INTERNATIONAL STANDARD

ISO 21920-1

First edition
2021-12

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

Part 1:
Indication of surface texture

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

Partie 1: Indication des états de surface

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Contents

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 document cancels and replaces ISO 1302:2002, which has been technically revised. In addition to the change of number, the main changes to ISO 1302:2002 are as follows:

— New specification elements for indication are defined.

— The maximum tolerance acceptance rule is the default tolerance acceptance rule.

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 A 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 H, Table H.1, and Annex I.

This document covers the indication of profile surface texture.

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

Part 1:
Indication of surface texture

1   Scope

This document specifies the rules for indication of surface texture by profile methods in technical product documentation by means of graphical symbols.

This document does not cover population requirements.

NOTE   See ISO 18391 for population (batch) specifications.

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

ISO 21920-3, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators*

ISO 81714-1, *Design of graphical symbols for use in the technical documentation of products — Part 1: Basic rules*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21920-2 and ISO 21920-3 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/

4   Tolerance acceptance rules

4.1   General

Tolerance acceptance rules define how the tolerance limits are applied to the measured parameter values. For profile surface texture, three tolerance acceptance rules can be indicated. See ISO 21920-3:2021, Table 1 for the position of the measurements.

4.2   Maximum tolerance acceptance rule

The maximum tolerance acceptance rule does not allow any measured value to exceed the tolerance limit. The symbol of the maximum tolerance acceptance rule is shown in Figure 1.

<div align="center">

Tmax

</div>

Figure 1 — Symbol of the maximum tolerance acceptance rule

The maximum tolerance acceptance rule is the default case and valid with or without indication of the 'Tmax' symbol.

NOTE 1   The suffix 'max' can be interpreted as the required maximal conformity of the measured value.

NOTE 2   The 'Tmax' symbol can be used to prevent misinterpretation of a specification.

4.3   16 % tolerance acceptance rule

A specified 16 % tolerance acceptance rule allows at most 16 % of all measured values of a parameter to violate the tolerance limit. The symbol of the 16 % tolerance acceptance rule is shown in Figure 2.

The 16 % tolerance acceptance rule shall be applied as specified in Annex E.

<div align="center">

T16%

</div>

Figure 2 — Symbol of the 16 % tolerance acceptance rule

The 16 % tolerance acceptance rule is valid for the parameter on the line where the 'T16 %' symbol is indicated.

If a bilateral tolerance is specified in one line, 16 % of all measured values may violate the upper tolerance limit and 16 % of all measured values may violate the lower tolerance limit.

NOTE 1   The 16 % tolerance acceptance rule defines how tolerance limits are applied to the measured values.

NOTE 2   In ISO 1302, the 16 % tolerance acceptance rule was called the 16 % rule.

NOTE 3   In contrast to ISO 1302, the 16 % tolerance acceptance rule is not the default (see Annex F for additional information).

NOTE 4   See ISO 21920-3:2021, Table 1 for the distribution of the measurements.

4.4   Median tolerance acceptance rule

If a median tolerance acceptance rule is specified, the median value of all measured values of a parameter shall meet the tolerance limits. The symbol of the median tolerance acceptance rule is shown in Figure 3.

<div align="center">

Tmed

</div>

Figure 3 — Symbol of the median tolerance acceptance rule

The median tolerance acceptance rule is valid for the parameter on the line where the 'Tmed' symbol is indicated.

At least three measured values shall be used to apply the median acceptance rule. A higher number of measurements can be specified in "other requirements" (symbol OR(n), see 7.17).

NOTE 1   The median tolerance acceptance rule defines how tolerance limits are applied to the measured values.

NOTE 2   If the median value of all measured values of a parameter meets the tolerance limit, no more than half the measured values exceed the tolerance limit.

5   Specification elements for indication of profile surface texture specifications

5.1   General

Indications of profile surface texture specify requirements on the surface of a workpiece as well as the specification operator.

NOTE   All specification elements permitted for indication of profile surface texture specifications are listed in 5.2 and 5.3 and described in Clause 7.

5.2   Mandatory indication to be explicitly specified

— Graphical symbol for profile surface tolerance.

— Symbol of the profile surface texture parameter.

— Tolerance limit of the profile surface texture parameter.

— For parameters without defined defaults: indication of the profile L-filter nesting index N_{ic} for R-parameters or profile S-filter nesting index N_{ic} for W-parameters or the setting class Scn.

NOTE 1   Parameters without defined default are not listed in ISO 21920-3: 2021, Tables 3 to 6.

NOTE 2   The indication of the nesting index or the setting class is optional for all parameters listed in ISO 21920-3:2021, Tables 3 to 6.

NOTE 3   It is the responsibility of the designer to choose and indicate the appropriate L-filter or S-filter. ISO 21920-3:2021, Tables 3 to 6 define defaults that can be used for surfaces without particular performance requirements.

NOTE 4   A cut-off wavelength for a profile filter is an example of a nesting index, see ISO 21920-2.

5.3   Optional indications to specify non-default or further requirements

— Tolerance type (upper, lower or bilateral tolerance limit).

— Symbol 'T16 %', 'Tmax' or 'Tmed' to specify a tolerance acceptance rule.

— Profile S-filter type.

— Profile S-filter nesting index.

— Profile L-filter type for R-parameters or profile S-filter type for W-parameters.

— Profile L-filter nesting index N_{ic} for R-parameters or profile S-filter nesting index N_{ic} for W-parameters.

— Evaluation length l_e for the evaluation length parameters. Section length l_{sc} and number of sections n_{sc} for the section length parameters.

— Profile F-operator association method and element.

— Profile F-operator nesting index.

— Method of profile extraction.

— Symbol 'OR(*n*)' to specify other requirements.

— Manufacturing process.

— Surface lay and direction of lay.

— Profile direction.

— Symbol 'Sc*n*' to specify a setting class.

NOTE   Default settings are defined in ISO 21920-3.

6   Indication of profile surface texture

6.1   General

Profile surface texture requirements in technical product specifications shall be specified by one of the graphical symbols described in 6.2.

A minimal indication of profile surface texture shall be built up of the graphical symbol, the parameter designation and the parameter tolerance limit value, see 6.3.

If several parameters are specified, the parameter in the first line is relevant for the determination of default settings (see ISO 21920-3).

All indicated specification elements are separated by a single blank character.

NOTE 1   Exceptions are defined in 9.1.

NOTE 2   See Annex G, Table G.1, for new issues in this document and changes to previous documents.

6.2   Graphical symbols

The form of the graphical symbols contains requirements for the production process. Proportions of the graphical symbols shall be indicated as specified in Annex A.

NOTE 1   See Figure 4 for the layout of the three defined graphical symbols and their interpretation.

NOTE 2   The bar above the symbol is to distinguish this symbol from the ones used in ISO 1302 and those used for indication of areal surface texture specifications.
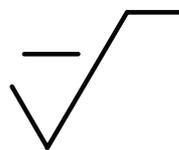
a) Any manufacturing process permitted
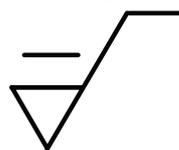
b) Material shall be removed
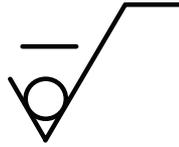
c) Material removal is not permitted

Figure 4 — Graphical symbols indicating profile surface texture

6.3 Minimal indication

6.3.1 General

If a minimal indication is specified, all defaults shall be applied. Because defaults cannot be defined for all parameters, the minimal indication is different for parameters with and without defined defaults.

6.3.2 Minimal indication for parameters with defined defaults

Figure 5 shows all symbols and indications mandatory for a minimal indication of profile surface texture requirements and parameters with defined defaults.
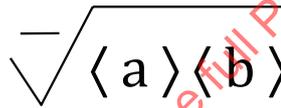
Key

a   symbol for parameter

b   tolerance limit value of the profile surface texture parameter

< > placeholder has to be specified

Figure 5 — Minimal indication for parameter with defined defaults (all defaults apply)

NOTE 1   Parameters with defined defaults are Rz, Ra, Rp, Rv, Rq, Rmax, Rt and Pt, see ISO 21920-3:2021, Tables 3 to 6.

NOTE 2   Exceptions are defined in 9.1.

NOTE 3   See Annex D for examples and additional information.

6.3.3 Minimal indication for parameters without defined defaults

Figure 6 shows all symbols and indications mandatory for a minimal indication of profile surface texture requirements and parameters without defined defaults. All defaults are defined by the mandatory specified setting class (Scn) or by one of the default values of the mandatory profile L-filter nesting index N_{ic} for R-parameters or profile S-filter nesting index N_{ic} for W-parameters.

Oblique strokes, "/", are used to separate the specification sections.

$$\overline{\sqrt{\langle\,a\,\rangle\langle\,b\,\rangle/\langle\,c\,\rangle}}$$

Key

a   symbol for parameter

b   tolerance limit value of the profile surface texture parameter

c   symbol for the specified setting class Scn or a default value of profile L-filter nesting index N_{ic} for R-parameters or profile S-filter nesting index N_{ic} for W-parameters

< >   placeholder has to be specified

Figure 6 — Minimal indication for parameter without defined defaults

NOTE 1   Parameters without defined defaults are not listed in ISO 21920-3:2021, Tables 3 to 6.

NOTE 2   The specified setting class leads directly to the specified column of ISO 21920-3:2021, Table 2, with the relevant default settings.

NOTE 3   Exceptions are defined in 9.1.

NOTE 4   See Annex D for examples and additional information.

6.4   Complete indication

6.4.1   General

The specification elements described in Clause 5 shall be arranged as shown in 6.4.2 to 6.4.5, depending on the parameter type. All specification elements for one parameter shall be indicated in one line.

NOTE 1   If several parameters or different specification elements for the same parameter need to be specified, the indication follows in one or several additional lines.

NOTE 2   See Annex D for examples of indication and additional information.

NOTE 3   The complete indication is shown to define the sequence of the indication of all specification elements and might be rarely used in practice.

6.4.2 Complete indication for evaluation length R-parameters

The specification elements for evaluation length R-parameters shall be arranged as shown in Figure 7.

NOTE   Evaluation length R-parameters include Ra, Rq, Rt, Rzx and Rk (see ISO 21920-2).

$$-\sqrt{\frac{[s][t]}{[a]\langle b\rangle\langle c\rangle[d]/[e][f]-[g][h]([m])[n][p]/[q][r]}{[u]}}$$

Key

a   tolerance type
b   symbol for R-parameter
c   tolerance limit value of the profile surface texture parameter
d   tolerance acceptance rule
e   profile S-filter type
f   profile S-filter nesting index
g   profile L-filter type
h   profile L-filter nesting index
m   evaluation length
n   profile F-operator association method and element
p   profile F-operator nesting index
q   method of profile extraction
r   placeholder for the OR(n) symbol for other requirements
s   manufacturing process
t   surface lay and direction of lay
u   profile direction relative to the surface lay
< > placeholder has to be specified
[ ] placeholder can be specified if different from the default or an additional requirement

Figure 7 — Indication for evaluation length R-parameters including all optional specification elements

6.4.3 Complete indication for section length R-parameters

The specification elements for section length R-parameters shall be arranged as shown in Figure 8.

NOTE   Section length R-parameters include Rz, Rp and Rv (see ISO 21920-2).

$$\sqrt[]{\underset{[\,u\,]}{\overset{[\,s\,][\,t\,]}{[\,a\,]\langle\,b\,\rangle\langle\,c\,\rangle[\,d\,]\,/\,[\,e\,][\,f\,]-[\,g\,][\,h\,]\,(\,[\,i\,]\,x\,[\,k\,]\,)\,[\,n\,][\,p\,]\,/\,[\,q\,][\,r\,]}}}$$

Key

a   tolerance type

b   symbol for R-parameter

c   tolerance limit value of the profile surface texture parameter

d   tolerance acceptance rule

e   profile S-filter type

f   profile S-filter nesting index

g   profile L-filter type

h   profile L-filter nesting index

i   section length

k   number of sections

n   profile F-operator association method and element

p   profile F-operator nesting index

q   method of profile extraction

r   placeholder for the OR(n) symbol for other requirements

s   manufacturing process

t   surface lay and direction of lay

u   profile direction relative to the surface lay

< >   placeholder has to be specified

[ ]   placeholder can be specified if different from the default or an additional requirement

NOTE   The parentheses around ([i] × [k]) bring out the relationship between these specification elements as the evaluation length results from this product.

Figure 8 — Indication for section length R-parameters including all optional specification elements

6.4.4 Complete indication for evaluation length P-parameters and W-parameters

The specification elements for evaluation length P-parameters and W-parameters shall be arranged as shown in Figure 9.

NOTE   Evaluation length P-parameters and W-parameters include Pt, Pa, Wt and Wa (see ISO 21920-2).

$$\underline{}\sqrt{\dfrac{[\,s\,]\,[\,t\,]}{[\,a\,]\,\langle\,b\,\rangle\,\langle\,c\,\rangle\,[\,d\,]\,/\,[\,e\,]\,[\,f\,]-(\,[\,m\,]\,)\,[\,n\,]\,[\,p\,]\,/\,[\,q\,]\,[\,r\,]}{[\,u\,]}}$$

Key

a   tolerance type

b   symbol for P-parameter or W-parameter

c   tolerance limit value of the profile surface texture parameter

d   tolerance acceptance rule

e   profile S-filter type

f   profile S-filter nesting index

m   evaluation length

n   profile F-operator association method and element

p   profile F-operator nesting index

q   method of profile extraction

r   placeholder for the OR(n) symbol for other requirements

s   manufacturing process

t   surface lay and direction of lay

u   profile direction relative to the surface lay

< >   placeholder has to be specified

[]   placeholder can be specified if different from the default

Figure 9 — Indication for evaluation length P-parameters and W-parameters including all optional specification elements

6.4.5 Complete indication for section length P-parameters and W-parameters

The specification elements for section length P-parameters and section length W-parameters shall be arranged as shown in Figure 10.

NOTE   Section length P-parameters and W-parameters include Pz, Pmax and Wz (see ISO 21920-2).

$$[\,s\,]\,[\,t\,]$$

$$\sqrt{}\ [\,a\,]\langle\,b\,\rangle\langle\,c\,\rangle[\,d\,]\,/\,[\,e\,]\,[\,f\,]-(\,[\,i\,]\,x\,[\,k\,]\,)\,[\,n\,]\,[\,p\,]\,/\,[\,q\,]\,[\,r\,]$$
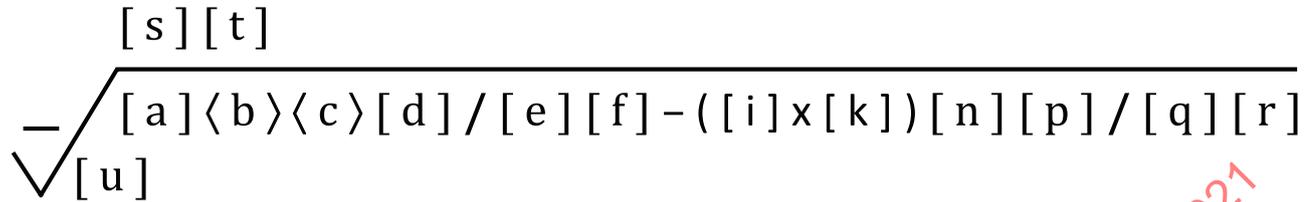
$$[\,u\,]$$

Key

a   tolerance type

b   symbol for P-parameter or W-parameter

c   tolerance limit value of the profile surface texture parameter

d   tolerance acceptance rule

e   profile S-filter type

f   profile S-filter nesting index

i   section length

k   number of sections

n   profile F-operator association method and element

p   profile F-operator nesting index

q   method of profile extraction

r   placeholder for the OR(n) symbol for other requirements

s   manufacturing process

t   surface lay and direction of lay

u   profile direction relative to the surface lay

< >   placeholder has to be specified

[ ]   placeholder can be specified if different from the default

Figure 10 — Indication for section length P-parameters and W-parameters including all optional specification elements

7   Rules for indication of profile surface texture specifications

7.1   General

The indication of profile surface texture specifications is arranged in a defined way to avoid ambiguities.

For all specification elements with variable values, defaults are defined which lead to reasonable and repeatable results on uniform surfaces.

In case of a minimal indication and when the specified parameter is listed in ISO 21920-3:2021, Tables 3 to 6, the specified parameter with its tolerance type and limit are the basis for the default settings. Otherwise, the specified profile filter nesting index value or the setting class is the basis for the default settings.

NOTE 1   For all specification elements with variable values, default values are defined in ISO 21920-3.

NOTE 2   Values other than defaults can be useful for functional or practical reasons.

NOTE 3   See 6.4 for the position of all specification elements.

7.2   Graphical symbol for the indication of profile surface texture specifications

When indicated, the graphical symbol indicates requirements to the surface of a workpiece.

NOTE   See 6.2 for layout and interpretation of the graphical symbol.

7.3   Profile surface texture parameter

The parameter symbol shall always be indicated (exceptions are defined in 9.1) and includes two items of information essential for the interpretation of the requirement:

— the first capital letter of the parameter symbol indicates which scale-limited profile (R, W or P) is the basis for the calculation.

— the following letter(s) indicate(s) which parameter definition is used.

7.4   Tolerance limit value of the profile surface texture parameter

The tolerance limit value of the specified parameter shall always be indicated directly after the symbol for the parameter separated by a single blank (exceptions are defined in 9.1).

7.5   Tolerance types

The profile surface texture requirement shall be indicated as a unilateral or bilateral tolerance. The symbols are:

U   for upper tolerance limit

L   for lower tolerance limit

NOTE 1   The default tolerance type is upper tolerance limit (see ISO 21920-3).

NOTE 2   Bilateral tolerances are specified by a lower and an upper tolerance limit (for indication see 9.6).

7.6   Tolerance acceptance rule

The tolerance acceptance rule shall be indicated by 'Tmax' for the maximum tolerance acceptance rule, 'T16 %' for the 16 % tolerance acceptance rule or 'Tmed' for the median tolerance acceptance rule. The maximum tolerance acceptance rule is the default case and valid with or without the indication of 'Tmax'.

NOTE   See Clause 4 for details.

7.7   Profile S-filter type

All profile filter types from the ISO 16610 series can be applied for the profile S-filter. The symbols for profile filter types shall be indicated as specified in Annex B, Table B.1.

7.8   Profile S-filter nesting index

The profile S-filter nesting index value specifies which small-scale lateral components are removed (see ISO 21920-2). The profile S-filter nesting index is specified in millimetres (mm).

NOTE 1   Profile S-filter nesting index N_{is} determines the maximum sampling distance for all profile surface texture parameters (see ISO 21920-3:2021, Table 2).

NOTE 2   If the profile S-filter nesting index N_{is} is specified as zero, the scale-limitation is only determined by the properties and internal settings of the instrument.

7.9 Profile L-filter type (for R-parameter) or profile S-filter type (for W-parameter)

All profile filter types from the ISO 16610 series can be applied for the profile L-filter or the profile S-filter. The symbols for profile filter types shall be indicated as specified in Annex B, Table B.1.

7.10 Profile L-filter nesting index (for R-parameter) or profile S-filter nesting index (for W-parameter)

The profile L-filter nesting index value specifies which large-scale lateral components are removed for R-parameters. The profile S-filter nesting index value specifies which small-scale lateral components are removed for W-parameters (see ISO 21920-2). The profile L-filter or the profile S-filter nesting index is specified in millimetres (mm).

7.11 Evaluation length

The evaluation length l_e specifies the length used for identifying the geometric structures that characterize the scale-limited profile (see ISO 21920-2). The evaluation length is specified in millimetres (mm).

7.12 Section length

The section length l_{sc} specifies the length used to calculate height parameters based on profile hills and profile dales (see ISO 21920-2).

NOTE 1   The indication of the section length is only valid for section length parameters.

NOTE 2   The value of section length can be different to the nesting index value of the profile L-filter or the profile S-filter.

NOTE 3   The section length is specified in millimetres (mm).

7.13 Number of sections

The number of sections n_{sc} specifies the number of section lengths used to calculate height parameters based on profile hills and profile dales (see ISO 21920-2). The number of sections shall be a positive integer.

NOTE 1   The indication of the number of sections is only valid for section length parameters.

NOTE 2   The evaluation length results from the product of the section length with the number of sections.

NOTE 3   The number of sections is the basis for the average calculation.

7.14 Profile F-operator association method and element

The association method and element of the profile F-operator defines how form is removed from the profile (see ISO 21920-2). The symbols for profile F-operator methods shall be indicated as specified in Annex C, Tables C.1 and C.2.

7.15 Profile F-operator nesting index

The profile F-operator nesting index specifies which form components are removed from the profile (see ISO 21920-2).

NOTE   Some F-operators have no nesting index.

7.16 Method of profile extraction

The method of profile extraction indication specifies that a non-default extraction of the scale-limited profile shall be applied.

NOTE 1   The default method of profile extraction is the mechanical profile (see ISO 21920-3).

NOTE 2   The symbol to indicate a non-default method of profile extraction is EP for electromagnetic profile (see ISO 21920-2).

NOTE 3   Detailed setting parameters for a non-default method of profile extraction can be indicated by the OR(n) symbol (see 7.17).

NOTE 4   The results of using different methods of profile extraction on an identical surface can be different.

7.17 Other requirements, OR(n)

The symbol 'OR(n)' indicates that added requirements are to be found in free text in another place on the technical product specification. If there is only one indication with OR(n) requirement, then n = 1, otherwise n shall be incremented.

NOTE   An example of a third indication with OR(n) symbol is OR(3).

7.18 Manufacturing process

The indication of the manufacturing process helps ensure, together with the other indications, that a surface with the desired characteristics is produced. The indicated manufacturing process shall be used to create the final surface.

NOTE   There can also be other reasons for indicating manufacturing process (e.g. for desired material properties).

7.19 Surface lay and direction of lay

The indication of surface lay and direction of lay contains requirements for the manufacturing process.

NOTE   Symbols and rules for the indication of surface lay and direction of lay are defined in 9.4.

7.20 Profile direction

The profile direction shall be indicated when the profile is obtained in a defined non-default direction.

NOTE   Symbols and rules for the indication of the profile direction are defined in 9.5.

7.21 Setting class, Scn

The symbol Scn indicates which setting class shall be applied for the determination of the default settings. A setting class or a default profile L-filter or a default profile S-filter nesting index value shall be specified for parameters without defined defaults (see 6.3.3)

NOTE 1   See ISO 21920-3 for the definition of the setting class.

NOTE 2   An example of an indicated symbol of the second setting class is Sc2.

NOTE 3   A specified setting class leads directly to the specified columns of ISO 21920-3:2021, Tables 2 to 6, with the relevant default settings.

8 Position on technical product documentation

8.1 General

Profile surface texture requirements shall be indicated only once for a given surface and, if possible, on the same view where the size or location, or both, are indicated.

The indicated surface requirements are valid for the surface of the entire feature touched by the graphical symbol or the arrowhead of the leader line. Restricted requirements for surface sectors can be indicated (see 9.2).

The indicated surface requirements are valid for the final state or the defined stage of the technical product specification.

## 8.2 Position and orientation of the graphical symbol

The graphical symbol shall be readable from the bottom or right-hand side of the drawing in accordance with ISO 129-1. A graphical symbol for profile surface texture can only be indicated away from the dimension line, except on a cylindrical feature. In this case it only applies to the feature the extension line starts from, not the opposite surface identified by the dimension line.

See Figure 11 for all defined options of position and orientation of the graphical symbol. For CAD drawings, Figure 11 l) is preferred.

Ra 0,7
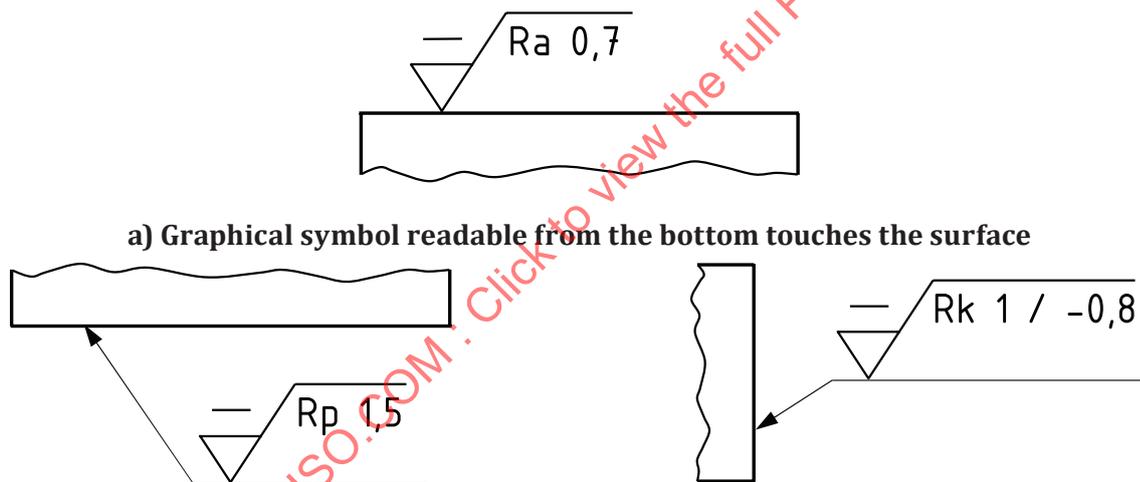
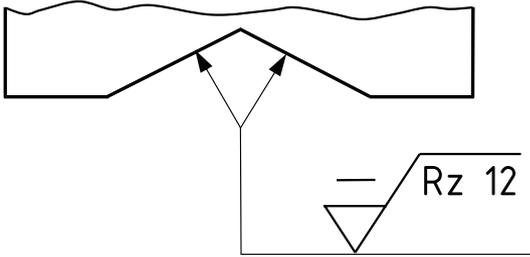**a) Graphical symbol readable from the bottom touches the surface**
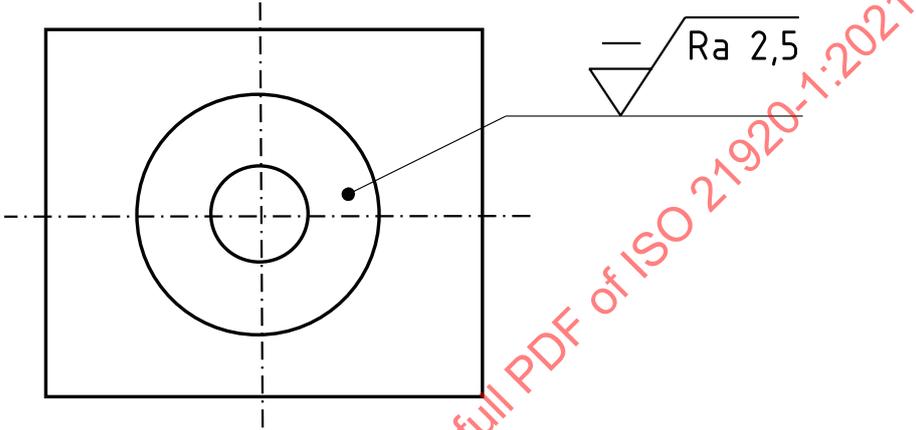
Rp 1,5

Rk 1 / −0,8

b) Graphical symbol readable from the bottom on a leader line terminating in an arrowhead

Ra 1
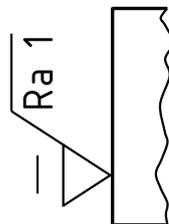
c) Graphical symbol readable from the right-hand side touches the surface

d) Graphical symbol readable from the bottom on a diverging leader line terminating in two arrowheads

e) Graphical symbol on a workpiece top view readable from the bottom on a leader line terminating in a dot

f) Graphical symbol readable from the bottom on a leader line intersecting a body edge line terminating in an arrowhead
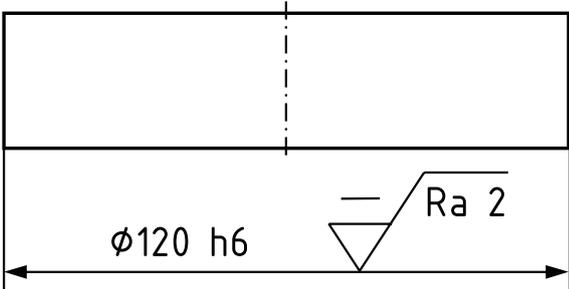
g) Graphical symbol readable from the bottom on a dimension line of a feature of size dimension, only applicable if there is no risk of misinterpretation
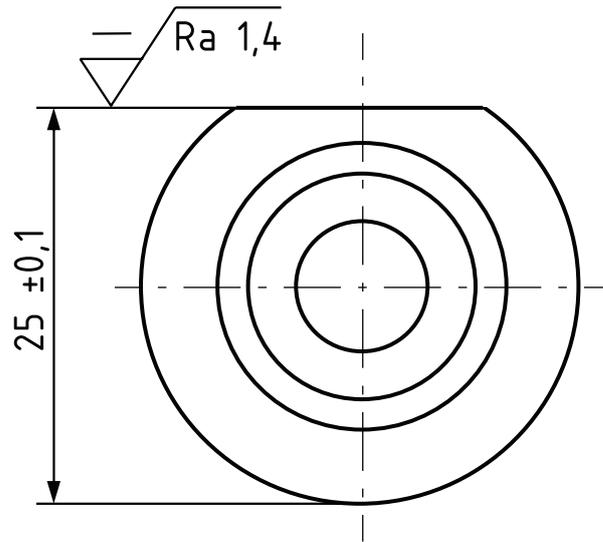
h) Graphical symbol readable from the bottom on an extension line

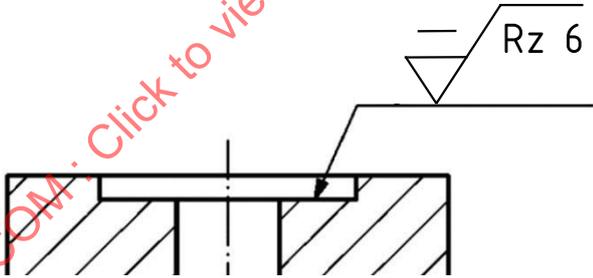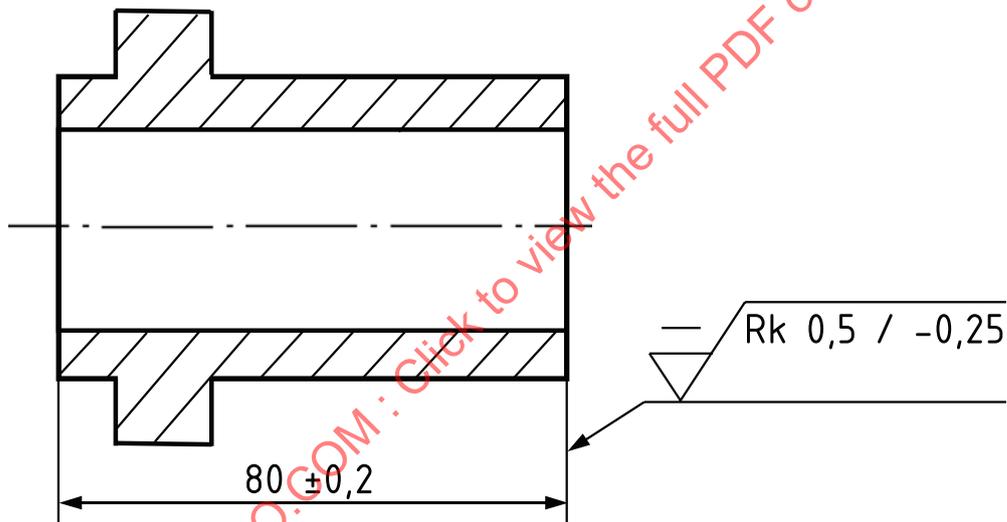**i) Graphical symbol readable from the bottom on a leader line terminating in an arrowhead on an extension line**
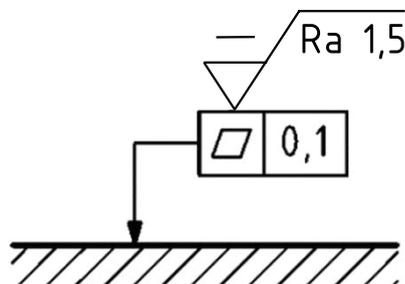
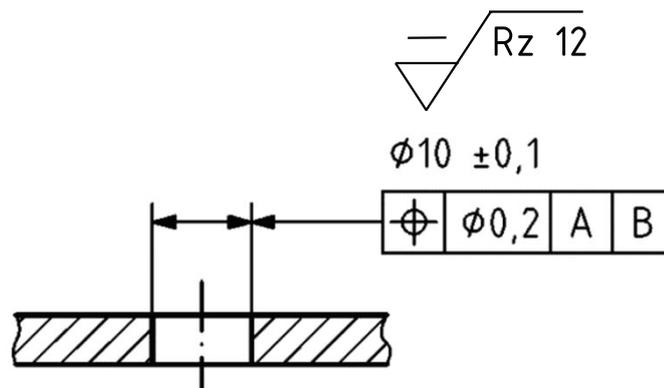**j) Graphical symbol readable from the bottom on the tolerance frame of a form, orientation, location or run-out requirement**

k) Graphical symbol readable from the bottom above geometrical tolerance indications away from the dimension line
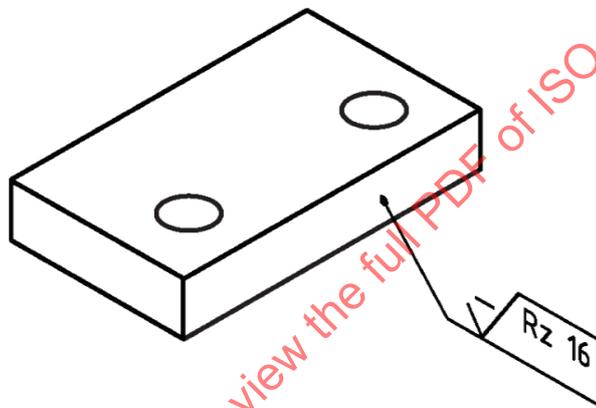
l) Graphical symbol in a three-dimensional model with a leader line terminating in a dot

NOTE   In i), the requirement only applies to the feature identified by the extension line, not the feature at the opposite end of the dimension line.

Figure 11 — Illustration for all defined options of position and orientation of the graphical symbol and the minimal indication

9   Simplified and additional indications

9.1   Simplified indications

9.1.1   General

Simplified indications may be used to improve the clarity and readability of technical product documentations.

9.1.2   General tolerances

The indication of general tolerances shall be placed close to the title block of the drawing. This indication applies to all features without explicitly indicated profile surface texture requirements and shall be followed by the graphical symbol alone (see Figure 12) or optionally all other explicitly indicated requirements in parentheses (see Figure 13).
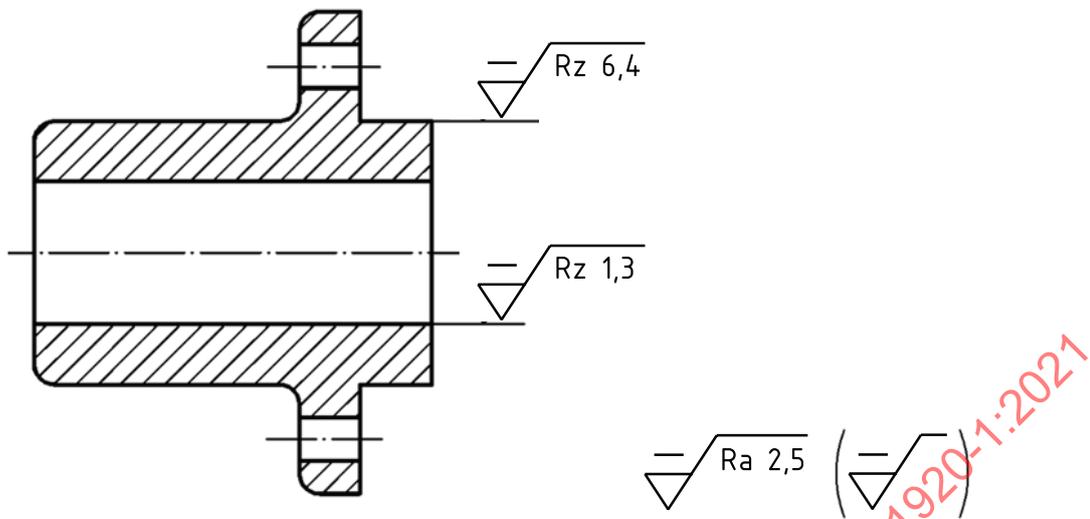
Figure 12 — Simplified indication followed by the graphical symbol
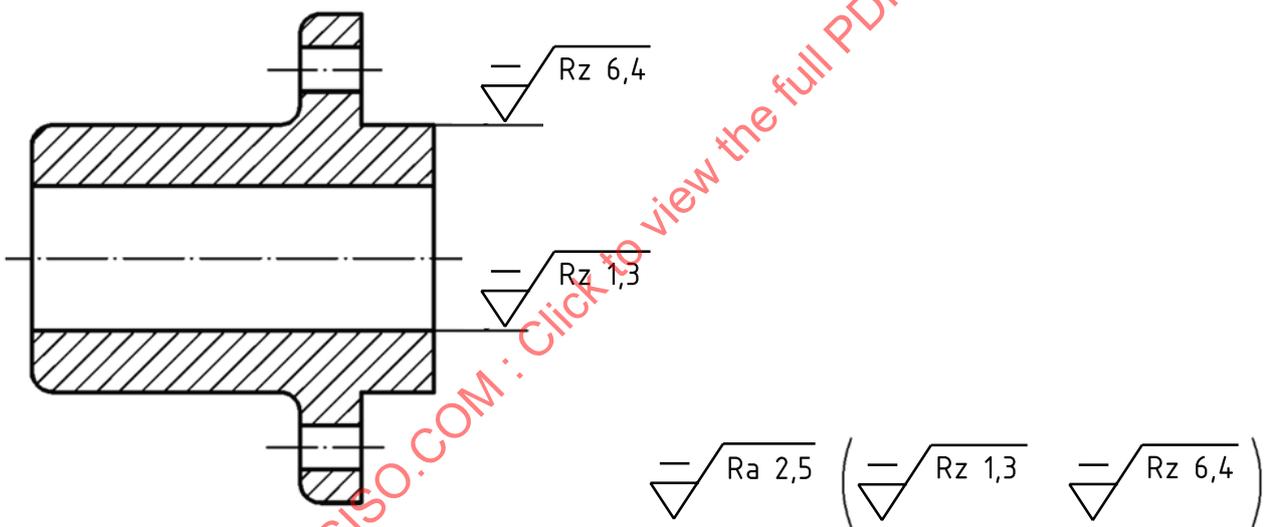
Figure 13 — Simplified indication followed by all other explicitly indicated requirements

9.1.3 Indication by the graphical symbol combined with a letter

The indication by the graphical symbol combined with a letter may be used to specify identical requirements to several features (see Figure 14) or to specify extensive requirements with a lot of non-default requirements (see Figure 15), or both. The explanation of these indications shall be placed close to the title block of the drawing as shown in Figures 14 and 15.
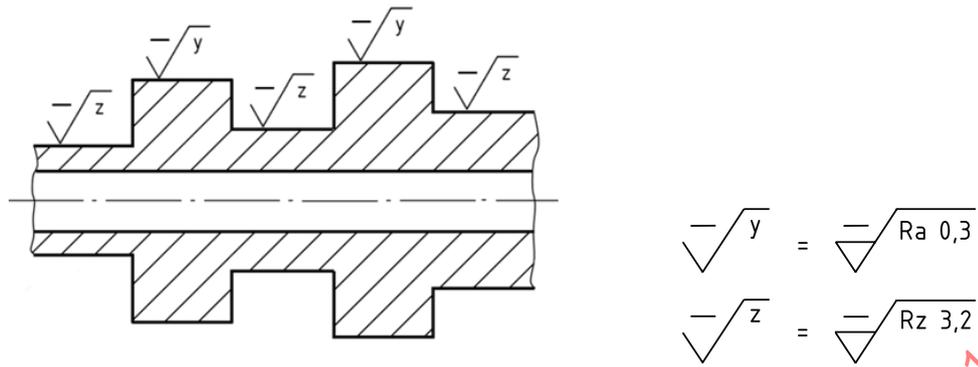
Figure 14 — Indication by the graphical symbol combined with a letter to specify identical requirements for several features
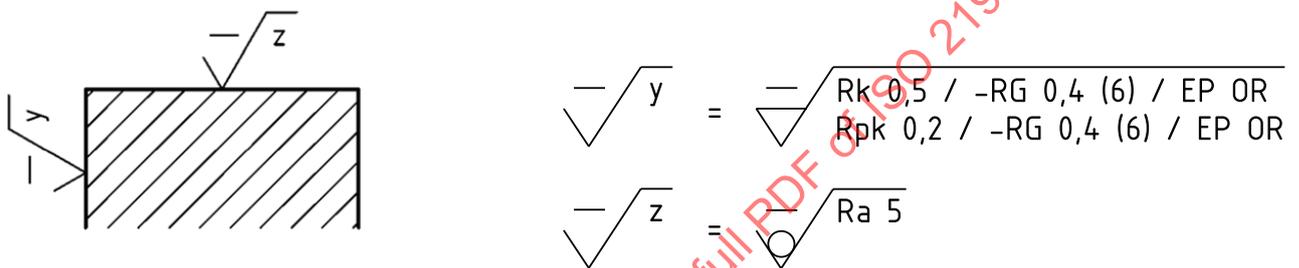
Figure 15 — Indication by the graphical symbol combined with a letter to specify identical and extensive requirements for several features

9.2 Restrictive specifications

If an indication is applied to a restricted part of a feature only, this restriction shall be shown as a long-dashed dotted wide line and dimensioned using theoretically exact dimensions (see Figure 16 for an example of indications and Figure 17 for interpretation).
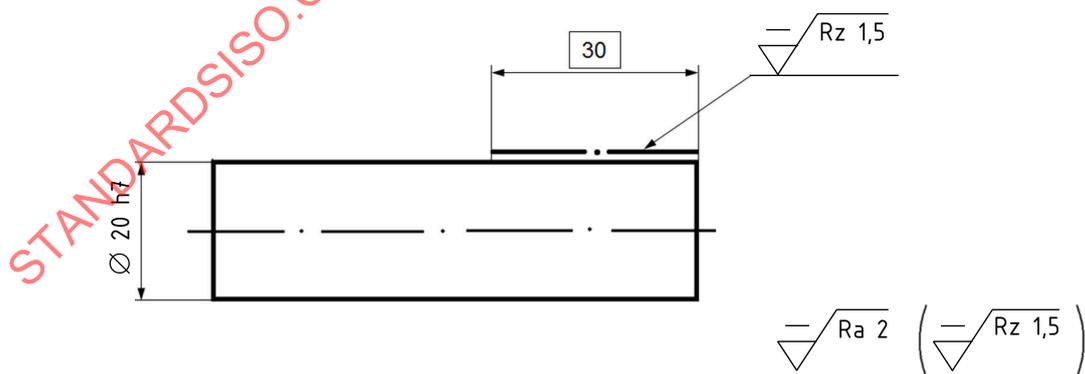
Figure 16 — Indication of a restricted part of a feature
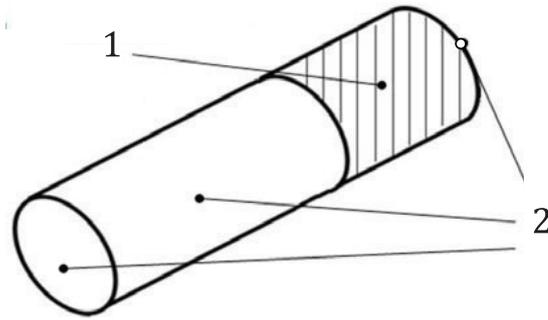
Key

1   area with requirement Rz 1,5 μm
2   areas with requirement Ra 2 μm

Figure 17 — Interpretation of the indication in Figure 16

9.3   Indication of identical specifications for a number of feature elements

Identical specifications for a number of identical feature elements can be indicated by the number of the relevant feature elements followed by ' × ' in front of the graphical symbol. See Figure 18 for an example of indication.
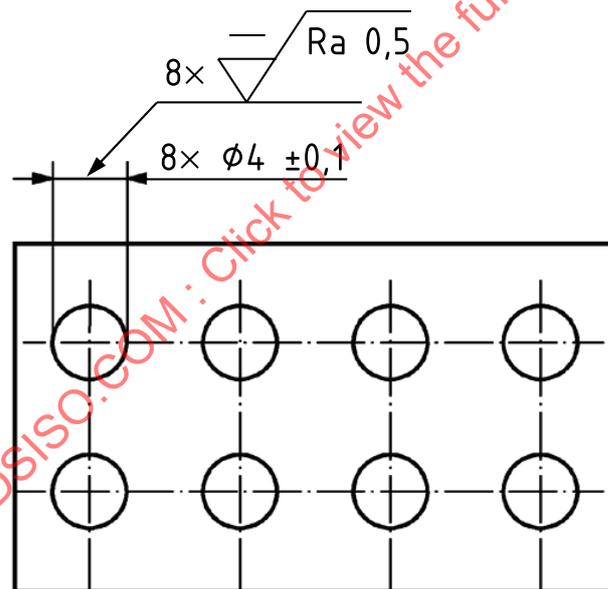
Figure 18 — Indication of a number of identical specifications of identical feature elements

9.4   Indication of surface lay and direction of lay

9.4.1   General

A surface lay requirement shall be indicated by the symbol (see 9.4.2), placed at the position [t] (see Figures 7 to 10). If the requirement contains a direction of lay, additional a section plane indicator and a datum feature indicator shall be indicated (see 9.4.3).

NOTE   The symbols and the indication at the position [t] in the Figures 7 to 10 are needed to distinguish between surface lay and profile direction requirements.

9.4.2 Indication of surface lay without a reference

See Table 1 for the indication of surface lay without a reference.

Table 1 — Symbols, interpretation and examples for the indication of surface lay

Graphical symbol	Interpretation and example	
M	Multidirectional	
C	Circular relative to centre of surface to which symbol applies	
R	Radial relative to centre of surface to which symbol applies	
P	Lay is particulate, non-directional or protuberant	
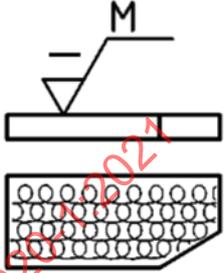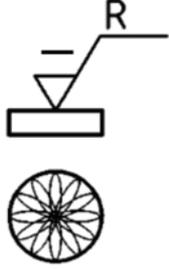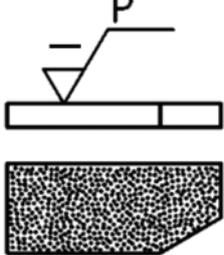
9.4.3 Indication of surface lay and direction of lay relative to a workpiece feature

See Table 2 for the indication of surface lay and direction of lay relative to a workpiece feature.

Table 2 — Symbols, examples of indication and interpretation of surface lay and direction of lay

Graphical symbol	Example of indication	Interpretation	Required direction of lay
=		Parallel to the direction, given by the intersection plane indicator and the datum feature indicator	
⊥		Perpendicular to the direction, given by the intersection plane indicator and the datum feature indicator	
X		Crossed in two oblique directions relative to the direction, given by the intersection plane indicator and the datum feature indicator	

Key
1 Required direction of lay

9.5 Indication of the profile direction

9.5.1 General

A profile direction can be indicated in two ways:

a) Relative to the predominant direction of the surface lay (see 9.5.2).

b) Relative to a workpiece feature (see 9.5.3).

9.5.2 Indication of the profile direction relative to the predominant direction of the surface lay

A profile direction requirement relative to the predominant direction of the surface lay shall be indicated by the relevant symbol from Table 3, placed at the position [u] (see Figures 7 to 10).

Table 3 — Graphical symbols for the indication of the profile direction

Graphical symbol	Interpretation
‡	Perpendicular to the predominant direction
⇛	Parallel to the predominant direction
◎	Circular to the centre of the surface to which the symbol applies
≠	At a defined angle to the predominant direction (0° < n < 90°), see Figure 19 for an example

$$\neq 45°$$
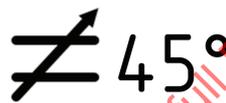
Figure 19 — Graphical symbol for the indication of the profile direction at a 45° angle to the predominant direction

9.5.3 Indication of the profile direction relative to a workpiece feature

A profile direction requirement relative to a workpiece feature shall be indicated by an intersection plane indicator and a datum feature indicator (see Figures 20 and 21).

a   Required profile direction.
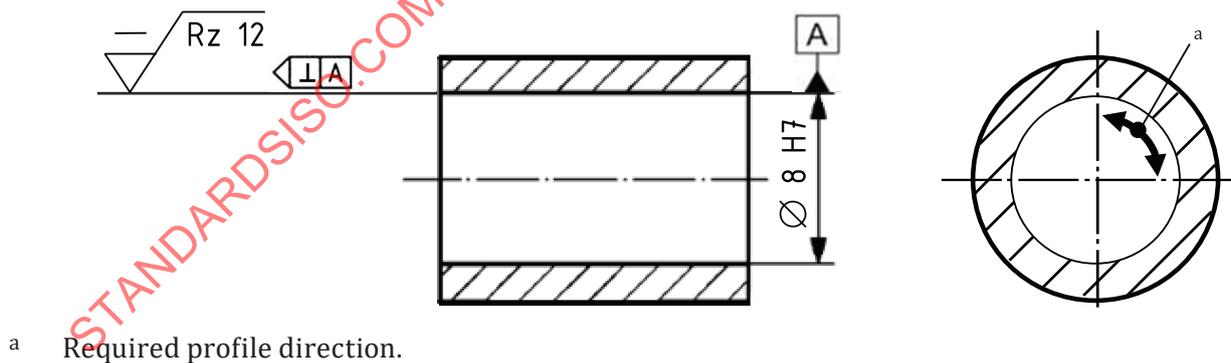
Figure 20 — Indication and interpretation of the specified profile direction by an intersection plane indicator in a 2D drawing
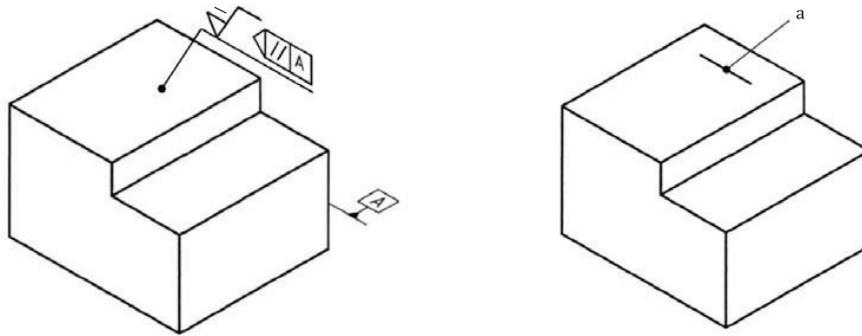
a   Required profile direction on an example position.

Figure 21 — Indication and interpretation of the specified profile direction by an intersection plane indicator in a 3D drawing

9.6 Indication of bilateral surface profile tolerances

Bilateral tolerances can be indicated in two ways:

a)   in separate lines for the upper and lower tolerance limit of one parameter (see Figure 22);

b)   in one line by using the interval indication (see Figure 23).

NOTE   Case b) can only be used if requirements are the same for both tolerance limits.

Figure 22 — Bilateral tolerance indicated in two lines
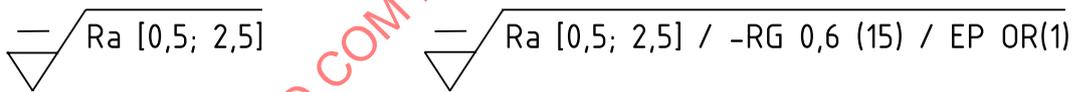
Figure 23 — Bilateral tolerances indicated in one line

9.7 Indication of different requirements for several additional processes on one surface feature

The indications for all processes shall be indicated with a numbered flagnote at the end of the specification. The requirements of the numbered flagnotes shall be defined close to the title block or in a complementary document. See Figure 24 for an example.
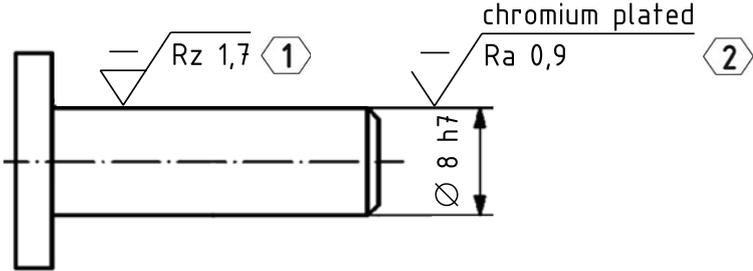
With the numbered flagnotes and its requirements placed close to the title block of the drawing.

⟨1⟩   before chromium plating

⟨2⟩   after chromium plating

Figure 24 — Indication of two requirements for one surface feature after different processes

Annex A
(normative)

Proportions and dimensions of graphical symbols

A.1 General requirements

In order to harmonize the size of the symbols specified in this document with those of other inscriptions on technical drawings (e.g. dimensions, geometrical tolerances) the rules given in ISO 81714-1 shall be applied.

A.2 Proportions

The basic graphical symbol and its complements (see Clause 6) shall be drawn in accordance with Figures A.1 to A.3. The shape of the symbols in Figure A.2, c) to g), is the same as that of the corresponding capital letter in ISO 3098-2 (lettering B, vertical). For dimensions, see A.3. The length of the horizontal stroke of the symbol in Figure A.1 depends on the indication to be placed above and beneath it. For simplified indications according to 9.1 the length of the horizontal stroke is equal to l_1.
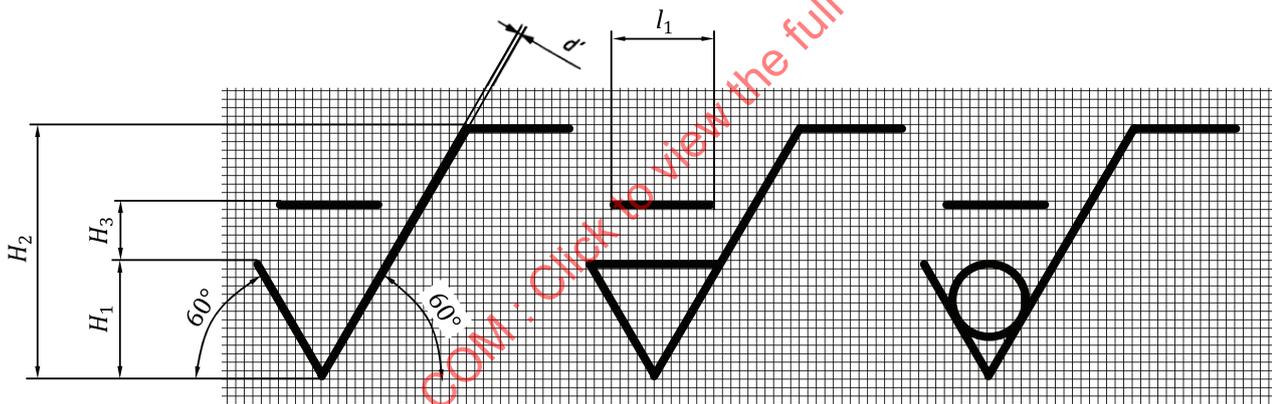
Figure A.1 — Proportions of the basic graphical symbol

| a) | b) | c) | d) | e) | f) | g) | h) | i) | j) | k) |
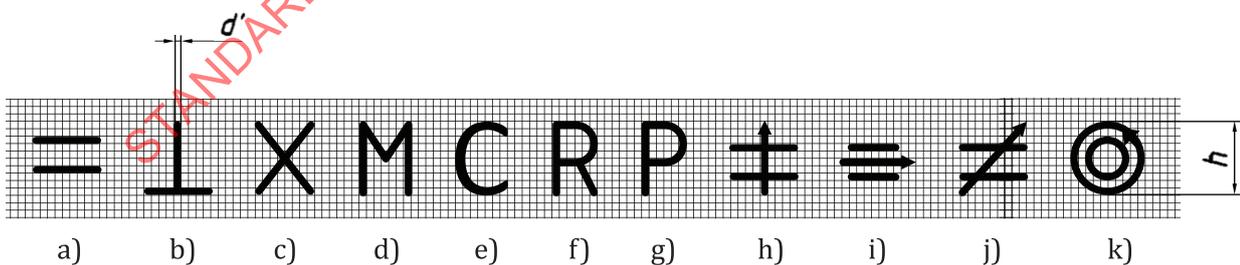
Figure A.2 — Proportions of the symbols

The height of all lettering in all areas in Figure A.3 shall be equal to h. For the placing of all areas, see Figures 7 to 10.
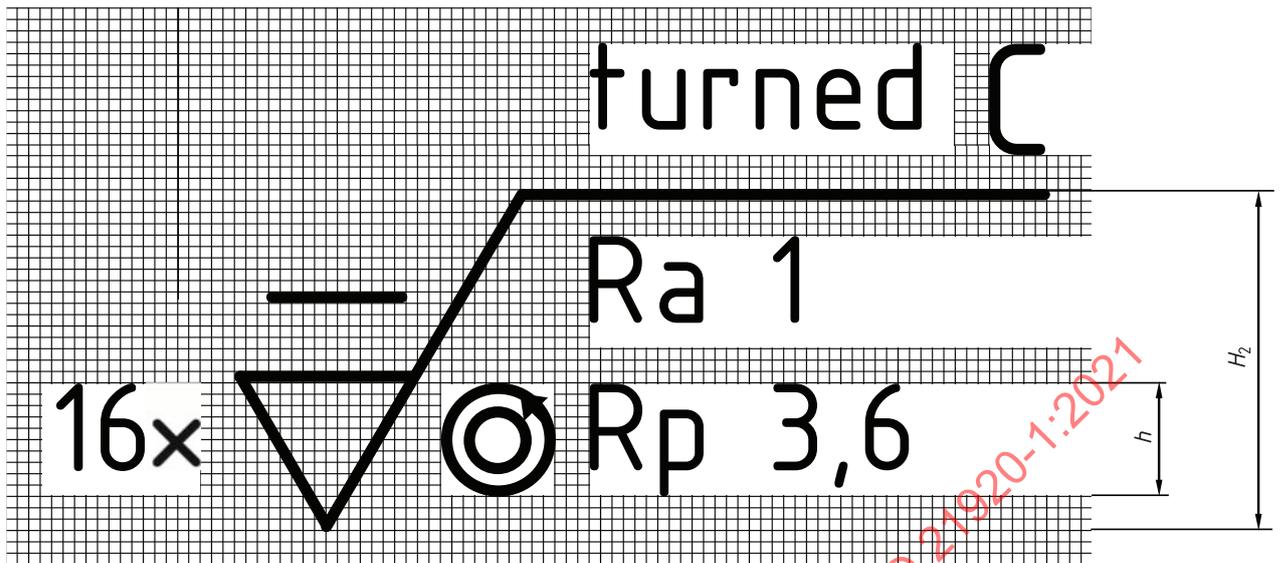
Figure A.3 — Proportions and dimensions

A.3 Dimensions

The dimensions of the graphical symbols and additional indications shall be as specified in Table A.1.

Table A.1 — Dimensions

Dimensions in millimetres

Height of numerals and letters, h (see ISO 3098-2)	2,5	3,5	5	7	10	14	20
Line width for symbols, d'	0,25	0,35	0,5	0,7	1	1,4	2
Line width for lettering, ($h/10$)							
Height, H_1	3,5	5	7	10	14	20	28
Height, H_2 (minimum)[a]	7,5	10,5	15	21	30	42	60
Height, H_3	2	2,5	3,5	5	7	10	14
Length, l_1	3	4,5	6	8,5	12	17	24
[a] H_2 depends on the number of lines of indication.							

Annex B
(normative)

Filter symbols for profile surface texture

Table B.1 — Symbols for filter association methods

Symbol	Name	ISO 16610 series designation	ISO document
G	Gaussian	FPLG	ISO 16610-21
S	Spline	FPLS	ISO 16610-22
RG	Robust Gaussian	FPRG	ISO 16610-31
RS	Robust spline	FPRS	ISO/TS 16610-32
SW	Spline wavelet	FPLWCS	ISO 16610-29
CW	Cubic wavelet	FPLWCP	ISO 16610-29
OD	Opening disc	FPMOD	ISO 16610-41
OH	Opening horizontal line segment	FPMOH	ISO 16610-41
CD	Closing disc	FPMCD	ISO 16610-41
CH	Closing horizontal line segment	FPMCH	ISO 16610-41
AD	Alternating series disc	FPMAD	ISO 16610-49

Annex C
(normative)

Symbols for association methods and association elements

Table C.1 — Symbols for association methods

Symbol	Association method
TLS	Total least square
LS	Least square

Table C.2 — Symbols for association elements

Symbol	Association elements
L	Line
Pn	Polynomial, n for the order
C	Circle

In cases where an association method and an association element are specified, the symbol of the association element shall be indicated directly after the symbol of the association method without a single blank character.

NOTE   The F-operator consists of the association and removal of the specified form element.

Annex D
(informative)

Indications for unambiguous surface profile specification

D.1 Examples of R-parameter specifications

See Figure D.1 for an example of a minimal indication for R-parameters with defined defaults and Table D.1 for explanation.

$$\sqrt{}\ \overline{Rz\ \ 3{,}2}$$

Figure D.1 — Minimal indication for an R-parameter with defined defaults by using all defaults

Table D.1 — Explanation and valid defaults for the example in Figure D.1

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement
	No manufacturing requirements
Rz	R-parameter: Rz
3,2	Tolerance limit value: 3,2 μm, leads to the valid default settings (see ISO 21920-3:2021, Table 3)
	Defaults applicable to the example (see ISO 21920-3:2021, Tables 1 and 3)
Tolerance type	Upper tolerance limit
Tolerance acceptance rule	Tmax
Profile S-filter type	Gaussian
Profile S-filter nesting index N_{is}	0,002 5 mm (requires a maximum sampling distance of 0,5 μm)
Profile L-filter type	Gaussian
Profile L-filter nesting index N_{ic}	0,8 mm
Section length l_{sc}	0,8 mm
Number of sections n_{sc}	5
Evaluation length l_e	4,0 mm
Profile F-operator association method and element	Association and removal of the specified form element with total least square
Profile F-operator nesting index	Not needed
Method of profile extraction	Mechanical profile
Other requirements (OR(n))	No other requirements are valid
Manufacturing process	No requirement
Surface lay and direction of lay	No requirement
Profile direction	Orthogonal to the surface lay

See Figures D.2 and D.3 for an example of two equivalent ways to specify a minimal indication for R-parameters without defined defaults and Table D.2 for explanation.

$$\overline{}\!\!\sqrt{\,\text{Rk } 0,3 \,/\, -0,25\,}$$

NOTE   Defaults are defined by the profile L-filter nesting index value N_{ic}.

Figure D.2 — Minimal indication for an R-parameter without defined defaults by using all defaults

$$\overline{}\!\!\sqrt{\,\text{Rk } 0,3 \,/\, \text{Sc2}\,}$$

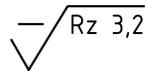NOTE   Defaults are defined by the setting class.

Figure D.3 — Minimal indication for an R-parameter without defined defaults by using all defaults

Table D.2 — Explanation and valid defaults for the examples in Figures D.2 and D.3

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement No manufacturing requirements
Rk	R-parameter: Rk
0,3	Tolerance limit value: 0,3 μm
0,25	Profile L-filter nesting index N_{ic}: 0,25 mm, leads to the valid default settings (see ISO 21920-3:2021, Table 2)
Sc2	Setting class: Sc2, leads to the valid default settings (see ISO 21920-3:2021, Table 2)
	Defaults applicable to the example (see ISO 21920-3:2021, Tables 1 and 2)
Tolerance type	Upper tolerance limit
Tolerance acceptance rule	Tmax
Profile S-filter type	Gaussian
Profile S-filter nesting index N_{is}	0,002 5 mm (requires a maximum sampling distance of 0,5 μm)
Profile L-filter type	Robust Gaussian
Profile L-filter nesting index N_{ic}	0,25 mm
Evaluation length l_e	1,25 mm
Profile F-operator association method and element	Association and removal of the specified form element with total least square
Profile F-operator nesting index	Not needed
Method of profile extraction	Mechanical profile
Other requirements (OR(n))	No other requirements are valid
Manufacturing process	No requirement
Surface lay and direction of lay	No requirement
Profile direction	Orthogonal to the surface lay

See Figure D.4 for an example of a complete indication for evaluation length R-parameter by using no default and Table D.3 for explanation.
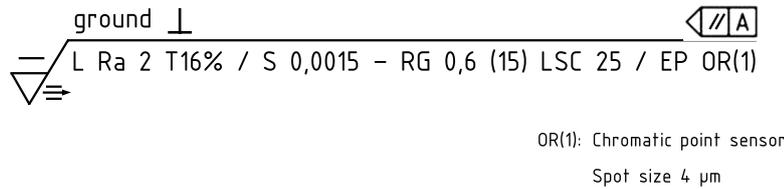
ground ⊥

L Ra 2 T16% / S 0,0015 — RG 0,6 (15) LSC 25 / EP OR(1)

⟨//|A|

OR(1): Chromatic point sensor

Spot size 4 μm

Figure D.4 — Indication for an evaluation length R-parameter including all definable specification elements by using no default

Table D.3 — Explanation for the example in Figure D.4

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement
	Material shall be removed
L	Tolerance type: lower tolerance limit
Ra	R-parameter: Ra
2	Tolerance limit value: 2,0 μm
T16 %	Tolerance acceptance rule: 16 % tolerance acceptance rule
S	Profile S-filter type: Spline
0,001 5	Profile S-filter nesting index N_{is}: 0,001 5 mm (requires a maximum sampling distance of 0,3 μm)
RG	Profile L-filter type: Robust Gaussian
0,6	Profile L-filter nesting index N_{ic}: 0,6 mm
(15)	Evaluation length l_e: 15 mm
LSC	Association and removal of a circle (C) with least square (LS)
25	Profile F-operator nesting index: circle-radius 25 mm
EP	Method of profile extraction: electromagnetic profile
OR(1)	Other requirements: chromatic point sensor, spot size 4 μm
ground	Manufacturing process: grinding
⊥ ⟨//|A|	Surface lay and direction of lay: perpendicular to the direction, given by the intersection plane indicator and the datum feature indicator
⇒	Profile direction: parallel to the grinding direction

See Figure D.5 for an example of a complete indication for section length R-parameter by using no default and Table D.4 for explanation.

ground =

L Rz 5 Tmed / S 0,002 — RG 0,5 (1,5 × 10) LSP2 / EP OR(2)

⟨//|A|

⟨⊥|A|

OR(1): Chromatic point sensor
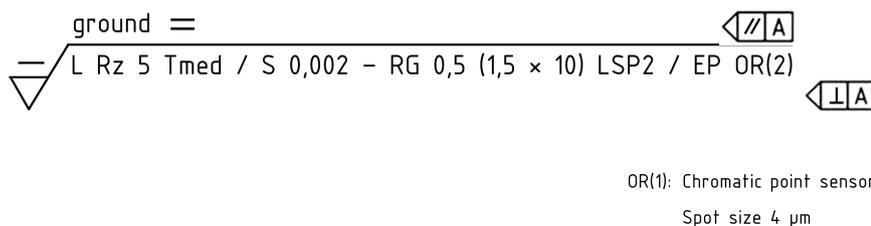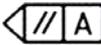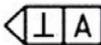
Spot size 4 μm

Figure D.5 — Indication for a section length R-parameter including all definable specification elements by using no default

Table D.4 — Explanation for the example in Figure D.5

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement
	Material shall be removed
L	Tolerance type: lower tolerance limit
Rz	R-parameter: Rz
5	Tolerance limit value: 5,0 µm
Tmed	Tolerance acceptance rule: median tolerance acceptance rule
S	Profile S-filter type: Spline
0,002	Profile S-filter nesting index N_{is}: 0,002 mm (requires a maximum sampling distance of 0,4 µm)
RG	Profile L-filter type: Robust Gaussian
0,5	Profile L-filter nesting index N_{ic}: 0,5 mm
(1,5 × 10)	Section length l_{sc}: 1,5 mm
	Number of sections n_{sc}: 10
	Resulting evaluation length l_e: 15 mm
LSP2	Association and removal of a polynom, second order (P2) with least square (LS)
EP	Method of profile extraction: electromagnetic profile
OR(2)	Other requirements: chromatic point sensor, spot size 4 µm.
	More than one OR(n)-requirement is indicated
ground	Manufacturing process: grinding
= ⟨//｜A⟩	Surface lay and direction of lay: parallel to the direction, given by the intersection plane indicator and the datum feature indicator
⟨⊥｜A⟩	Profile direction: perpendicular to the direction, given by the datum feature indicator

See Figures D.6 to D.9 for examples of a minimal indication for material ratio parameters (except the lower tolerance limit) and Tables D.5 to D.8 for explanation.

No material ratio parameter is listed in ISO 21920-3:2021, Tables 3 to 6, so the setting class or the profile L-filter nesting index N_{ic} value shall be specified.

$$\overline{\text{L Rmr(−0,5) 80 \% / −0,8}}$$

NOTE   The reference level 0 % is the highest point of the material ratio curve and need not be indicated (see ISO 21920-2).

Figure D.6 — Indication for an R-profile material ratio parameter with defined reference level 0 %

Table D.5 — Explanation for the example in Figure D.6

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement No manufacturing requirements
L	Tolerance type: lower tolerance limit
Rmr(−0,5)	R-parameter: Rmr(p, d_c), with default $p = 0$ % (not indicated), $d_c = -0,5$ µm
80 %	Tolerance limit value: 80 %
0,8	Profile L-filter nesting index N_{ic}: 0,8 mm, leads to the valid default settings (see ISO 21920-3:2021, Table 2)

L Rmr(5 %, −0,2) 70 % / Sc2

NOTE 1 See ISO 21920-2 for the specification of the reference level p in percentage of the material ratio curve.

NOTE 2 The d_c-value is negative if it is below the reference level p and positive if it is above the reference level p.

Figure D.7 — Indication for an R-profile material ratio parameter with a non-zero reference level

Table D.6 — Explanation for the example in Figure D.7

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement No manufacturing requirements
L	Tolerance type: lower tolerance limit
Rmr(5 %, −0,2)	R-parameter: Rmr(p, d_c), $p = 5$ %, $d_c = -0,2$ µm
70 %	Tolerance limit value: 70 %
Sc2	Setting class: Sc2, leads to the valid default settings (see ISO 21920-3:2021, Table 2)

L Rdc(60 %) 1,8 / −2,5

Figure D.8 — Indication for the R-profile inverse material ratio parameter

Table D.7 — Explanation for the example in Figure D.8

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement No manufacturing requirements
L	Tolerance type: lower tolerance limit
Rdc(60 %)	R-parameter: Rdc(p, q), with default $p = 0$ % (not indicated), $q = 60$ %
1,8	Tolerance limit value: 1,8 µm
2,5	Profile L-filter nesting index N_{ic}: 2,5 mm, leads to the valid default settings (see ISO 21920-3:2021, Table 2)

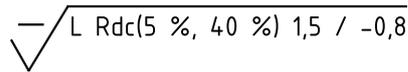$$\overline{}\diagup\text{L Rdc(5 \%, 40 \%) 1,5 / -0,8}$$

Figure D.9 — Indication for the R-profile section height difference parameter

Table D.8 — Explanation for the example in Figure D.9

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement No manufacturing requirements
L	Tolerance type: lower tolerance limit
Rdc(5 %, 40 %)	R-parameter: Rdc(p, q), p = 5 %, q = 40 %
1,5	Tolerance limit value: 1,5 µm
0,8	Profile L-filter nesting index N_{ic}: 0,8 mm, leads to the valid default settings (see ISO 21920-3:2021, Table 2)

See Figures D.10 to D.13 for examples of an indication for material ratio parameters using no default and Tables D.9 to D.12 for explanation.

$$\overline{}\diagup\text{L Rmr(-0,5) 80 \% T16\% / S 0,008 - RG 0,2 (1,2) LSP2 / EP OR(1)}$$
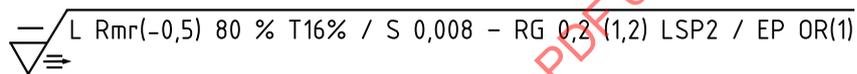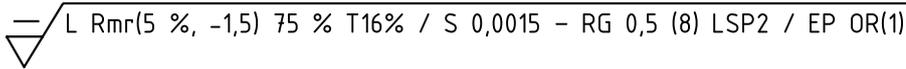
OR(1): Profile extraction from CSI areal primary surface

NOTE   The reference level 0 % is the highest point of the material ratio curve and need not be indicated (see ISO 21920-2).

Figure D.10 — Indication for an R-profile material ratio parameter with defined reference level 0 % by using no default

Table D.9 — Explanation for the example in Figure D.10

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement Material shall be removed
L	Tolerance type: lower tolerance limit
Rmr(−0,5)	R-parameter: Rmr(p, d_c), with default p = 0 % (not indicated), d_c = −0,5 µm
80 %	Tolerance limit value: 80 %
T16 %	Tolerance acceptance rule: 16 % tolerance acceptance rule
S	Profile S-filter type: Spline
0,008	Profile S-filter nesting index N_{is}: 0,008 mm (requires a maximum sampling distance of 1,5 µm)
RG	Profile L-filter type: Robust Gaussian
0,2	Profile L-filter nesting index N_{ic}: 0,2 mm
(1,2)	Evaluation length l_e: 1,2 mm
LSP2	Association and removal of a polynom, second order (P2) with least square (LS)
EP	Method of profile extraction: electromagnetic profile
OR(1)	Other requirements: profile extraction from CSI areal primary surface
⇒	Profile direction: parallel to the predominant direction

$$\overline{}/ \text{L Rmr(5 \%, -1,5) 75 \% T16\% / S 0,0015 - RG 0,5 (8) LSP2 / EP OR(1)}$$

OR(1): Profile extraction from CSI areal primary surface

NOTE 1 See ISO 21920-2 for the specification of the reference level in percentage of the material ratio curve.

NOTE 2 The c-value is negative if it is below the reference c-value and positive if it is above the reference c-value.

Figure D.11 — Indication for an R-profile material ratio parameter by using no default

Table D.10 — Explanation for the example in Figure D.11

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement
	Material shall be removed
L	Tolerance type: lower tolerance limit
Rmr(5 %, −1,5)	R-parameter: Rmr(p, d_c), p = 5 %, d_c = −1,5 µm
75 %	Tolerance limit value: 75 %
T16 %	Tolerance acceptance rule: 16 % tolerance acceptance rule
S	Profile S-filter type: Spline
0,001 5	Profile S-filter nesting index N_{is}: 0,001 5 mm (requires a maximum sampling distance of 0,3 µm)
RG	Profile L-filter type: Robust Gaussian
0,5	Profile L-filter nesting index N_{ic}: 0,5 mm
(8)	Evaluation length l_e: 8 mm
LSP2	Association and removal of a polynom, second order (P2) with least square (LS)
EP	Method of profile extraction: electromagnetic profile
OR(1)	Other requirements: profile extraction from CSI areal primary surface
⇒	Profile direction: parallel to the predominant direction

$$\overline{}/ \text{L Rdc(75 \%) 2,5 T16\% / S 0,004 - RG 0,6 (15) LSP2 / EP OR(1)}$$
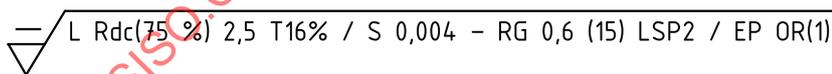
OR(1): Chromatic point sensor

Spot size 5 µm

Figure D.12 — Indication for the R-profile inverse material ratio parameter by using no default

Table D.11 — Explanation for the example in Figure D.12

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement
	Material shall be removed
L	Tolerance type: lower tolerance limit
Rdc(75 %)	R-parameter: Rdc(p, q), with default p = 0 % (not indicated), q = 75 %
2,5	Tolerance limit value: 2,5 µm
T16 %	Tolerance acceptance rule: 16 % tolerance acceptance rule
S	Profile S-filter type: Spline

Table D.11 *(continued)*

Specification elements	Explanation
0,004	Profile S-filter nesting index N_{is}: 0,004 mm (requires a maximum sampling distance of 0,8 µm)
RG	Profile L-filter type: Robust Gaussian
0,6	Profile L-filter nesting index N_{ic}: 0,6 mm
(15)	Evaluation length l_e: 15 mm
LSP2	Association and removal of a polynom, second order (P2) with least square (LS)
EP	Method of profile extraction: electromagnetic profile
OR(1)	Other requirements: chromatic point sensor, spot size 5 µm
⇒	Profile direction: parallel to the predominant direction

L Rdc(5 %, 30 %) 1,5 Tmed / S 0,0015 – RG 0,6 (5) LSP2 / EP OR(1)

OR(1): Chromatic point sensor
Spot size 2 µm

Figure D.13 — Indication for the R-profile section height difference parameter by using no default

Table D.12 — Explanation for the example in Figure D.13

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement Material shall be removed
L	Tolerance type: lower tolerance limit
Rdc(5 %, 30 %)	R-parameter: Rdc(p, q), p = 5 %, q = 30 %
1,5	Tolerance limit value: 1,5 µm
Tmed	Tolerance acceptance rule: median tolerance acceptance rule
S	Profile S-filter type: Spline
0,001 5	Profile S-filter nesting index N_{is}: 0,001 5 mm (requires a maximum sampling distance of 0,3 µm)
RG	Profile L-filter type: Robust Gaussian
0,6	Profile L-filter nesting index N_{ic}: 0,6 mm
(5)	Evaluation length l_e: 5 mm
LSP2	Association and removal of a polynom, second order (P2) with least square (LS)
EP	Method of profile extraction: electromagnetic profile
OR(1)	Other requirements: chromatic point sensor, spot size 2 µm
⇒	Profile direction: parallel to the predominant direction

D.2 Examples of W-parameter specifications

See Figure D.14 for an example of a minimal indication for W-parameters and Table D.13 for explanation.

No W-parameter is listed in ISO 21920-3:2021, Tables 3 to 6, so the setting class or the profile S-filter nesting index value N_{ic} shall be specified.
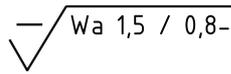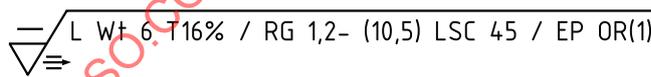
Figure D.14 — Minimal indication for a W-parameter by using all defaults

Table D.13 — Explanation and valid defaults for the example in Figure D.14

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement No manufacturing requirements
Wa	W-parameter: Wa
1,5	Tolerance limit value: 1,5 μm
0,8	Profile S-filter nesting index N_{ic}: 0,8 mm, leads to the valid default settings (see ISO 21920-3:2021, Table 2)
	Defaults applicable to the example (see ISO 21920-3:2021, Tables 1 and 2)
Tolerance type	Upper tolerance limit
Tolerance acceptance rule	Tmax
Profile S-filter type	Gaussian
Evaluation length l_e	4,0 mm
Profile F-operator association method and element	Association and removal of the specified form element with total least square
Method of profile extraction	Mechanical profile
Other requirements (OR(n))	No other requirements are valid
Manufacturing process	No requirement
Surface lay and direction of lay	No requirement
Profile direction	Orthogonal to the surface lay

See Figure D.15 for an example of a complete indication for evaluation length W-parameter by using no default and Table D.14 for explanation.

OR(1): Chromatic point sensor
Spot size 4 μm

Figure D.15 — Indication for an evaluation length W-parameter by using no default

Table D.14 — Explanation for the example in Figure D.15

Specification elements	Explanation
Graphical symbol	Profile surface texture requirement Material shall be removed
L	Tolerance type: lower tolerance limit
Wt	W-parameter: Wt
6	Tolerance limit value: 6,0 μm
T16 %	Tolerance acceptance rule: 16 % tolerance acceptance rule
RG	Profile S-filter type: Robust Gaussian
1,2	Profile S-filter nesting index N_{ic}: 1,2 mm