
**Sintered metal materials, excluding
hardmetals — Measurement of surface
roughness**

*Matériaux métalliques frittés, à l'exclusion des métaux-durs —
Mesurage de la rugosité de surface*

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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and units	2
5 Principle	2
6 Procedure	3
7 Expression of results	4
Bibliography	5

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 23519 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 3, *Sampling and testing methods for sintered metal materials (excluding hardmetals)*.

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Sintered metal materials, excluding hardmetals — Measurement of surface roughness

1 Scope

This International Standard specifies a method to determine the surface roughness of sintered parts of metal materials. It also establishes principles for the use of the suitable parameters for measurement.

2 Normative references

The following referenced documents are indispensable for the application 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 4287, *Geometrical Product Specification (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 13565-1, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Surface having stratified functional properties — Part 1: Filtering and general measurement conditions*

ISO 13565-2, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Surfaces having stratified functional properties — Part 2: Height characterization using the linear material ratio curve*

ISO 13565-3, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Surfaces having stratified functional properties — Part 3: Height characterization using the material probability curve*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4287 apply.

4 Symbols and units

For the purposes of this document, the following symbols and units apply.

Symbol	Quantity	Unit
R_{pk}	Reduced peak height	μm
R_p	Maximum profile peak height	μm
R_v	Maximum profile valley depth	μm
R_z	Maximum height of profile	μm
R_t	Total height of profile	μm
R_a	Arithmetic mean deviation of the assessed profile	μm
R_q	Root mean square deviation of the assessed profile	μm
R_s	Surface roughness	μm
R_{Sm}	Mean width of the profile elements	μm
$R_{mr}(c)$	Material ratio of the profile	%
R_k	Core roughness depth	μm
R_{vk}	Reduced valley depth	μm
d	Density	g/cm^3
c	Level	μm

5 Principle

The surface roughness is measured according to standard procedures. Because of the porosity and the nature of the surface of sintered materials, their surface roughness cannot be compared with the surface roughness of wrought materials. As most of the roughness parameters are defined by measuring the height of the surface peaks, porosity will negatively influence this value, because the depth of the pore will increase the value of the peak. This International Standard specifies the most suitable way to measure surface roughness and the correct parameters to use.

6 Procedure

The surface roughness shall be measured in accordance with ISO 13565-1, ISO 13565-2 and ISO 13565-3, by using the following particular parameters:

- a) always use a filtered profile (roughness profile), by applying the standard Gaussian filter, with a cut-off of 0,8 mm;
- b) use a total evaluation length of 4 mm, which is five times the cut-off value of 0,8 mm;

NOTE Only in the case of a roughness higher than 4,0 R_a , the cut-off will be increased up to 2,5 mm, so the new evaluation length will be 12,5 mm. This is because the surface is so irregular that a longer evaluation length is necessary to obtain a real statistical approach.

- c) use a probe with a radius of 2 μm that will define the surface irregularities as well as possible;
- d) express the results as parameters R_k and R_{pk} , in micrometres.

Roughness parameters that are strongly affected by porosity, which do not really characterize the surface state, but rather the addition between the surface state and the size of the open porosity, shall not be used. This is the case for R_p , R_v , R_z , R_t , R_a , R_q , R_s and R_{Sm} .

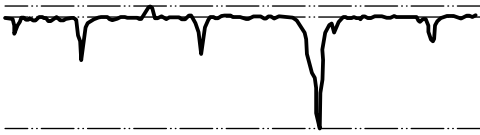
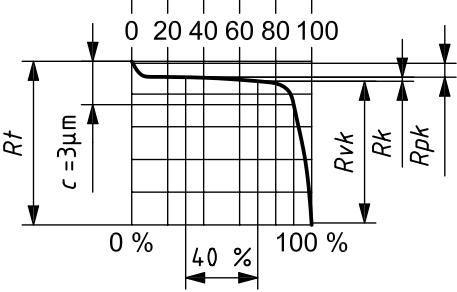
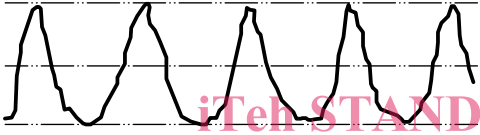
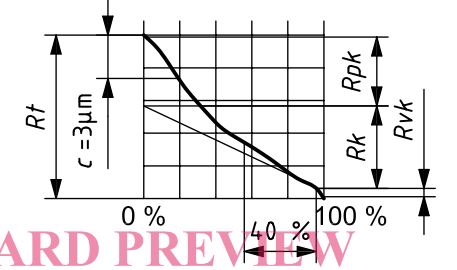
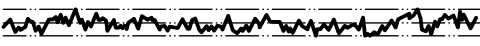
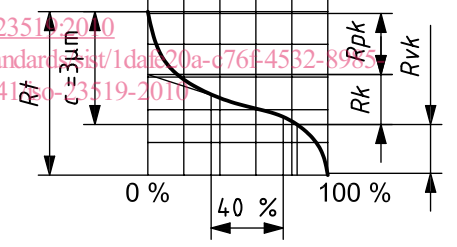
In order to illustrate the convenience of R_{pk} and the inconvenience of other parameters typical for wrought materials, a comparison between different materials and surface conditions is shown in Table 1.

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Table 1 — Comparison of roughness of powder metallurgy (PM) material with wrought materials

Material	Surface profile	BAC ^a curve supporting surface	Roughness
Sintered and sized $d = 6,6 \text{ g/cm}^3$	 Figure 1 — Surface profile — Sintered and sized	 Figure 2 — BAC curve — Sintered and sized	$Ra = 1,22$
			$Rt = 10,6$
			$Rmr(3) = 91 \%$
			$Rpk = 0,8$
			$Rk = 0,6$
			$Rvk = 9,1$
Turned solid material	 Figure 3 — Surface profile — Turned solid material	 Figure 4 — BAC curve — Turned solid material	$Ra = 1,28$
			$Rt = 10,7$
			$Rmr(3) = 20 \%$
			$Rpk = 4,5$
			$Rk = 5,4$
			$Rvk = 0,6$
Ground solid material	 Figure 5 — Surface profile — Ground solid material	 Figure 6 — BAC curve — Ground solid material	$Ra = 0,6$
			$Rt = 4,2$
			$Rmr(3) = 83 \%$
			$Rpk = 1,3$
			$Rk = 1,4$
			$Rvk = 1,3$

NOTE The way to obtain the BAC curve and to determine the Rpk - and Rvk -roughness parameters are described in ISO 4287 and ISO 13565-2.

^a BAC: Bearing area curve.

7 Expression of results

The result is the surface roughness, expressed as parameters Rk and Rpk , in micrometres.

The result should be reported to the nearest $0,1 \mu\text{m}$.

Bibliography

- [1] ISO 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*
- [2] ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*
- [3] ISO 11562, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Metrological characteristics of phase correct filters*
- [4] ISO 12085, *Geometrical Product Specification (GPS) — Surface texture: Profile method — Motif parameters*

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