



BSI Standards Publication

Geometrical product specifications (GPS) — Surface texture: Profile

Part 2: Terms, definitions and surface texture parameters

National foreword

This British Standard is the UK implementation of EN ISO 21920-2:2022. It is identical to ISO 21920-2:2021. It supersedes BS EN ISO 4287:1998+A1:2009, BS EN ISO 12085:1997, BS EN ISO 13565-1:1998, BS EN ISO 13565-2:1998 and BS EN ISO 13565-3:2000, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee TPR/1, Technical Product Realization.

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Profile - Part 2: Terms, definitions and surface texture
parameters (ISO 21920-2:2021)

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surface: Méthode du profil - Partie 2: Termes,
définitions et paramètres d'état de surface (ISO 21920-
2:2021)

Geometrische Produktspezifikation (GPS) -
Oberflächenbeschaffenheit: Profile - Teil 2: Begriffe
und Parameter für die Oberflächenbeschaffenheit (ISO
21920-2:2021)

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EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO 21920-2:2022) has been prepared by Technical Committee ISO/TC 213 "Dimensional and geometrical product specifications and verification" in collaboration with Technical Committee CEN/TC 290 "Dimensional and geometrical product specification and verification" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2022, and conflicting national standards shall be withdrawn at the latest by July 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 12085:1997, EN ISO 4287:1998, EN ISO 13565-2:1997 and EN ISO 13565-3:2000.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 21920-2:2021 has been approved by CEN as EN ISO 21920-2:2022 without any modification.

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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 first edition of ISO 21920-2 cancels and replaces ISO 4287:1997, ISO 13565-2:1996 and ISO 13565-3:1998, which have been technically revised.

It also incorporates the Amendment ISO 4287:1997/Amd 1:2009 and the Technical Corrigenda ISO 4287:1997/Cor 1:1998, ISO 4287:1997/Cor 2:2005 and ISO 13565-2:1996/Cor 1:1998.

The main changes are related to ISO 4287 and are as follows:

- all field parameters are now related to the evaluation length;
- unambiguous evaluation of profile elements;
- definition of new parameters, in particular parameters based on the watershed transformation.

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.

This corrected version of ISO 21920-2:2021 incorporates the following corrections:

- ISO 12085:1996 and ISO 12085:1996/Cor 1:1998 have been removed from the list of documents which this document replaces as they have been reinstated.

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 B 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 K](#).

This document develops the terminology, concepts and parameters for profile surface texture.

Throughout this document, parameters are written as abbreviated terms with lower-case suffixes (as in R_q) when used in a sentence, and are written as symbols with subscripts (as in R_q) when used in formulae, to avoid misinterpretations of compound letters as an indication of multiplication between quantities in formulae. The parameters with lower-case suffixes are used in product documentation, drawings and data sheets.

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

Part 2: Terms, definitions and surface texture parameters

1 Scope

This document specifies terms, definitions and parameters for the determination of surface texture by profile methods.

NOTE 1 The main changes to previous ISO profile documents are described in [Annex I](#).

NOTE 2 An overview of profile and areal standards in the GPS matrix model is given in [Annex J](#).

NOTE 3 The relation of this document to the GPS matrix model is given in [Annex K](#).

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16610-1 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 General terms

3.1.1

skin model

non-ideal surface model

<of a workpiece> model of the physical interface of the workpiece with its environment

[SOURCE: ISO 17450-1:2011, 3.2.2]

3.1.2

surface texture

geometrical irregularities contained in a scale-limited profile

Note 1 to entry: Surface texture does not include geometrical irregularities contributing to the form or shape of the profile.

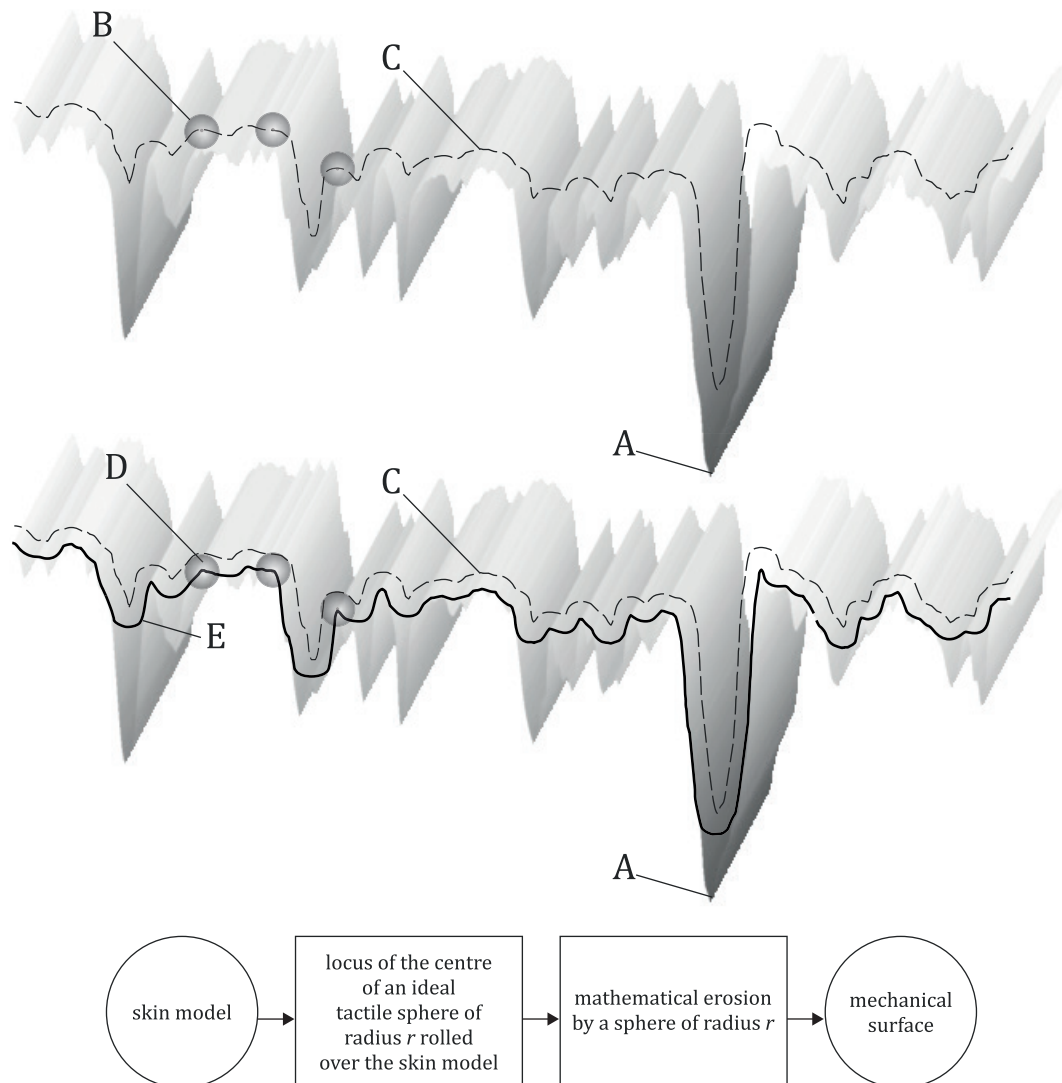
3.1.3

mechanical surface

boundary of the mathematical erosion, by a sphere of radius r , of the locus of the centre of an ideal tactile sphere, also with radius r , rolled over the skin model of a workpiece

Note 1 to entry: [Figure 1](#) is an example to show the effect of mechanical filtering and is not related to a real measured surface.

[SOURCE: ISO 14406:2010, 3.1.1, modified — Notes to entry replaced.]



Key

- A skin model
- B ideal tactile sphere of radius r
- C envelope curve of the locus of the centre of an ideal tactile sphere B rolled over the skin model
- D sphere of radius r
- E mechanical surface: boundary of the mathematical erosion, by the sphere D, of the envelope curve C

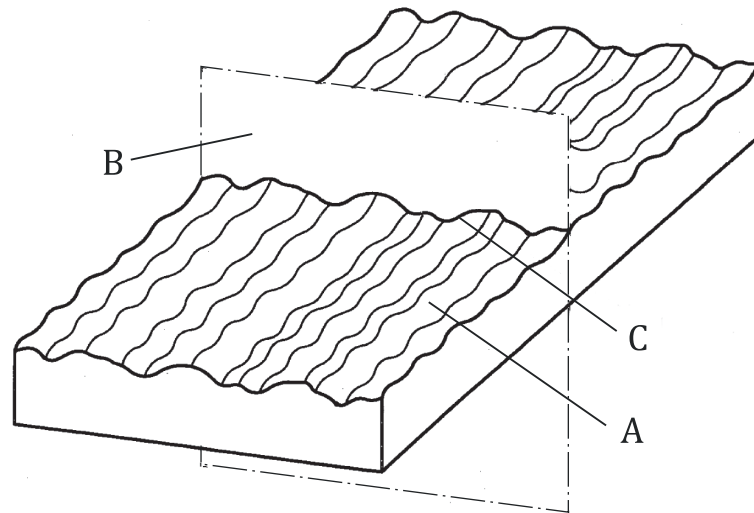
Figure 1 — Mechanical surface

3.1.4**profile trace**

intersection of the skin model by an intersection plane perpendicular to the skin model and in a specified direction

Note 1 to entry: See [Figure 2](#).

Note 2 to entry: See ISO 21920-3:2021, 4.3.

**Key**

- A skin model
- B intersection plane
- C profile trace

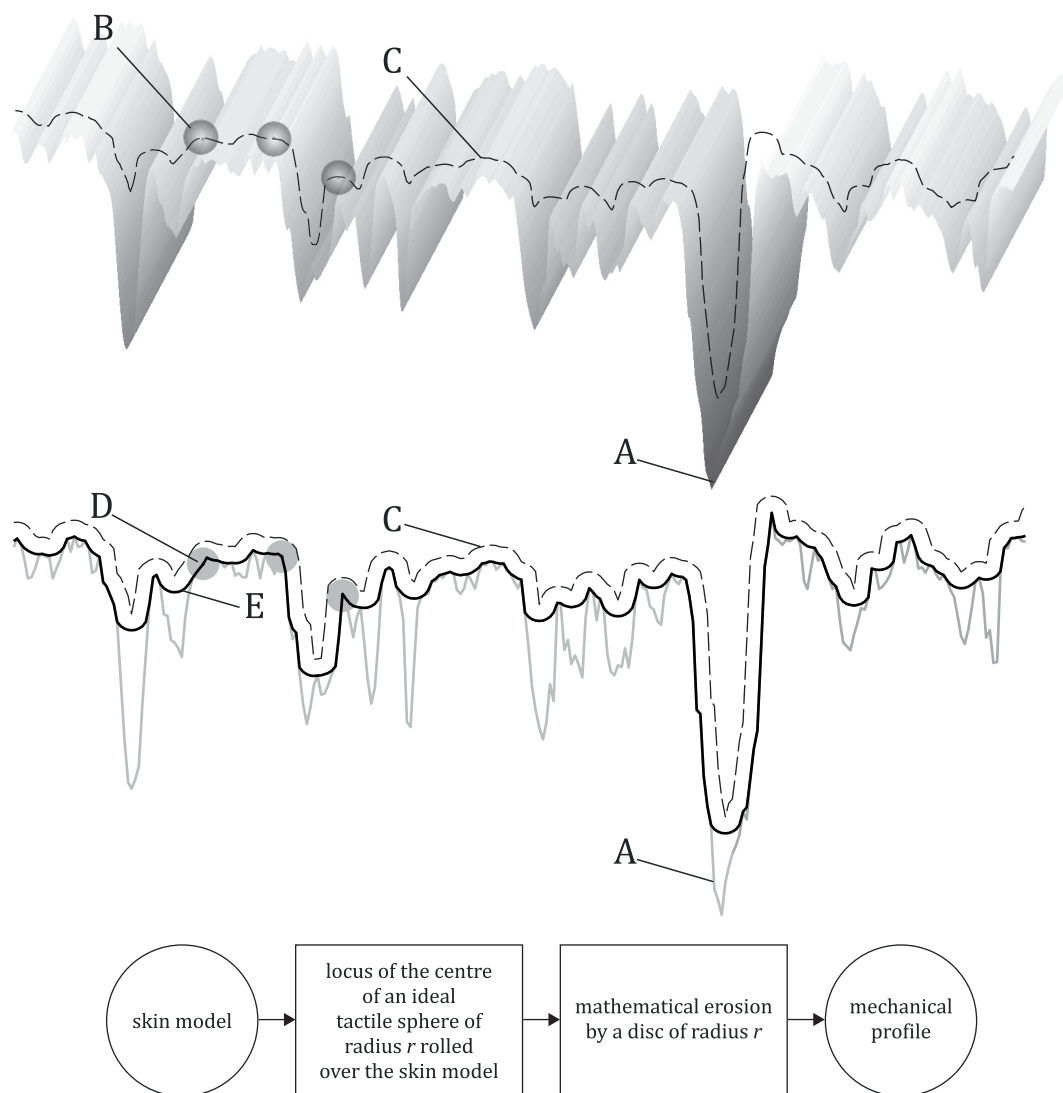
Figure 2 — Profile trace

3.1.5**mechanical profile**

boundary of the mathematical erosion, by a circular disc of radius r , of the locus of the centre of an ideal tactile sphere, also with radius r , rolled along a trace over the skin model of a workpiece

Note 1 to entry: [Figure 3](#) is an example to show the effect of mechanical filtering and is not related to a real measured profile.

Note 2 to entry: The treatment of non-measured points and spurious points is part of the extraction process (see ISO 17450-1:2011, 8.1.3) and is not considered in this document.



Key

- A skin model
- B ideal tactile sphere of radius r
- C envelope curve of the planar locus of the centre of an ideal tactile sphere rolled over the skin model
- D circular disc of radius r
- E mechanical profile: boundary of the mathematical erosion, by the circular disc D, of the envelope curve C

Figure 3 — Mechanical profile

3.1.6

electromagnetic surface

surface obtained by the electromagnetic interaction with the skin model of a workpiece

Note 1 to entry: See [Figure 4](#).

Note 2 to entry: The electromagnetic surface is an inherent characteristic of a skin model of a workpiece.

Note 3 to entry: Electromagnetic surfaces depend on the optical measurement principle used for extraction.

[SOURCE: ISO 14406:2010, 3.1.2, modified — Notes to entry replaced.]

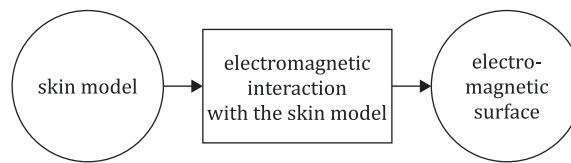


Figure 4 — Electromagnetic surface

3.1.7

electromagnetic profile

profile obtained by the electromagnetic interaction with the skin model of a workpiece

Note 1 to entry: See [Figure 5](#).

Note 2 to entry: The electromagnetic profile is an inherent characteristic of a skin model of a workpiece.

Note 3 to entry: Electromagnetic profiles depend on the optical measurement principle used for extraction.

Note 4 to entry: In most cases, the profile trace results from the intersection of the skin model by an intersection plane perpendicular to the *skin model* ([3.1.1](#)) and in a specified direction (see ISO 21920-3).

Note 5 to entry: The treatment of non-measured points and spurious points is part of the extraction process and is not considered in this document.

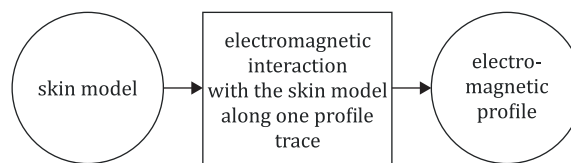


Figure 5 — Electromagnetic profile

3.1.8

auxiliary surface

surface obtained by an interaction, other than mechanical or electromagnetic, with the *skin model* ([3.1.1](#)) of a workpiece

Note 1 to entry: A software measurement standard is an example of an auxiliary surface. Other physical measurement principles which differ from a mechanical or electromagnetic surface, such as scanning tunnelling microscopy or atomic force microscopy, can also serve as an auxiliary surface. See [Figure 6](#).

3.1.9

auxiliary profile

profile obtained by an interaction, other than mechanical or electromagnetic, with the *skin model* ([3.1.1](#)) of a workpiece

Note 1 to entry: A software measurement standard is an example of an auxiliary profile. Other physical measurement principles which differ from a mechanical or electromagnetic profile, such as scanning tunnelling microscopy or atomic force microscopy, can also serve as an auxiliary profile. See [Figure 6](#) and [Annex H](#).

3.1.10

specification coordinate system

system of coordinates in which surface texture parameters are specified

Note 1 to entry: If the nominal surface is a plane (or portion of a plane), it is common practice to use a rectangular coordinate system in which the axes form a right-handed Cartesian set, the *x*-axis and the *y*-axis also lying on the nominal surface, and the *z*-axis being in an outward direction (from the material to the surrounding medium). This convention is adopted throughout the rest of this document.

3.1.11

nesting index

N_{is} , N_{ic} , N_{if}

number or set of numbers indicating the relative level of nesting for a particular primary mathematical model

Note 1 to entry: The cut-off wavelength for the Gaussian filter is an example of a nesting index.

Note 2 to entry: Using the different nesting indices, specific lateral scale components of a scale-limited profile are extracted.

[SOURCE: ISO 16610-1:2015, 3.2.1, modified — definition and notes to entry revised.]

3.1.12

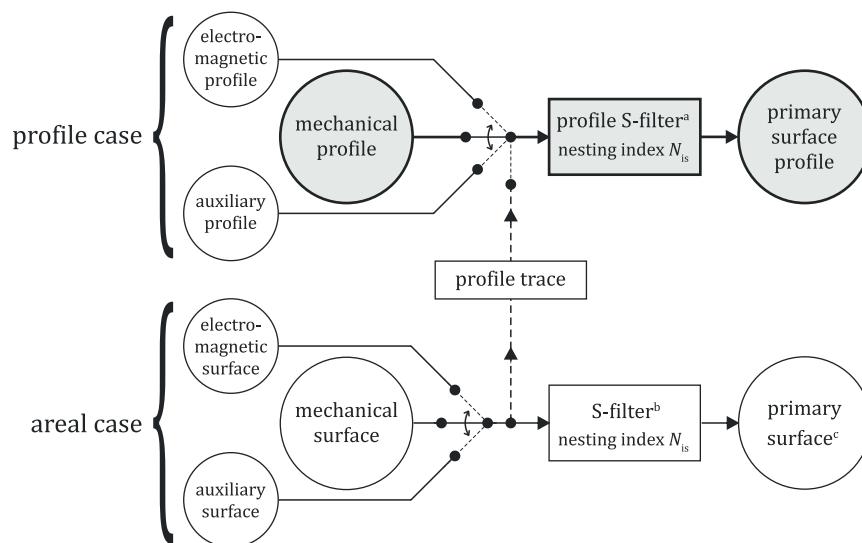
primary surface profile

surface profile trace obtained when a surface profile trace is represented as a specified primary mathematical model with specified nesting index N_{is}

Note 1 to entry: In the ISO 21920 series, a profile S-filter is used to derive the primary surface profile from a profile trace (e.g. mechanical profile). See [Figure 6](#) and [Annex H](#).

Note 2 to entry: For some applications, the profile S-filter is not used. In such cases, for example for multi-scale analysis, the nesting index is equal to “zero”.

Note 3 to entry: In most situations, the primary surface profile can be derived with sufficient accuracy from either the mechanical surface (the default choice), the electromagnetic surface or the auxiliary surface, using an intersection plane perpendicular to the chosen type of surface and in a specified direction. See [Figure 6](#).



NOTE The evaluation chain for the default case is indicated by the grey fill colour.

^a See [3.1.13.1](#) for profile S-filter.

^b See ISO 25178-2:2021, 3.1.6.1, for S-filter.

^c See ISO 25178-2:2021, 3.1.5, for primary surface.

Figure 6 — Definition of the primary surface and primary surface profile

3.1.13

profile filter

filtration operator applied to a profile

3.1.13.1**profile S-filter**

profile filter which removes small lateral scale components from a profile

Note 1 to entry: See [Figure 7](#).

3.1.13.2**profile L-filter**

profile filter which removes large lateral scale components from a profile

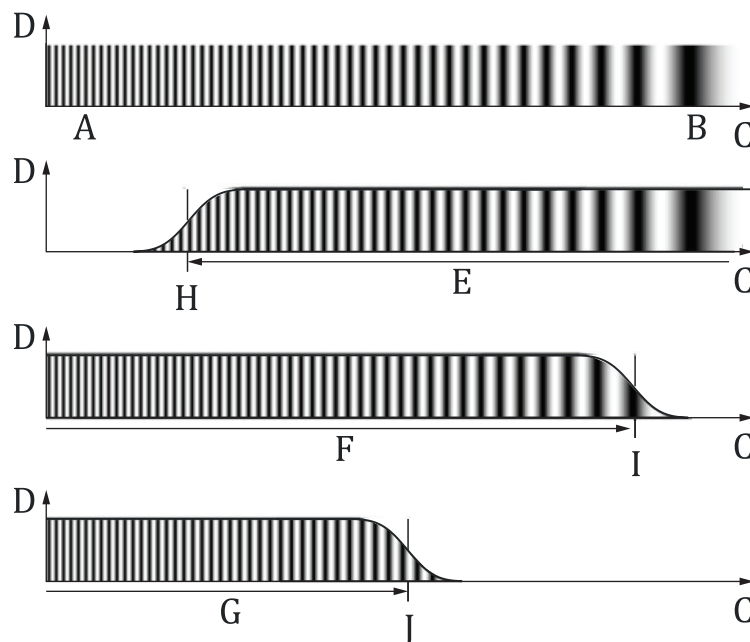
Note 1 to entry: Some profile L-filters are sensitive to form and require the profile F-operation first as a prefilter before being applied.

Note 2 to entry: See [Figure 7](#).

3.1.13.3**profile F-operation**

operation which removes form from a profile

Note 1 to entry: See [Figure 7](#).

**Key**

- A small lateral scale (e.g. short wavelengths)
- B large lateral scale (e.g. long wavelengths)
- C scale axis
- D amplitude axis
- E lateral scale component extracted by the profile S-filter
- F lateral scale component extracted by the profile F-operation
- G lateral scale component extracted by the profile L-filter
- H profile S-filter nesting index N_{is}
- I profile F-operation nesting index N_{if}
- J profile L-filter nesting index N_{ic}

Figure 7 — Relationships between the S-filter, L-filter and F-operation

3.1.14

scale-limited profile

profile structure scale components between specified nesting indices

EXAMPLE A profile is scale-limited after applying a profile filter with a specified nesting index.

3.1.14.1

primary profile

P-profile

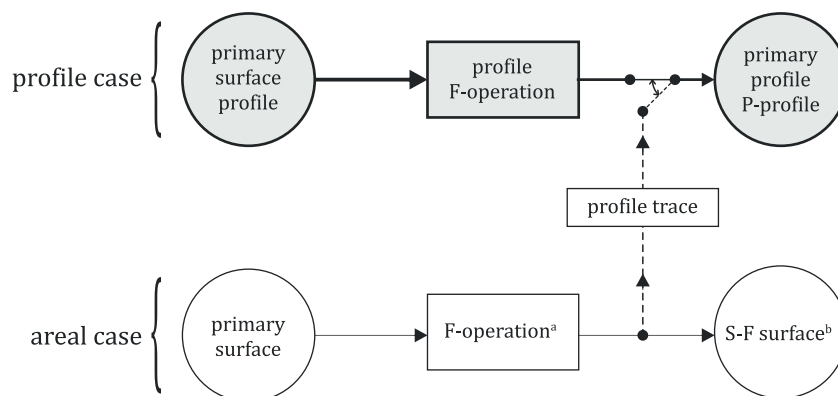
scale-limited profile at any position x derived from the primary surface profile by removing the form using a profile F-operation with nesting index N_{if}

Note 1 to entry: In most cases, the primary profile can be derived with sufficient accuracy from the S-F surface using an intersection plane perpendicular to the S-F surface and in a specified direction. See [Figure 8](#).

Note 2 to entry: The primary profile is the basis for evaluation of the *P-parameters* (3.2.5). See [Figures 9](#) and [10](#).

Note 3 to entry: The profile F-operation can be performed as a multi-stage operation, for example a combination of a total least square fit and a profile L-filter.

Note 4 to entry: See [Annex H](#) for additional information.



NOTE The evaluation chain for the default case is indicated by the grey fill colour.

^a See ISO 25178-2:2021, 3.1.6.3, for F-operation.

^b See ISO 25178-2:2021, 3.1.7, for S-F surface.

Figure 8 — Primary profile derived from the primary surface profile (default) or S-F surface

3.1.14.2

waviness profile

W-profile

scale-limited profile at any position x derived from the primary profile by removing small-scale lateral components by a specific type of profile S-filter with a nesting index N_{ic}

Note 1 to entry: The waviness profile is the basis for evaluation of the *W-parameters* (3.2.6). See [Figures 9](#) and [10](#).

Note 2 to entry: The choice of filter settings for W-parameters is highly dependent on the functional requirements. This is why no default tables for W-parameters are found in ISO 21920-3.

Note 3 to entry: See [Annex H](#) for additional information.

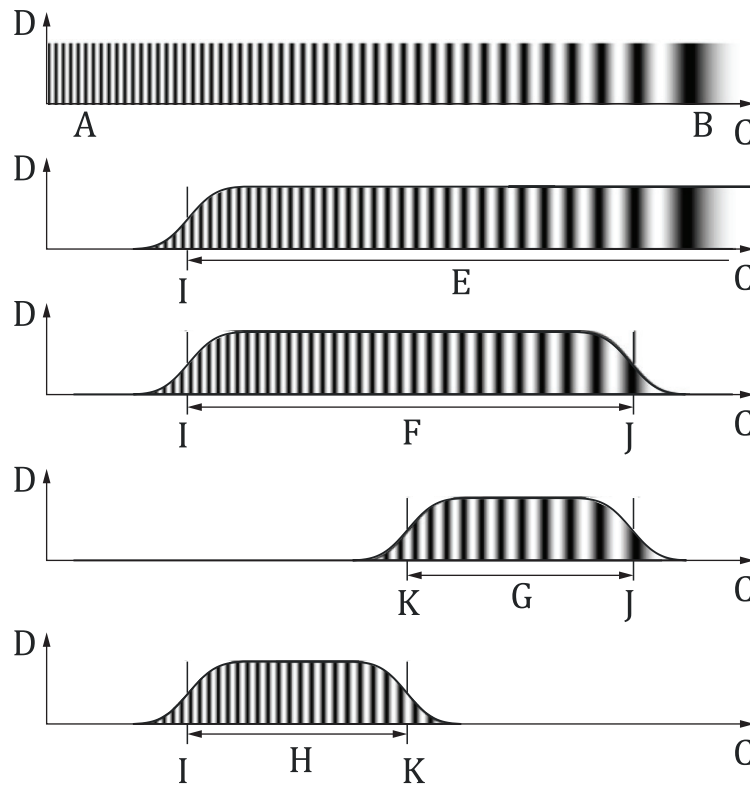
3.1.14.3 roughness profile

R-profile

scale-limited profile at any position x derived from the primary profile by removing large-scale lateral components by a specific type of profile L-filter with a nesting index N_{ic}

Note 1 to entry: The roughness profile is the basis for evaluation of the *R-parameters* (3.2.7). See [Figures 9](#) and [10](#).

Note 2 to entry: See [Annex H](#) for additional information.



Key

- A small lateral scale
- B large lateral scale
- C scale axis
- D amplitude axis
- E lateral scale component of primary surface profile
- F lateral scale component of P-profile
- G lateral scale component of W-profile
- H lateral scale component of R-profile
- I profile S-filter nesting index N_{is}
- J profile F-operation nesting index N_{if}
- K profile L-filter nesting index N_{ic}

Figure 9 — Relationship between the primary surface profile, P-profile, W-profile and R-profile

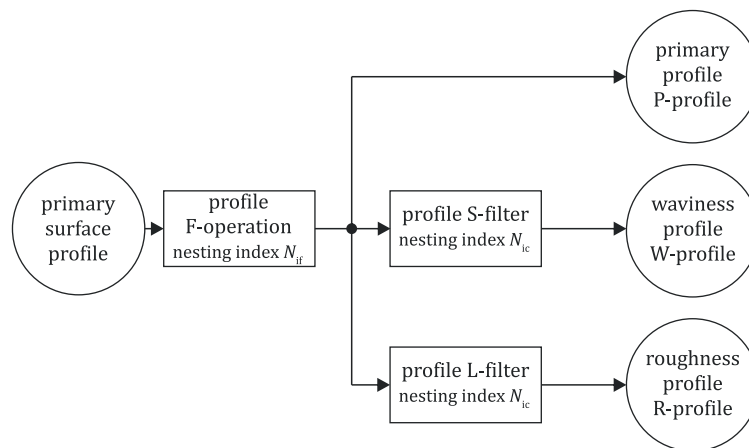


Figure 10 — Measuring chain to determine the P-profile, W-profile and R-profile

3.1.15

reference line

line corresponding to a specific large lateral scale component

Note 1 to entry: The x -axis of the *specification coordinate system* (3.1.10) coincides with the reference line of the assessed profile and the z -axis is oriented in an outward direction (from the material to the surrounding medium). This convention is adopted throughout the rest of this document.

Note 2 to entry: The reference line for the primary profile and waviness profile are the large lateral scale component of primary surface profile removed by the profile F-operation.

Note 3 to entry: The reference line for the roughness profile is the component of the primary profile removed by the profile L-filter.

3.1.16

evaluation length

l_e

length in the direction of the x -axis used for identifying the geometrical structures characterizing the scale-limited profile

Note 1 to entry: The traverse length is longer than the evaluation length.

Note 2 to entry: See 3.2.3 for evaluation length parameters.

Note 3 to entry: In ISO 4287, the evaluation length was given by l_n .

3.1.17

section length

l_{sc}

length in the direction of the x -axis used to obtain *section length parameters* (3.2.4)

Note 1 to entry: Default values of l_{sc} are found in ISO 21920-3.

3.1.18

number of sections

n_{sc}

integer number used to obtain *section length parameters* (3.2.4)

Note 1 to entry: Default values of n_{sc} are found in ISO 21920-3.

3.2 Geometrical parameter terms

NOTE Parameter symbols are written with subscripts (e.g. R_q) when used in formulae to avoid misinterpretations of compound letters as an indication of multiplication between quantities. Parameter symbols are written with lower-case suffixes (e.g. R_q) when used in product documentation, drawings and data sheets.

3.2.1

field parameter

parameter defined from all the points on a scale-limited profile

3.2.2

feature parameter

parameter defined from a subset of predefined topographic features from the scale-limited profile

Note 1 to entry: For feature parameters, see [Clause 5](#).

3.2.3

evaluation length parameter

parameter defined on the evaluation length

Note 1 to entry: See [Clause 4](#), [5.2](#) and [5.3](#) for evaluation length parameters.

3.2.4

section length parameter

parameter defined on a set of section length

Note 1 to entry: See [5.1](#) for section length parameters.

3.2.5

P-parameter

parameter determined from the primary profile

3.2.6

W-parameter

parameter determined from the waviness profile

3.2.7

R-parameter

parameter determined from the roughness profile

Note 1 to entry: Formulae for parameter definitions are exemplarily given for R-parameters. P- and W-parameters are defined in a similar manner, replacing the parameters related to the R-profile with those related to the P-profile or W-profile. Default specification operators for the different types of parameter definitions can be found in ISO 21920-3.

3.2.8

height

signed normal distance from the reference line to the scale-limited profile

Note 1 to entry: Where the scale-limited profile is below the reference line, the height has a negative value.

Note 2 to entry: This definition as an absolute coordinate applies when the term 'height' is used alone. Later terms in this document include the word 'height' or 'depth' in their name, such as the maximum height R_z (see [5.1.6](#)) or *dale local depth* ([3.3.18](#)). The definitions of some of those later terms use an alternative reference point and/or refer to an unsigned distance in a specified direction from the reference point. See those definitions for details.

3.2.9

depth

height multiplied by minus one

Note 1 to entry: Where the scale-limited profile is above the reference line, the depth has a negative value.

Note 2 to entry: This definition as an absolute coordinate applies when the term ‘depth’ is used alone. Later terms in this document include the word ‘height’ or ‘depth’ in their name, such as the maximum height R_z (see 5.1.6) or *dale local depth* (3.3.18). The definitions of some of those later terms use an alternative reference point and/or refer to an unsigned distance in a specified direction from the reference point. See those definitions for details.

3.2.10

ordinate value

$z(x)$

height of the assessed scale-limited profile

3.2.11

local gradient

$dz(x)/dx$

first derivative of the scale-limited profile z with respect to the position x

Note 1 to entry: See [Annex A](#) for the determination of the gradient.

Note 2 to entry: The local gradient is also called slope.

3.2.12

local curvature

$\kappa(x)$

curvature of the scale-limited profile z with respect to the position x

$$\kappa(x) = \frac{d^2 z(x)/dx^2}{\left(1 + (dz(x)/dx)^2\right)^{\frac{3}{2}}} \quad (1)$$

Note 1 to entry: See [Annex A](#) and [Annex B](#) for the determination of the curvature.

Note 2 to entry: For most engineering surfaces, the local gradient (slope) is small, enabling a good approximation of local curvature by the local second derivative $\kappa(x) \equiv (d^2 z(x))/dx^2$.

3.2.13

autocorrelation function

$f_{ACF}(t_x)$

function which describes the correlation between a scale-limited profile z and the same profile spatially shifted by t_x

$$f_{ACF}(t_x) = \frac{\frac{1}{l_e - |t_x|} \int_{l_0}^{l_e} (z(x) - \bar{z})(z(x + t_x) - \bar{z}) dx}{\frac{1}{l_e} \int_0^{l_e} (z(x) - \bar{z})^2 dx} \quad (2)$$

where

$\bar{z}$ is the arithmetic mean of the profile $z(x)$ over the evaluation length l_e ;

$l_0 = \{x \in \mathbf{R} \mid \max(0, -t_x) \leq x \leq \min(l_e, l_e - t_x)\}$ is the overlap interval;

$|t_x| < l_e$ is the spatial shift.

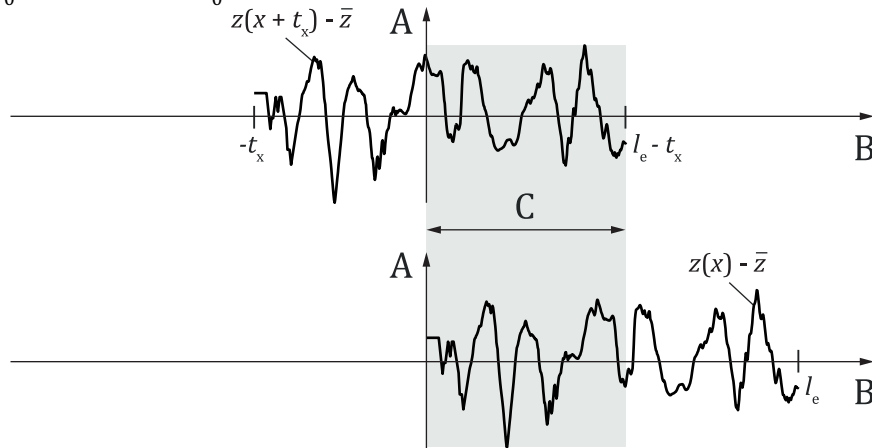
Note 1 to entry: See [Figure 11](#) for an illustration of the overlap interval.

Note 2 to entry: The autocorrelation function is symmetrical in t_x , i.e. $f_{ACF}(t_x) = f_{ACF}(-t_x)$.

Note 3 to entry: [Formula \(2\)](#) is an unbiased estimator for the autocorrelation function.

Note 4 to entry: Some disciplines use a shift-dependent Pearson correlation coefficient instead of the autocorrelation function. It is defined by [Formula \(3\)](#).

$$\rho_{XX}(t_x) = \frac{\int_{l_0} (z(x) - \bar{z})(z(x+t_x) - \bar{z}) dx}{\sqrt{\int_{l_0} (z(x) - \bar{z})^2 dx \cdot \int_{l_0} (z(x+t_x) - \bar{z})^2 dx}} \quad \text{with } -1 \leq \rho_{XX}(t_x) \leq 1 \quad (3)$$



Key

A height

C overlap interval l_0

B x-axis (reference line)

Figure 11 — Illustration of the overlap interval l_0

3.2.14

Fourier transformation

$F(p)$

operator which transforms the scale-limited profile z into Fourier domain

$$F(p) = \int_0^{l_e} z(x) e^{-i2\pi p x} dx \quad (4)$$

where

i is the imaginary unit $i^2 = -1$;

p is the spatial frequency.

3.2.15

amplitude spectral density

$f_{ASD}(p)$

absolute value of the Fourier transformation of the scale-limited profile z

$$f_{ASD}(p) = |F(p)| \quad (5)$$

where

$F(p)$ is the Fourier transformation of the scale-limited profile z ;

p is the spatial frequency.

3.2.16

power spectral density

$f_{\text{PSD}}(p)$

function which describes the power of a scale-limited profile z in the Fourier domain

$$f_{\text{PSD}}(p) = \frac{|F(p)|^2}{l_e} \quad (6)$$

where

$F(p)$ is the Fourier transformation of the scale-limited profile z ;

p is the spatial frequency.

Note 1 to entry: The power spectral density fulfils [Formula \(7\)](#):

$$\frac{1}{l_e} \int_0^{l_e} z^2(x) dx = \int_{-\infty}^{\infty} f_{\text{PSD}}(p) dp \quad (7)$$

3.3 Geometrical feature terms

3.3.1

segmentation

method which partitions a scale-limited profile into distinct features

Note 1 to entry: There are three types of segmentation:

- for the parameters based on peak heights and pit depths (see [5.1](#)), the segmentation is realized by identification of the *hills* ([3.3.11](#)) and *dales* ([3.3.17](#)) by determination of the positions where the ordinate values change their sign or are equal to zero;
- for the parameters based on profile elements (see [5.2](#)), the segmentation is realized by the *crossing-the-line segmentation* ([3.3.2](#));
- for the parameters based on feature characterization (see [5.3](#)), the segmentation is realized by the *watershed segmentation* ([3.3.3](#)).

3.3.2

crossing-the-line segmentation

operation based on crossings of the reference line by a scale-limited profile in conjunction with a combination algorithm, to leave a set of significant segments

Note 1 to entry: See [Annex E](#) for determining crossing-the-line segmentation.

Note 2 to entry: The crossing-the-line segmentation requires *height discrimination* ([3.3.31](#)).

3.3.3

watershed segmentation

filtration operation that spatially decomposes a profile into mutually exclusive portions of that profile

3.3.4

peak

<watershed segmentation> point on the profile which is higher than all other points within a neighbourhood of that point

Note 1 to entry: There is a theoretical possibility of a plateau. In this case, the peak is the middle single point on the plateau.

3.3.5**peak**

<reference line> highest point of a *hill* ([3.3.11](#))

Note 1 to entry: There is a theoretical possibility of a plateau. In this case, the peak is the middle single point on the plateau.

3.3.6**number of peaks**

n_p

integer number representing the number of significant peaks within the evaluation length

Note 1 to entry: The number of significant peaks depends on the segmentation method.

3.3.7**pit**

<watershed segmentation> point on the profile which is lower than all other points within the neighbourhood of that point

Note 1 to entry: There is a theoretical possibility of a plateau. In this case, the pit is the middle single point on the plateau.

3.3.8**pit**

<reference line> lowest point of a *dale* ([3.3.17](#))

Note 1 to entry: There is a theoretical possibility of a plateau. In this case, the peak is the middle single point on the plateau.

3.3.9**number of pits**

n_v

integer number representing the number of significant pits within the evaluation length

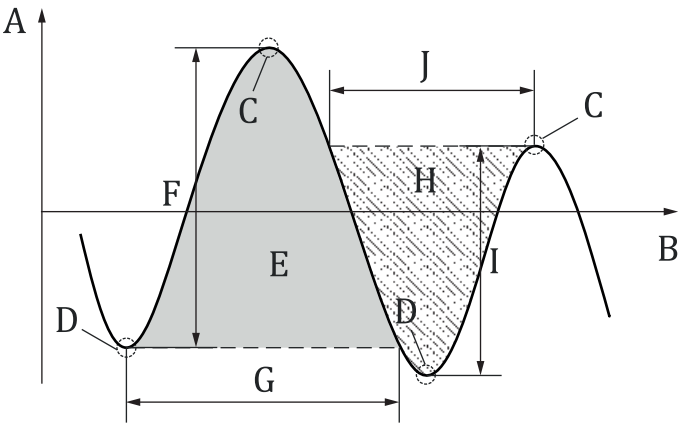
Note 1 to entry: The number of significant pits depends on the segmentation method.

3.3.10**hill**

<watershed segmentation> region around a peak such that all maximal upward paths end at the peak

Note 1 to entry: This definition is used for parameters based on feature characterization (see [5.3](#)).

Note 2 to entry: See [Figure 12](#).



Key

A	height	F	hill local height
B	x -axis (reference line)	G	hill local width
C	peak	H	dale/dale local volume (hatched fill area)
D	pit	I	dale local depth
E	hill/hill local volume (grey fill colour)	J	dale local width

Figure 12 — Hill local height, dale local depth, hill local width, dale local width, hill local volume and dale local volume (watershed segmentation)

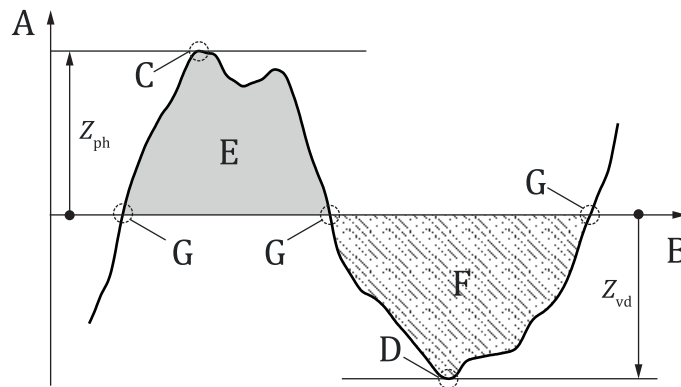
3.3.11

hill

<reference line> outwardly directed (from material to surrounding medium) contiguous portion of the scale-limited profile above the reference line bounded by the two adjacent points where the ordinate values change their sign

Note 1 to entry: This definition is used for parameters based on peak heights and pit depths (see 5.1) and parameters based on profile elements (see 5.2).

Note 2 to entry: See Figure 13.

**Key**

A	height	F	dale
B	x -axis (reference line)	G	change of sign of the ordinate values
C	peak	Z_{ph}	peak height
D	pit	Z_{vd}	pit depth
E	hill		

Figure 13 — Peak height and pit depth (reference line)**3.3.12****hill local height**

height difference between a peak and the highest pit connected to that peak

Note 1 to entry: See [Figure 12](#).

3.3.13**hill local width**

length of the line intersecting a hill at a height associated to the highest pit connected to that hill

Note 1 to entry: See [Figure 12](#).

3.3.14**hill local volume**

ratio of the hill area above the highest pit connected to that hill to the evaluation length

Note 1 to entry: See grey fill colour in [Figure 12](#).

Note 2 to entry: The volume is expressed in millilitres per metre square (ml / m^2).

Note 3 to entry: For anisotropic surfaces, the areal and profile volume parameters are highly correlated.

3.3.15**peak height**

Z_{ph}

height difference between a peak and the reference line

Note 1 to entry: See [Figure 13](#).

3.3.16**dale**

<watershed segmentation> region around a pit such that all maximal downward paths end at the pit

Note 1 to entry: This definition is used for parameters based on feature characterization (see [5.3](#)).

Note 2 to entry: See [Figure 12](#).

3.3.17

dale

<reference line> inwardly directed (from surrounding medium to material) contiguous portion of the scale-limited profile below the reference line bounded by the two adjacent points where the ordinate values change their sign

Note 1 to entry: This definition is used for parameters based on peak heights and pit depths (see 5.1) and parameters based on profile elements (see 5.2).

Note 2 to entry: See [Figure 13](#).

3.3.18

dale local depth

height difference between a pit and the lowest peak connected to that pit

Note 1 to entry: See [Figure 12](#).

3.3.19

dale local width

length of the line intersecting a dale at a height associated to the lowest peak connected to that dale

Note 1 to entry: See [Figure 12](#).

3.3.20

dale local volume

ratio of the dale area below the lowest peak connected to that dale to the evaluation length

Note 1 to entry: See hatched filled area in [Figure 12](#).

Note 2 to entry: The volume is expressed in millilitres per metre square (ml / m^2).

Note 3 to entry: For anisotropic surfaces, the areal and profile volume parameters are highly correlated.

3.3.21

pit depth

Z_{vd}

depth difference between a pit and the reference line

Note 1 to entry: See [Figure 13](#).

3.3.22

motif

hill or dale defined with watershed segmentation

Note 1 to entry: The term motif is used to designate a feature obtained by segmentation.

Note 2 to entry: On a profile, a hill (or dale) is enclosed between two pits (or peaks).

3.3.23

topographic feature

line feature or point feature on a scale-limited profile

3.3.24

line feature

hill or dale

3.3.25

point feature

peak or pit

3.3.26
hill change tree

graph which describes the relationships between peaks and pits sorted by their hill local heights

Note 1 to entry: Peaks are represented on a change tree by the ends of lines. Pits are represented on a change tree by joining lines.

Note 2 to entry: See [Figure 14](#).

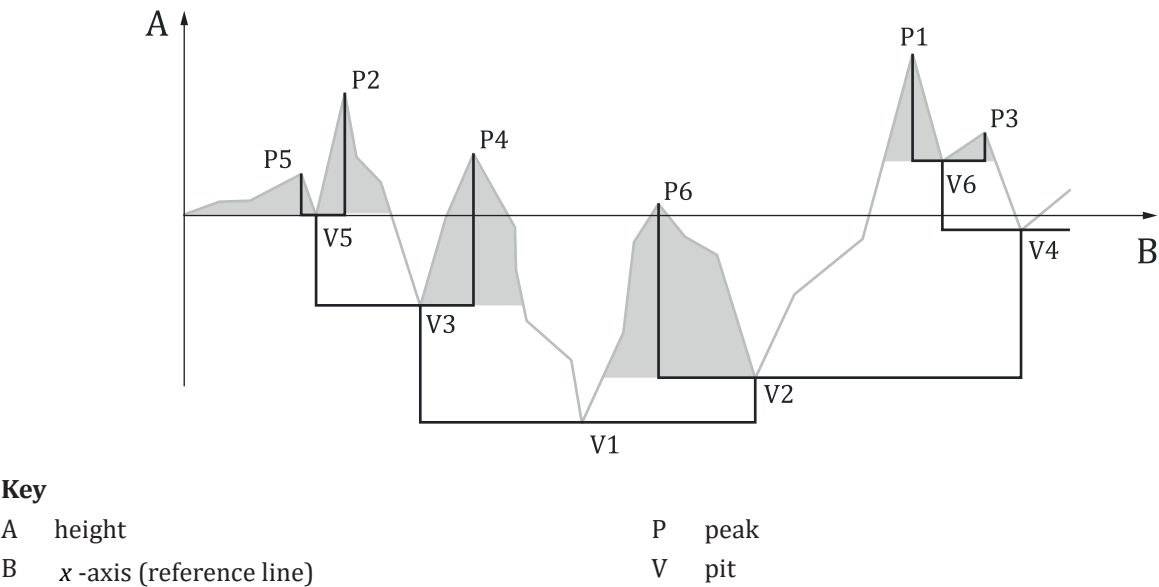


Figure 14 — Hill change tree

3.3.27
dale change tree

graph which describes the relationships between pits and peaks sorted by their dale local depths

Note 1 to entry: Pits are represented on a change tree by the end of lines. Peaks are represented on a change tree by joining lines.

Note 2 to entry: See [Figure 15](#).

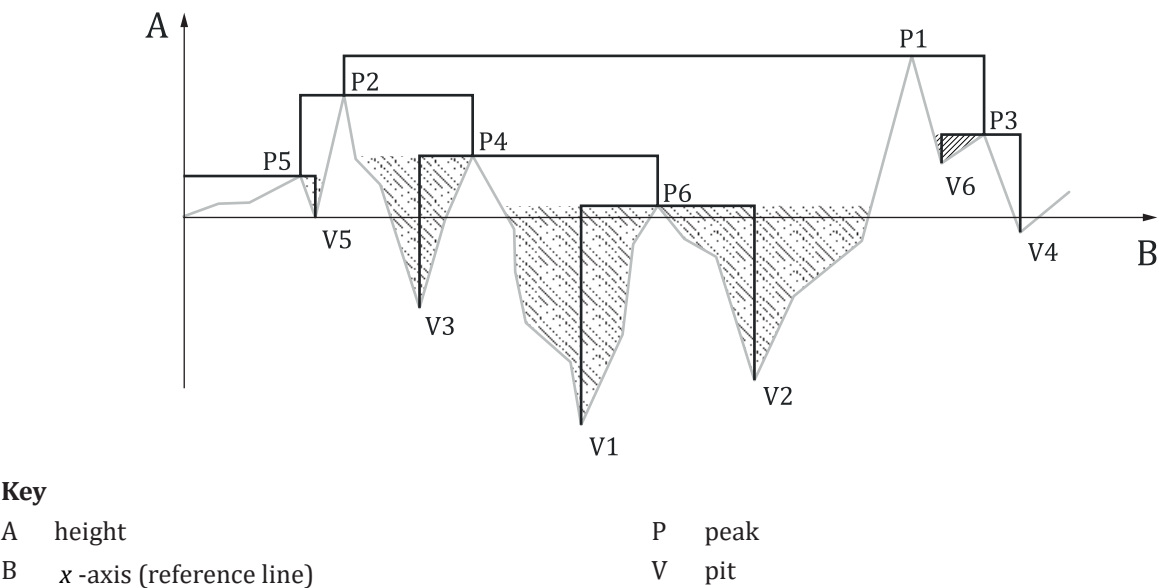


Figure 15 — Dale change tree