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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

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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 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).

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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).

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This first edition of ISO 21920-3 cancels and replaces ISO 4288:1996, which has been technically revised. It also incorporates the Technical Corrigendum ISO 4288:1996/Cor. 1:1998.

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.

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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.

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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, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 1: Indication of surface texture*

ISO 21920-2, *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*

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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 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
setting class
*Sc*n
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.

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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.

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

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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.

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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. 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. 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 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.

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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.

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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 Sc*n*

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 Sc*n*.

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 Sc*n*.

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 Sc*n*.

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

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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 λ_c, for R-parameters) **or profile S-filter nesting index N_{ic}** (cut-off λ_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 λ_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.					

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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 ≤ 0,16	0,16 < U ≤ 0,8	0,8 < U ≤ 16	16 < U ≤ 80	U > 80
Ra, µm	U ≤ 0,02	0,02 < U ≤ 0,1	0,1 < U ≤ 2	2 < U ≤ 10	U > 10
Rp, µm	U ≤ 0,06	0,06 < U ≤ 0,3	0,3 < U ≤ 6	6 < U ≤ 30	U > 30
Rv, µm	U ≤ 0,10	0,10 < U ≤ 0,5	0,5 < U ≤ 10	10 < 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 ≤ 0,23	0,23 < U ≤ 1,15	1,15 < U ≤ 23	23 < U ≤ 115	U > 115
Rt, µm	U ≤ 0,26	0,26 < U ≤ 1,3	1,3 < U ≤ 26	26 < U ≤ 130	U > 130
Profile L-filter nesting index N_{ic} (cut-off λ_c) mm	0,08	0,25	0,8	2,5	8

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