FINAL
DRAFT

INTERNATIONAL
STANDARD

ISO/FDIS
21920-3

# Geometrical product specifications (GPS) — Surface texture: Profile —

## Part 3:
## Specification operators

*Spécification géométrique des produits (GPS) — État de surface: Méthode du profil —*

*Partie 3: Opérateurs de spécification*

## ISO/CEN PARALLEL PROCESSING

Reference number
ISO/FDIS 21920-3:2021(E)

© ISO 2021

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/FDIS 21920-3
https://standards.iteh.ai/catalog/standards/sist/378ad936-6cdd-4cfb-9560-
5eb1cf2298ac/iso-fdis-21920-3

**COPYRIGHT PROTECTED DOCUMENT**

## Contents

# 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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 first edition of ISO 21920-3 cancels and replaces ISO 4288:1996, which has been technically revised.

The main changes to ISO 4288:1996 are as follows:

— no distinction between periodic and non-periodic profiles;

— the basis for defaults is the drawing indication;

— the maximum tolerance acceptance rule is the default tolerance acceptance rule;

— for the determination of the profile position, surface defects are considered as part of the specified surface in the default case.

A list of all parts in the ISO 21920 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 the chains of standards on profile surface texture.

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

This document specifies the specification operators according to ISO 17450-2.

Throughout this document, parameters are written as abbreviated terms with lower-case suffixes (as in Rq) which are used in product documentation, drawings and data sheets.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

# Geometrical product specifications (GPS) — Surface texture: Profile —

## Part 3: Specification operators

## 1 Scope

This document specifies the complete specification operator for surface texture by profile methods.

## 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 21920-1,[1])*Geometrical product specifications (GPS) — Surface texture: Profile — Part 1: Indication of surface texture*

ISO 21920-2,[2])*Geometrical product specifications (GPS) — Surface texture: Profile — Part 2: Terms, definitions and surface texture parameters*

ISO 16610-21, *Geometrical product specifications (GPS) — Filtration — Part 21: Linear profile filters: Gaussian filters*

ISO 16610-31, *Geometrical product specifications (GPS) — Filtration — Part 31: Robust profile filters: Gaussian regression filters*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21920-1 and ISO 21920-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

**3.1**
**setting class**
S*cn*
identifier to label default settings

Note 1 to entry: Specific setting classes are Sc1, Sc2, Sc3, Sc4 and Sc5.

Note 2 to entry: The setting class specifies the relevant column of Tables 2 to 6.

---

1) Under preparation. Stage at the time of publication: ISO/FDIS 21920-1:2021.

2) Under preparation. Stage at the time of publication: ISO/FDIS 21920-2:2021.

# 4 Complete specification operator

## 4.1 Introduction

For non-explicitly specified specification elements (see ISO 21920-1) and often-used specification operators, default settings are used. Default settings should not be expected to ensure correlation with any particular workpiece function.

The advantage of the default specification operators given in 4.3 and 4.4 is to simplify the drawing indications.

## 4.2 General

The complete specification operator (see ISO 17450-2) consists of all the operators required for an unambiguous specification. It consists of an ordered full set of unambiguous specification operations in an unambiguous order. For profile surface texture, the complete specification operator defines all setting elements.

The basis for the default settings is the drawing indication according to ISO 21920-1. For R-parameters either the setting class or the profile L-filter nesting index shall be specified. For W-parameters either the setting class or the profile S-filter nesting index shall be specified.

For the R-parameters Ra, Rq, Rz, Rp, Rv, Rzx and Rt, and for Pt, all default settings can be specified by the specification of the tolerance limit, see 4.4.3 to 4.4.6.

A flowchart illustrating the general way to determine the specification operators is given in Annex A. Examples for the determination of default settings are given in Annex B. Annex C provides an overview of the most important changes in the determination of the default settings according to this document in relation to ISO 4288. A recommendation for the selection of settings in the absence of a specification is given in Annex D. Annex E provides an overview of the profile and areal standards in the GPS matrix model.

NOTE 1    There is no distinction between periodic and non-periodic profiles.

NOTE 2    This document describes specification operators. For the verification, the following applies: "the verification operator is the physical implementation of the specification operator. It may have exactly the same operations in the same order, in which case the method uncertainty is zero, or it may have different operations or perform the operations in a different order, in which case the method uncertainty is not zero." [SOURCE: ISO 8015:2011, 5.10.1]

NOTE 3    There are no defaults for electromagnetic profiles.

## 4.3 General default settings

When specifying surface texture by the profile method the surface is the toleranced feature. Therefore, the profile direction and the profile position are an integral part of the specification. Surface imperfections and surface defects are part of the specified surface and shall be taken into account when determining profile locations, if not otherwise stated.

The general default settings given in Table 1, independent of the specified parameter type, shall be implemented.

NOTE    Considering surface imperfections and surface defects as part of the specified surface is a change from ISO 4288.

#### Table 1 — General default settings

| Criterion | Default setting |
|---|---|
| Procedure of profile extraction | Mechanical profile |
| Profile direction | The direction yielding the maximum values of roughness height parameters (perpendicular to the dominant lay direction) |
| Profile position | The profile position depends on the tolerance acceptance rule according to ISO 21920-1.<br><br>For the maximum tolerance acceptance rule: location on that part of the surface on which critical values can be expected. If this location cannot be clearly identified separate traces shall be distributed equally over this part of the surface.<br><br>For the 16 % tolerance acceptance rule and for the median tolerance acceptance rule: uniformly distributed traces shall be taken to represent the entire surface, see NOTE 1. |
| Tolerance type | Upper tolerance limit |
| Tolerance acceptance rule | The maximum tolerance acceptance rule according to ISO 21920-1 |
| Profile S-filter type | Gaussian filter according to ISO 16610-21 |
| Profile L-filter type (for R-parameters) Profile S-filter type (for W-parameters) | Gaussian filter according to ISO 16610-21<br><br>Exception: The default L-filter for Rk, Rpk, Rvk, Rpkx, Rvkx, Rmrk1, Rmrk2, Rak1, Rak2, Rpq, Rmq and Rvq is the robust Gaussian filter, second order according to ISO 16610-31, see NOTE 2. |
| Profile F-operator association method and element | Association and removal of the specified form element with total least square, see NOTES 3 and 4. |

NOTE 1   For the verification, this part of the surface can be identified, for example, by visual inspection.

NOTE 2   The change of the default filter type for Rk, Rpk, Rvk, Rpkx, Rvkx, Rmrk1, Rmrk2, Rak1, Rak2, Rpq, Rmq and Rvq leads to a better elimination of large-scale components and can generate slightly differing values of these parameters from the values obtained on the basis of ISO 13565-1.

NOTE 3   For the definition of "Association" see ISO 17450-1.

NOTE 4   For a circle, the radius shall also be included in the least square optimization and not held fixed to the nominal value. The F-operator is applied to the evaluation length.

## 4.4   Default settings based on the specification

### 4.4.1   General rules

This subclause defines rules for the default settings based on the specification in addition to the general default settings.

If several parameters are specified within one graphical symbol, the parameter in the first line shall be used to select the default settings.

If more than one specification element is specified, the topmost specification element shall be used to define the column for all non-explicitly specified default settings in Tables 2 to 6.

If a nesting index $N_{ic}$ not listed in Tables 2 to 6 is specified, a second specification element shall be specified, for example the setting class S$cn$, to define the column for all other non-explicitly specified settings.

If a nesting index $N_{is}$ not listed in Tables 2 to 6 is specified, the maximum sampling distance $d_x$ shall be $N_{is}/5$, for example if $N_{is} = 5$ µm then the maximum sampling distance $d_x = 1$ µm.

If there is a contradiction between the default profile direction and the default measuring length, the profile direction shall be respected first.

NOTE    See examples in B.1 to B.8.

### 4.4.2    Default settings based on *N*ic or S*cn*

For all R-parameters, except for Ra, Rq, Rz, Rp, Rv, Rzx and Rt, one of the following specifications shall be given in the drawing indication:

— the profile L-filter nesting index $N_{ic}$; or

— the setting class S*cn*.

For all W-parameters one of the following specifications shall be given in the drawing indication:

— the profile S-filter nesting index $N_{ic}$; or

— the setting class S*cn*.

For all P-parameters, except for Pt, one of the following specifications shall be given in the drawing indication:

— the profile S-filter nesting index $N_{is}$; or

— the setting class S*cn*.

This defines the default settings according to the corresponding column in Table 2, which defines the non-explicitly specified settings.

Table 2 — Default settings based on $N_{ic}$ or Sc$n$

| | Setting class | | | | |
|---|---|---|---|---|---|
| | Sc1 | Sc2 | Sc3 | Sc4 | Sc5 |
| **Profile L-filter nesting index** $N_{ic}$ (cut-off $\lambda_c$, for R-parameters) **or profile S-filter nesting index** $N_{ic}$ (cut-off $\lambda_c$, for W-parameters) mm | 0,08 | 0,25 | 0,8 | 2,5 | 8 |
| **Evaluation length** $l_e$ mm | 0,4 | 1,25 | 4 | 12,5 | 40 |
| | Exception: the default evaluation length $l_e$ for P-parameters is the length of the specified feature | | | | |
| **Profile S-filter nesting index** $N_{is}$ (cut-off $\lambda_s$) µm | 2,5 | 2,5 | 2,5 | 8 | 25 |
| **Maximum sampling distance** $d_x$ µm | 0,5 | 0,5 | 0,5 | 1,5 | 5 |
| **Maximum nominal tip radius** $r_{tip}$ µm | 2 | 2 | 2 | 5 | 10 |
| | Only for section length parameters | | | | |
| **Section length** $l_{sc}$ mm | 0,08 | 0,25 | 0,8 | 2,5 | 8 |
| | Exception: the default section length $l_{sc}$ for section length P-parameters is $l_e$ / 5 | | | | |
| **Number of sections** $n_{sc}$ | 5 | 5 | 5 | 5 | 5 |

NOTE     For P-parameters, there is no difference between Sc1, Sc2 and Sc3 but these columns are retained to keep the same structure as in Tables 2 to 6.

### 4.4.3   Default settings for Ra, Rq, Rz, Rp, Rv, Rzx and Rt based on the upper tolerance limit

The default settings for Ra, Rq, Rz, Rp, Rv, Rzx and Rt based on the specified upper tolerance limit U or the specified setting class, Sc$n$, are given in Table 3.

If the setting class is specified, it defines the default settings for all non-specified specification elements even if other specification elements are specified.

Table 3 — Default settings for Ra, Rq, Rz, Rp, Rv, Rzx and Rt based on the upper tolerance limit

| | Setting class | | | | |
|---|---|---|---|---|---|
| | Sc1 | Sc2 | Sc3 | Sc4 | Sc5 |
| **Specified parameter** | Upper tolerance limit (U) of the specified parameter | | | | |
| **Rz**, µm | U ≤ 0,160 | 0,160 < U ≤ 0,80 | 0,80 < U ≤ 16,0 | 16,0 < U ≤ 80 | U > 80 |
| **Ra**, µm | U ≤ 0,020 | 0,020 < U ≤ 0,10 | 0,10 < U ≤ 2,0 | 2,0 < U ≤ 10 | U > 10 |
| **Rp**, µm | U ≤ 0,060 | 0,060 < U ≤ 0,30 | 0,30 < U ≤ 6,0 | 6,0 < U ≤ 30 | U > 30 |
| **Rv**, µm | U ≤ 0,100 | 0,100 < U ≤ 0,50 | 0,50 < U ≤ 10,0 | 10,0 < U ≤ 50 | U > 50 |
| **Rq**, µm | U ≤ 0,032 | 0,032 < U ≤ 0,16 | 0,16 < U ≤ 3,2 | 3,2 < U ≤ 16 | U > 16 |
| **Rzx**, µm | U ≤ 0,230 | 0,230 < U ≤ 1,15 | 1,15 < U ≤ 23,0 | 23,0 < U ≤ 115 | U > 115 |
| **Rt**, µm | U ≤ 0,260 | 0,260 < U ≤ 1,30 | 1,30 < U ≤ 26,0 | 26,0 < U ≤ 130 | U > 130 |
| **Profile L-filter nesting index** $N_{ic}$ (cut-off $\lambda_c$) mm | 0,08 | 0,25 | 0,8 | 2,5 | 8 |

**Table 3** *(continued)*

| | Setting class | | | | |
|---|---|---|---|---|---|
| | **Sc1** | **Sc2** | **Sc3** | **Sc4** | **Sc5** |
| **Specified parameter** | Upper tolerance limit (U) of the specified parameter | | | | |
| **Rz**, µm | U ≤ 0,160 | 0,160 < U ≤ 0,80 | 0,80 < U ≤ 16,0 | 16,0 < U ≤ 80 | U > 80 |
| **Evaluation length $l_e$,** mm | 0,4 | 1,25 | 4 | 12,5 | 40 |
| **Profile S-filter nesting index $N_{is}$** (cut-off $\lambda_s$) µm | 2,5 | 2,5 | 2,5 | 8 | 25 |
| **Maximum sampling distance $d_x$** µm | 0,5 | 0,5 | 0,5 | 1,5 | 5 |
| **Maximum nominal tip radius $r_{tip}$** µm | 2 | 2 | 2 | 5 | 10 |
| Only for section length parameters, for example Rz, Rp, Rv | | | | | |
| **Section length $l_{sc}$** mm | 0,08 | 0,25 | 0,8 | 2,5 | 8 |
| **Number of sections $n_{sc}$** | 5 | 5 | 5 | 5 | 5 |

### 4.4.4 Default settings for Ra, Rq, Rz, Rp, Rv, Rzx and Rt based on bilateral tolerance limits

The default settings for Ra, Rq, Rz, Rp, Rv, Rzx and Rt based on the specified bilateral tolerance limits or the specified setting class, Sc*n*, are given in Table 4.

NOTE    Tolerance centre: C = (U + L)/2

**Table 4 — Default settings for Ra, Rq, Rz, Rp, Rv, Rzx and Rt based on bilateral tolerance limits**

| | Setting class | | | | |
|---|---|---|---|---|---|
| | **Sc1** | **Sc2** | **Sc3** | **Sc4** | **Sc5** |
| **Specified parameter** | Tolerance centre (C) of the bilateral tolerance of the specified parameter | | | | |
| **Rz**, µm | C ≤ 0,128 | 0,128 < C ≤ 0,64 | 0,64 < C ≤ 12,8 | 12,8 < C ≤ 64 | C > 64 |
| **Ra**, µm | C ≤ 0,016 | 0,016 < C ≤ 0,08 | 0,08 < C ≤ 1,6 | 1,6 < C ≤ 8 | C > 8 |
| **Rp**, µm | C ≤ 0,048 | 0,048 < C ≤ 0,24 | 0,24 < C ≤ 4,8 | 4,8 < C ≤ 24 | C > 24 |
| **Rv**, µm | C ≤ 0,080 | 0,080 < C ≤ 0,40 | 0,40 < C ≤ 8,0 | 8,0 < C ≤ 40 | C > 40 |
| **Rq**, µm | C ≤ 0,026 | 0,026 < C ≤ 0,13 | 0,13 < C ≤ 2,6 | 2,6 < C ≤ 13 | C > 13 |
| **Rzx**, µm | C ≤ 0,184 | 0,184 < C ≤ 0,92 | 0,92 < C ≤ 18,4 | 18,4 < C ≤ 92 | C > 92 |
| **Rt**, µm | C ≤ 0,208 | 0,208 < C ≤ 1,04 | 1,04 < C ≤ 20,8 | 20,8 < C ≤ 104 | C > 104 |
| **Profile L-filter nesting index $N_{ic}$** (cut-off $\lambda_c$) mm | 0,08 | 0,25 | 0,8 | 2,5 | 8 |
| **Evaluation length $l_e$** mm | 0,4 | 1,25 | 4 | 12,5 | 40 |
| **Profile S-filter nesting index $N_{is}$** (cut-off $\lambda_s$) µm | 2,5 | 2,5 | 2,5 | 8 | 25 |
| **Maximum sampling distance $d_x$** µm | 0,5 | 0,5 | 0,5 | 1,5 | 5 |