filters: Basic concepts*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*



## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16610-1, ISO 16610-20, ISO/IEC Guide 99, and the following 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**
**surface profile**
line resulting from the intersection between a surface portion and an ideal plane

[SOURCE: ISO 16610-1:2015, 3.1.2, modified — Note 1 to entry and Note 2 to entry removed.]

**3.1.1**
**open profile**
surface profile with finite length and two ends

Note 1 to entry: The surface profile does not intersect with itself.

Note 2 to entry: An open profile has a compact support, i.e., within a certain interval the height values of an open profile can be any real number. Outside the interval the height values of an open profile are zero.

[SOURCE: ISO 16610-1:2015, 3.7, modified — Note 2 to entry added.]

**3.1.2**
**unbounded open profile**
surface profile with infinite length

Note 1 to entry: In this document, the term "unbounded" refers to the $x$ -axis.

**3.1.3**
**closed profile**
connected finite length surface profile without ends

Note 1 to entry: The surface profile does not intersect with itself, i.e. it is a simple closed curve or Jordan curve.

Note 2 to entry: A closed profile is periodic with the finite period length $L$.

Note 3 to entry: A typical example of a closed profile is one from a roundness measurement.

[SOURCE: ISO 16610-1:2015, 3.8, modified — Note 2 to entry and Note 3 to entry added.]

**3.2**
**linear profile filter**
profile filter which separates surface profiles into large lateral scale and small lateral scale components and is also a linear function

Note 1 to entry: If $\mathrm{F}$ is a function and $\mathrm{X}$ and $\mathrm{Y}$ are profiles, then $\mathrm{F}$ is a linear function implies $\mathrm{F}(a\,\mathrm{X}+b\,\mathrm{Y})=a\,\mathrm{F}(\mathrm{X})+b\,\mathrm{F}(\mathrm{Y})$.

[SOURCE: ISO 16610-20:2015, 3.1]



**3.3**
**weighting function**
function for calculating large lateral scale components by convolution (see ISO 16610-20:2015, 4.1) of the surface profile heights with this function



Note 1 to entry: The convolution performs a weighted moving average of the surface profile heights. The weighting function, reflected at the $x$ -axis, defines the weights for the averaging process.

[SOURCE: ISO 16610-20:2015, 3.3, modified – The definition has been replaced.]

**3.4**
**transmission characteristic of a filter**
characteristic that indicates the amount by which the amplitude of a sinusoidal surface profile is attenuated as a function of its wavelength

Note 1 to entry: The transmission characteristic is the Fourier transformation of the weighting function.

[SOURCE: ISO 16610-20:2015, 3.4]

**3.5**
**cut-off wavelength**
wavelength of a sinusoidal surface profile of which 50 % of the amplitude is transmitted by a linear profile filter

Note 1 to entry: Linear profile filters are identified by the filter type and the cut-off wavelength value.

Note 2 to entry: The cut-off wavelength is the recommended nesting index for linear profile filters.

[SOURCE: ISO 16610-20:2015, 3.5]

**3.6**
**undulations per revolution**
**UPR**
integer number of sinusoidal undulations contained in a closed profile

Note 1 to entry: In this document, UPR is a frequency and is denoted by $f$.

**3.7**
**cut-off frequency in undulations per revolution**
frequency in undulation per revolution of a sinusoidal closed profile of which 50 % of the amplitude is transmitted by the closed profile filter

# 4 Characteristics of the Gaussian filter for an unbounded open profile

## 4.1 General information

In this section, the ideal filtering of an unbounded open profile of theoretical infinite length is considered. For this purpose, the unbounded open profile is convolved with the ideal Gaussian weighting function of infinite length. The treatment of open profiles with finite length, as defined in 3.1.1, is considered in Annex A.

## 4.2 Gaussian weighting function for an unbounded open profile

The Gaussian weighting function with cut-off wavelength $\lambda_c$ (see Figure 1) for an unbounded open profile is given by Formula (1):

$$s(v) = \frac{1}{\alpha \lambda_c} e^{-\pi\left(\frac{v}{\alpha \lambda_c}\right)^2} \quad (1)$$



where

$v$ is the distance from the centre (maximum) of the Gaussian weighting function;

$s(v)$ is the Gaussian weighting function depending on $v$;

$\lambda_c$ is the cut-off wavelength;

$\alpha$ is the constant to provide 50 % transmission characteristic at the cut-off wavelength $\lambda_c$.



NOTE $\alpha = \sqrt{\frac{\ln 2}{\pi}} \approx 0,4697 \approx \frac{318}{677} \approx \frac{31}{66}$.