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Geometrical product specifications (GPS) — Surface texture: Profile method — Flowchart for *PSm*, *RSm*, *WSm* and *Pc*, *Rc*, *Wc*

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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*.

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

Feature characterization of rough surfaces is of growing interest in terms of a function-oriented description of technical surfaces. A well-known set of feature parameters is the mean width and mean height of profile elements defined in ISO 4287. Unfortunately, the definition given in ISO 4287 is insufficient for an unambiguous implementation in a high-level programming language. Due to the lack of a flowchart, results given by different software packages are not comparable. The main intention of this document is to provide an unambiguous algorithm for feature parameters PSm, RSm, WSm and Pc, Rc, Wc according to ISO 4287.

The flowchart defined in this document was developed by Seewig and Scott[5] and represents an extension of crossing the line segmentation proposed by Scott[4]. The flowchart is based on new knowledge gathered over the past 10 years.

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Geometrical product specifications (GPS) — Surface texture: Profile method — Flowchart for *PSm*, *RSm*, *WSm* and *Pc*, *Rc*, *Wc*

1 Scope

This document provides an unambiguous calculation of parameters *PSm*, *RSm*, *WSm* and *Pc*, *Rc*, *Wc*, as defined in ISO 4287, by means of a flowchart.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 General terms

3.1.1
profile
set of ordered pairs (x,z) which describe the intersection of a surface with a specified plane

Note 1 to entry: For every point *x* on the *X*-axis, there is exactly one ordinate *z*. The relation between *x* and *z* is given by a formula $z=f(x)$.

Note 2 to entry: Usually profiles have value pairs (x,z) above and below the *X*-axis.

Note 3 to entry: In surface metrology three profiles are defined. The primary profile, the roughness profile and the waviness profile. Each profile corresponds to a specific lateral scale.

3.1.2
evaluation length
lm
length in the direction of the *X*-axis used for assessing the profile under evaluation

[SOURCE: ISO 4287:1997, 3.1.10, modified — symbol changed from *ln* and notes to entry removed.]

3.1.3
profile peak
outwardly directed (from material to surrounding medium) portion of the assessed profile connecting two adjacent intersection points of the profile and the *X*-axis

3.1.4
profile peak height
normal distance between the *X*-axis and the highest ordinate of the profile peak

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3.1.5
profile valley
inwardly directed (from surrounding medium to material) portion of the assessed profile connecting two adjacent intersection points of the assessed profile and the *X*-axis

3.1.6
profile valley depth
normal distance between the *X*-axis and the lowest ordinate of the profile valley

3.1.7
profile element
profile peak/valley and the adjacent profile valley/peak within the evaluation length

Note 1 to entry: Profile elements are calculated from the beginning to the end of the evaluation length and vice versa.

3.1.8
profile element height
sum of the profile peak height and the profile valley depth of a profile element

3.1.9
profile element spacing
distance on the *X*-axis between the beginning of two adjacent profile elements

Note 1 to entry: The positive or negative portion of the assessed profile at the beginning or end of the evaluation length is considered as an imperfect profile element and is used for the determination of the profile element spacing.

3.1.10
profile peak height discrimination
minimum height of profile peaks of the assessed profile which is taken into account

Note 1 to entry: The minimum height of profile peaks is 10 % of *Pp* for primary profile parameters, 10 % of *Rp* for roughness profile parameters and 10 % of *Wp* for waviness profile parameters.

3.1.11
profile valley depth discrimination
minimum depth of profile valleys of the assessed profile which is taken into account

Note 1 to entry: The minimum depth of profile valleys is 10 % of *Pv* for primary profile parameters, 10 % of *Rv* for roughness profile parameters and 10 % of *Wv* for waviness profile parameters.

3.1.12
sgm
sign of a real number z depending on the numbers u and $l \in \mathbb{R}_0^+$

$$\operatorname{sgm}(z,l,u)=\begin{cases}1 & \text{if} \quad z\geq u\\ -1 & \text{if} \quad z\leq -l\\ 0 & \text{otherwise}\end{cases}$$

3.1.13
root
intersection of the assessed profile with the *X*-axis by linear interpolation

$$\operatorname{root}\left(x_a,z_a,x_b,z_b\right)=\begin{cases}\dfrac{\left(x_a+x_b\right)}{2} & \text{if} \quad z_b=z_a\\ \min\left(\max\left(\dfrac{\left(x_a\cdot z_b-x_b\cdot z_a\right)}{\left(z_b-z_a\right)},x_a\right),x_b\right) & \text{otherwise}\end{cases}$$

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with $x_a, z_a \in \mathbb{R}$ and $x_b, z_b \in \mathbb{R}$ as the coordinates of the profile whose linear connection intersects the *X*-axis

Note 1 to entry: If the intersection point lies outside the interval $[x_a, x_b]$, then the associated interval limit is used instead of the intersection point.

3.2 Surface profile parameters

3.2.1
mean height of the profile elements *Pc*, *Rc*, *Wc*
mean value of the profile element heights Zt_i within the evaluation length

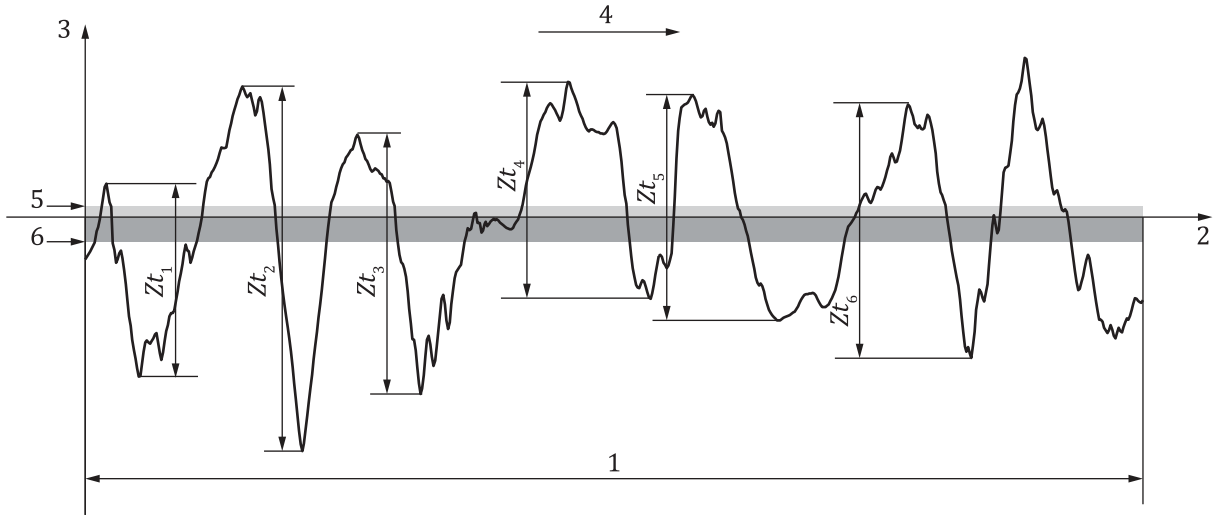
$$Rc = \frac{1}{m} \sum_{i=1}^{m} Zt_i$$

where m is the total number of profile elements calculated from the beginning to the end of the evaluation length and vice versa.

Note 1 to entry: See Figure 1 and Figure 2.

Note 2 to entry: In ISO 4287, the mean height of the profile elements is defined over the sampling length.

Note 3 to entry: Formulae for parameter definitions are exemplarily given for roughness profile parameters. Primary profile parameters and waviness profile parameters are defined in a similar manner, replacing the parameters related to the roughness profile with those related to the primary profile or waviness profile.



Key

1 evaluation length
2 *X*-axis
3 profile height
4 direction of evaluation
5 profile peak height discrimination
6 profile valley depth discrimination

Figure 1 — Heights Zt_i of profile elements which are calculated from the beginning to the end of the evaluation length

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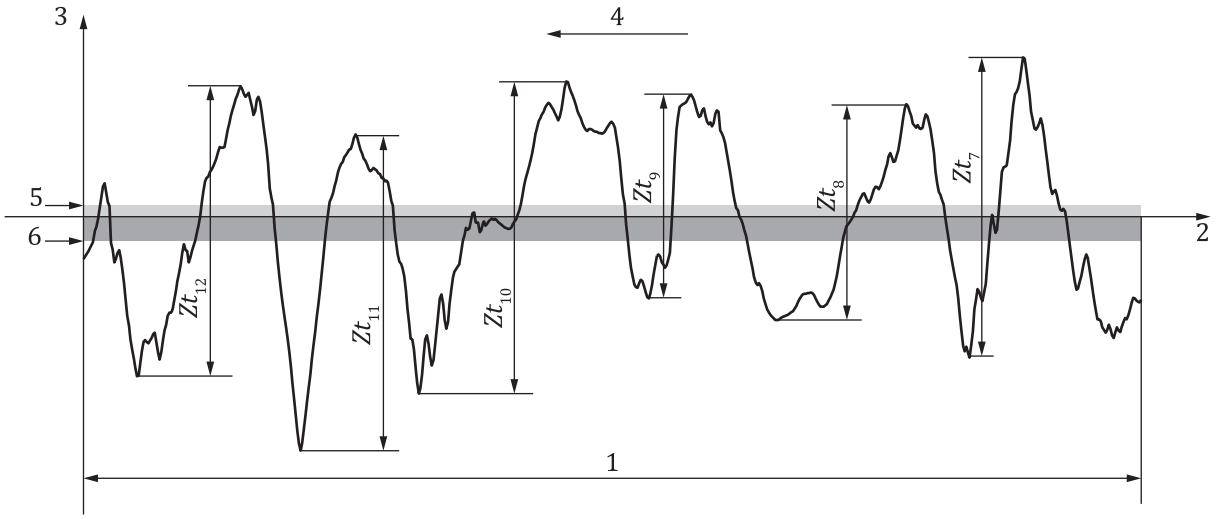

Key

1 evaluation length
2 *X*-axis
3 profile height
4 direction of evaluation
5 profile peak height discrimination
6 profile valley depth discrimination

Figure 2 — Heights Zt_i of profile elements which are calculated from the end to the beginning of the evaluation length

3.2.2
mean spacing of the profile elements *PSm*, *RSm*, *WSm*
mean value of the profile element spacings Xs_i within the evaluation length

$$RSm = \frac{1}{m}\sum_{i=1}^{m} Xs_i$$

where m is the total number of profile elements calculated from the beginning to the end of the evaluation length and vice versa.

Note 1 to entry: See Figure 3 and Figure 4.

Note 2 to entry: In ISO 4287, the parameter is defined as the mean width of the profile elements.

Note 3 to entry: In ISO 4287, the mean width of the profile elements is defined over the sampling length.

Note 4 to entry: Formulae for parameter definitions are exemplarily given for roughness profile parameters. Primary profile parameters and waviness profile parameters are defined in a similar manner, replacing the parameters related to the roughness profile with those related to the primary profile or waviness profile.

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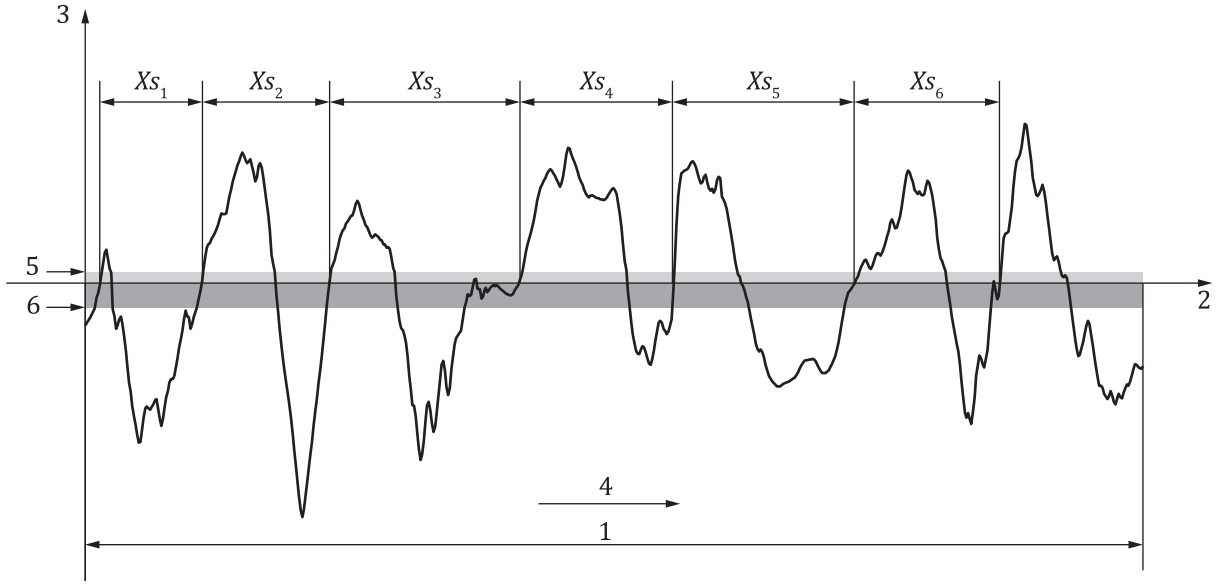

Key

1 evaluation length
2 *X*-axis
3 profile height
4 direction of evaluation
5 profile peak height discrimination
6 profile valley depth discrimination

Figure 3 — Spacings Xs_i of the profile elements which are calculated from the beginning to the end of the evaluation length

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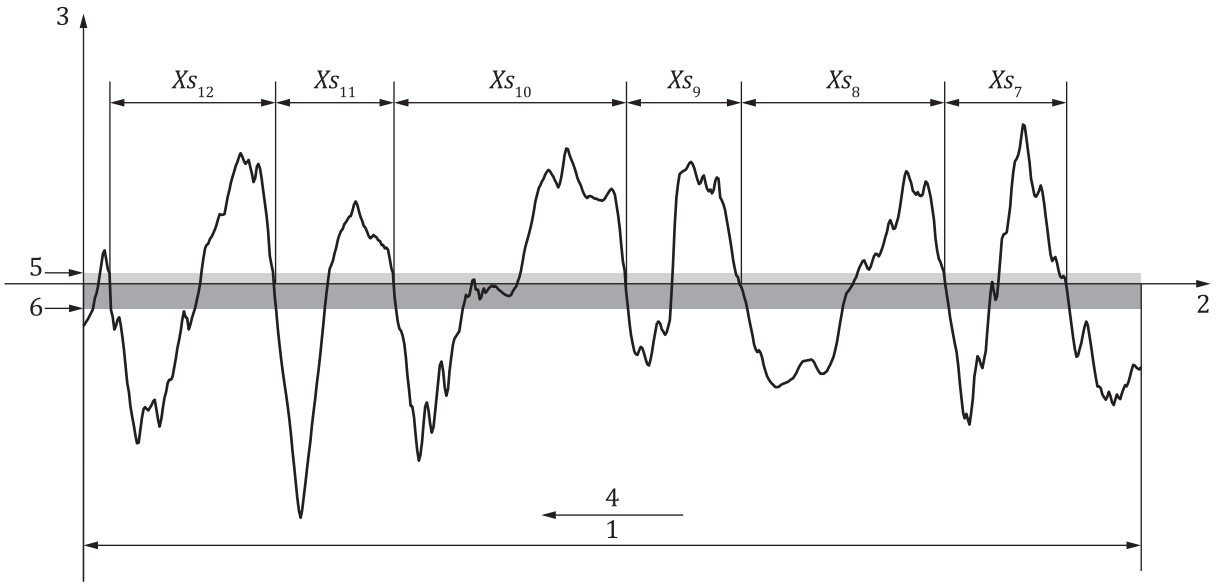

Key

1 evaluation length
2 *X*-axis
3 profile height
4 direction of evaluation
5 profile peak height discrimination
6 profile valley depth discrimination

Figure 4 — Spacings Xs_i of the profile elements which are calculated from the end to the beginning of the evaluation length

4 Flowchart for parameters *PSm*, *RSm*, *WSm* and *Pc*, *Rc*, *Wc*

4.1 General

To calculate the mean spacing of the profile elements PSm, RSm, WSm and the mean height of the profile elements Pc, Rc, Wc the flowchart is separated into four parts.

— Part one: detection of profile peaks and profile valleys with arbitrary height or depth within the evaluation length.

— Part two: calculation of significant profile peaks and profile valleys applying the profile peak height discrimination and profile valley depth discrimination.

— Part three: merging of adjacent significant profile peaks or adjacent significant profile valleys.

— Part four: calculation of the profile parameters PSm, RSm, WSm and Pc, Rc, Wc.

NOTE The flowchart is specified for a generic type of profile, designated by the letter *X*, with parameters *XSm* and *Xc*. Primary profile parameters, roughness profile parameters and waviness profile parameters are defined in a similar manner, replacing the parameters related to the *X* profile with those related to the primary profile, roughness profile or waviness profile.

The following variables are used:

i, j, k	running index
m	number of profile elements

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