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

Part 2: Terms, definitions and surface texture parameters

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

Partie 2: Terms, définitions et paramètres d'état de surface

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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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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 12085:1996, 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, ISO 12085:1996/Cor 1:1998 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.

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 Rq) 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]

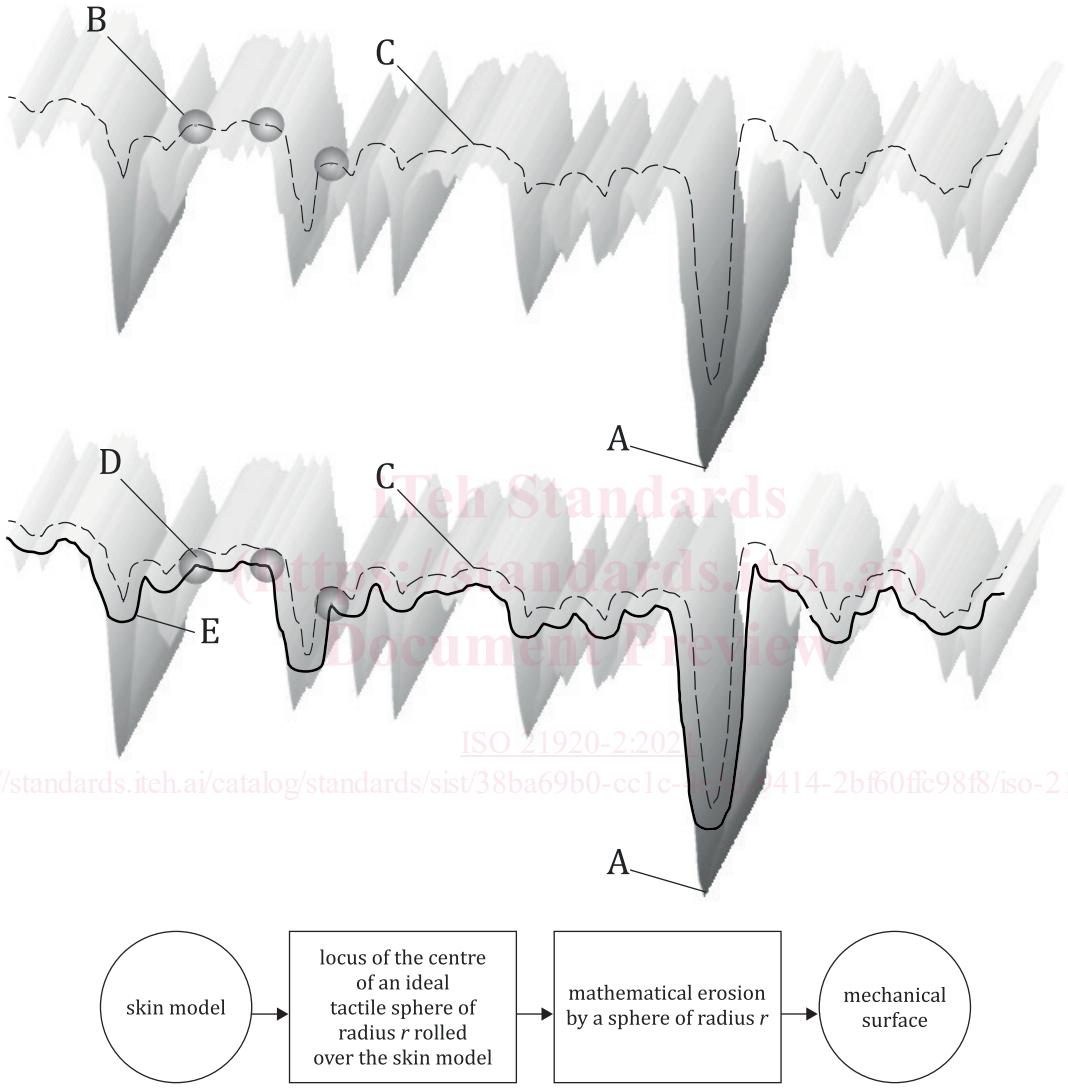
3.1.2
surface texture
geometrical irregularities contained in a scale-limited profile

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.]



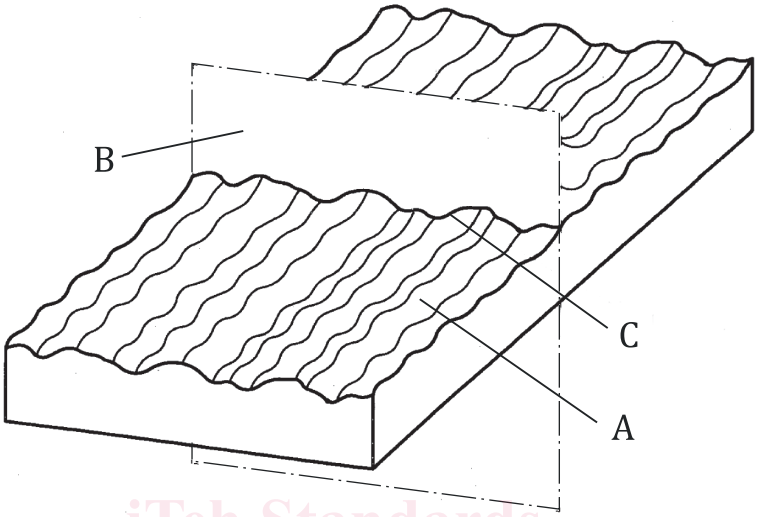
Key
A skin model
B ideal tactile sphere of radius r
C envelope curve of the locus of the centre of an ideal tactile sphere B rolled over the skin model
D sphere of radius r
E mechanical surface: boundary of the mathematical erosion, by the sphere D, of the envelope curve C

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.



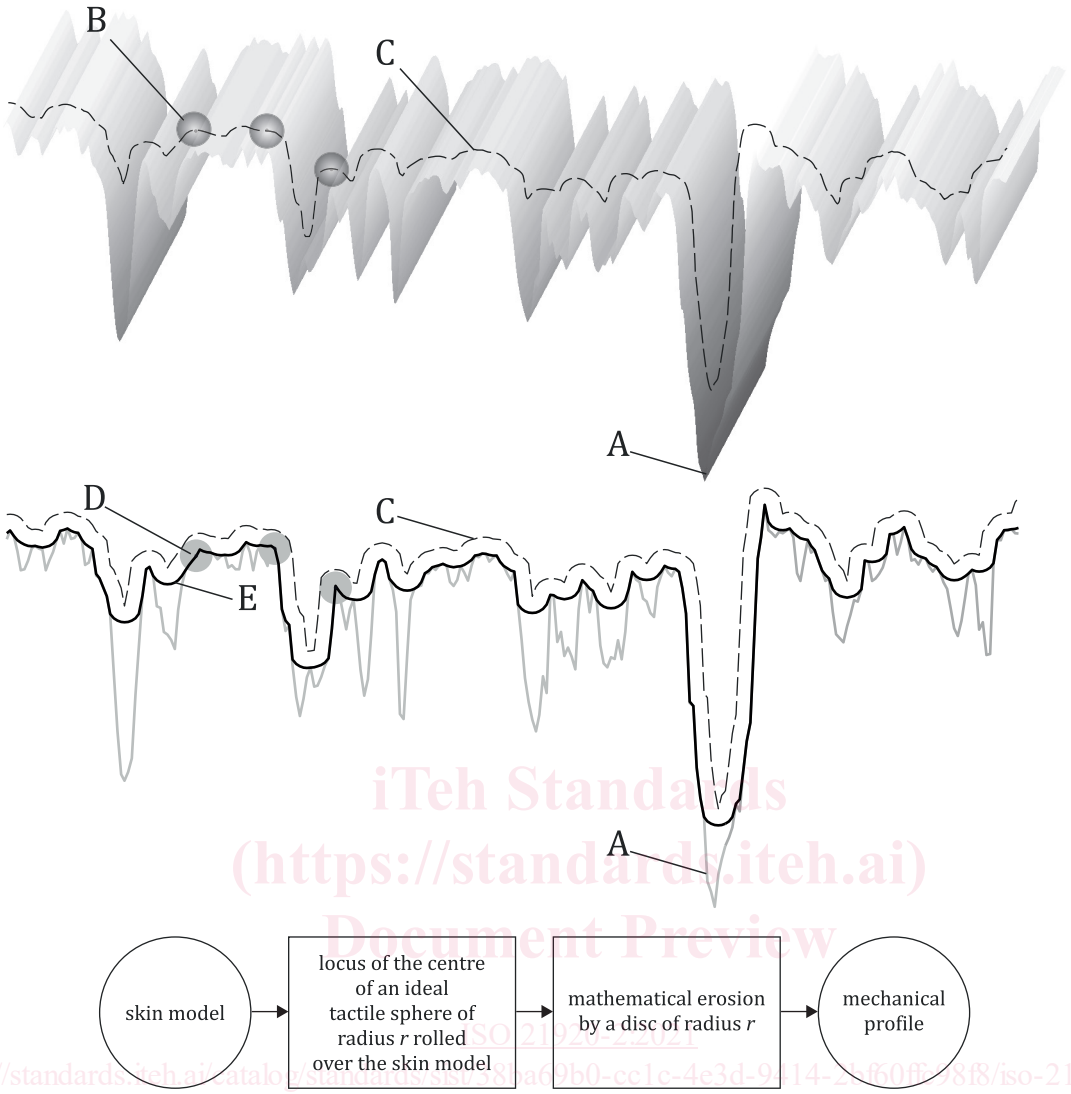
Key
A skin model
B intersection plane
C profile trace

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.]

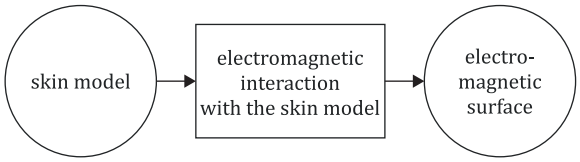


Figure 4 — Electromagnetic surface

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.

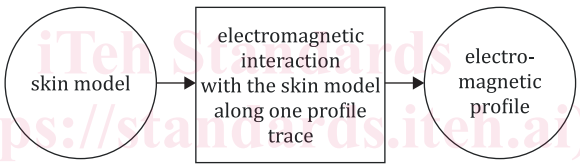


Figure 5 — Electromagnetic profile

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.

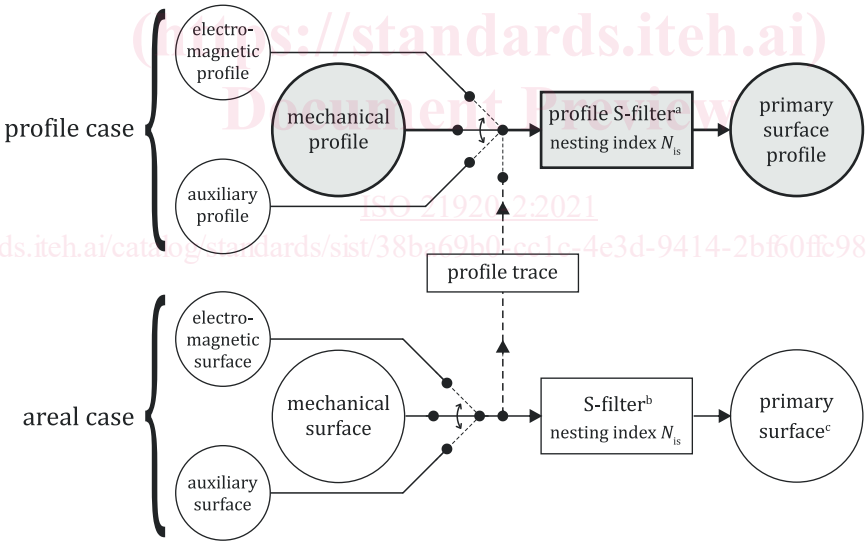
[SOURCE: ISO 16610-1:2015, 3.2.1, modified — definition and notes to entry revised.]

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.

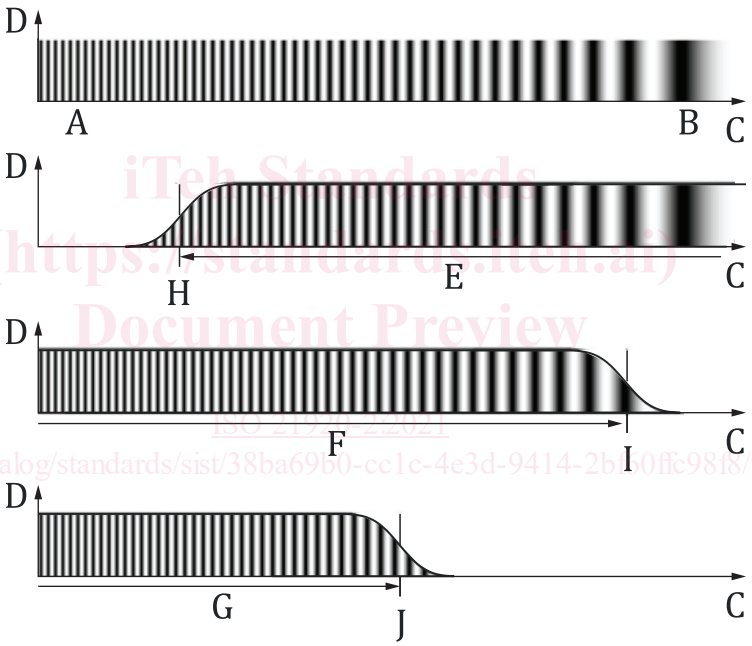
3.1.13.2
profile L-filter
profile filter which removes large lateral scale components from a profile

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.

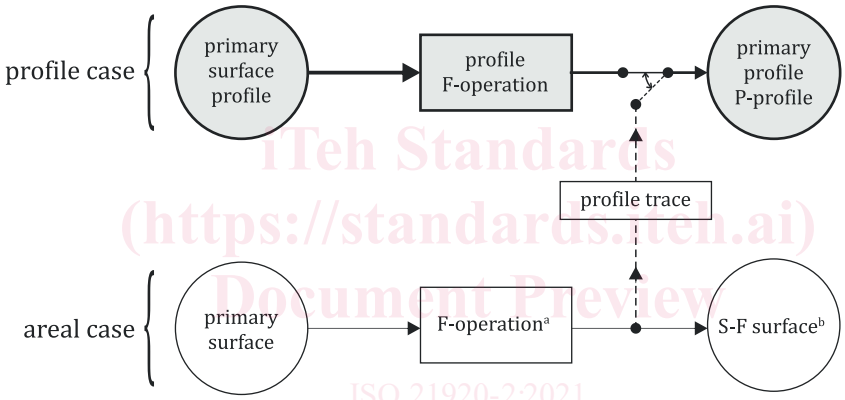
3.1.14.1
primary profile
P-profile
scale-limited profile at any position x derived from the primary surface profile by removing the form using a profile F-operation with nesting index N_{if}

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.

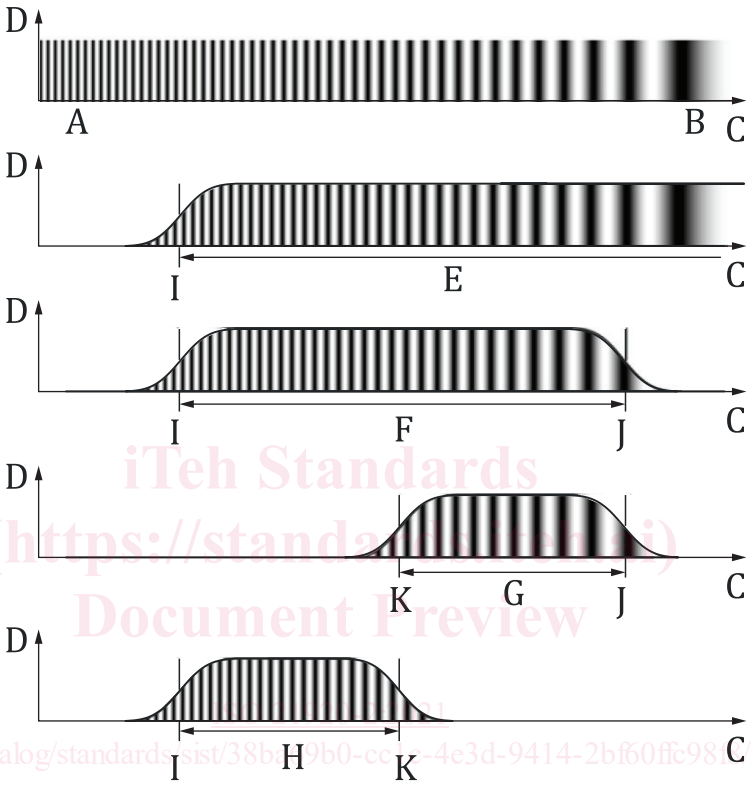
Note 2 to entry: The choice of filter settings for W-parameters is highly dependent on the functional requirements. This is why no default tables for W-parameters are found in ISO 21920-3.

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