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(JSA)

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

ICS 17.040.20; 17.040.30

Reference number : JIS B 0671-3 : 2002 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from the Japanese Standards Association (JSA), with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This Standard has been made based on **ISO 13565-3:1998 Geometrical Product Specifications (GPS) — Surface texture: Profile method; Surfaces having stratified functional properties — Part 3: Height characterization using the material probability curve** for the purposes of making easy to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of International Standard which is based on Japanese Industrial Standard.

JIS B 0671 group consists of the following three parts with the general title *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Surfaces having stratified functional properties*.

Part 1: Filtering and general measurement conditions

Part 2: Height characterization using the linear material ratio curve

Part 3: Height characterization using the material probability curve

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

Introduction This part of JIS B 0671 has been prepared based on the first edition of 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* published in 1998 without modifying the technical contents.

This part of JIS B 0671 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see TR B 0007). It influences the chain link 2 of the chains of standards on roughness profile and primary profile.

For more detailed information on the relation of this Standard to the GPS matrix model see annex E.

This part of JIS B 0671 provides a numerical characterization of surfaces consisting of two vertical random components, namely, a relatively coarse “valley” texture and a finer “plateau” texture. This type of surface is used for lubricated, sliding contact, for example in cylinder liners and fuel injectors. The calculations necessary to determine the parameters R_{pq} , R_{vq} , and R_{mq} (P_{pq} , P_{vq} , and P_{mq}) used to characterize these two components separately involves the generation of the material probability curve, the determination of its linear regions, and the linear regressions through these regions.

The parameters are undefined for surfaces not consisting of two such components.

“Informations” underlined with dots in this Standard are the matters not included in the original International Standard.

Remarks TR B 0007 is identical with ISO/TR 14638 : 1995 *Geometrical Product Specifications (GPS) — Masterplan*.

1 Scope This part of JIS B 0671 establishes the evaluation process for determining parameters from the linear regions of the material probability curve, which is the Gaussian representation of the material ratio curve. The parameters are intended to aid in assessing tribological behaviour, for example of lubricated, sliding surfaces, and to control the manufacturing process.

Remarks The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

ISO 13565-3 : 1998 *Geometrical Product Specifications (GPS) – Surface texture : Profile method ; Surfaces having stratified functional properties – Part 3 : Height characterization using the material probability curve (IDT)*

Information “Tribology” is a generic term of science and technology concerning contact surfaces of relative motion and their application such as friction, abrasion and lubrication.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of coming into effect is given to these referred standards, only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter are not applied. The normative references without the indication of the year of coming into effect apply limiting only to the most recent edition (including amendments).

JIS B 0601 *Geometrical Product Specification (GPS) – Surface texture : Profile method – Terms, definitions and surface texture parameters*

Remarks ISO 4287 : 1997 *Geometrical Product Specifications (GPS) – Surface texture : Profile method – Terms, definitions and surface texture parameters* is identical with the said standard.

JIS B 0651 *Geometrical Product Specification (GPS) – Surface texture : Profile method – Nominal characteristics of contact (stylus) instrument*

Remarks ISO 3274 : 1996 *Geometrical Product Specifications (GPS) – Surface texture : Profile method – Nominal characteristics of contact (stylus) instruments* is identical with the said standard.

JIS B 0671-1 *Geometrical Product Specifications (GPS) – Surface texture : Profile method ; Surfaces having stratified functional properties – Part 1 : Filtering and general measurement conditions*

Remarks ISO 13565-1 : 1996 *Geometrical Product Specifications (GPS) – Surface texture : Profile method ; Surfaces having stratified functional properties – Part 1 : Filtering and general measurement conditions* is identical with the said standard.

JIS B 0671-2 *Geometrical Product Specifications (GPS) – Surface texture : Profile method ; Surfaces having stratified functional properties – Part 2 : Height characterization using the linear material ratio curve*

Remarks ISO 13565-2 : 1996 *Geometrical Product Specifications (GPS) – Surface texture : Profile method ; Surfaces having stratified functional properties – Part 2 : Height characterization using the linear material ratio curve* is identical with the said standard.

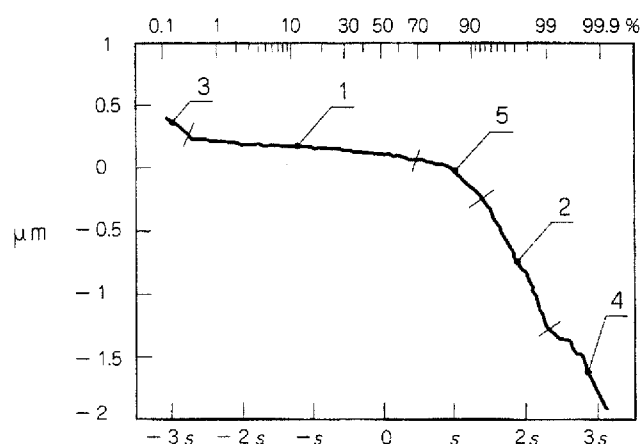
ISO 1302 : 1992 *Technical drawings – Methods of indicating surface texture*

3 Definitions For the purposes of this part of JIS B 0671, the definitions given in JIS B 0601, JIS B 0651, JIS B 0671-2 and the following apply.

3.1 material probability curve a representation of the material ratio curve in which the profile material length ratio is expressed as Gaussian probability in standard deviation values, plotted linearly on the horizontal axis.

NOTE This scale is expressed linearly in standard deviations according to the Gaussian distribution. In this scale the material ratio curve of a Gaussian distribution becomes a straight line. For stratified surfaces composed of two Gaussian distributions, the material probability curve will exhibit two linear regions (see 1 and 2 in figure 1).

Information The definition of material length ratio is given in 4.5.1 *Material ratio of the profile of JIS B 0601*.



Key

- 1 Plateau region
- 2 Valley region
- 3 Debris or outlying peaks in the data (profile)
- 4 Deep scratches or outlying valleys in the data (profile)
- 5 Unstable region (curvature) introduced at the plateau to valley transition point based on the combination of two distributions

Figure 1 Material probability curve

3.2 R_{pq} (P_{pq}) parameter slope of a linear regression performed through the plateau region (see figure 2)

NOTE R_{pq} (P_{pq}) can thus be interpreted as the R_q (P_q)-value (in micrometres) of the random process that generated the plateau component of the profile.

Information The definition of R_q (P_q) value is given in 4.2.2 *Roof mean square deviation of the assessed profile of JIS B 0601*.

3.3 R_{vq} (P_{vq}) parameter slope of a linear regression performed through the valley region (see figure 2)

NOTE Rvq (Pvq) can thus be interpreted as the Rq (Pq)-value (in micrometres) of the random process that generated the valley component of the profile.

3.4 Rmq (Pmq) parameter relative material ratio at the plateau to valley intersection (see figure 2)

4 Procedure The roughness profile used for determining the parameters Rpq , Rvq and Rmq shall be calculated in accordance with JIS B 0671-1. This roughness profile is different from that in JIS B 0601. The profile for determining the parameters Ppq , Pvq and Pmq shall be the primary profile.

Three non-linear effects can be present in the material probability curve as shown in figure 1 for measured surface data from a two-process surface. These effects shall be eliminated by limiting the fitted portions of the material probability curve, using only the statistically sound, Gaussian portions of the material probability curve excluding a number of influences.

In figure 1 the non-linear effects originate from:

- debris or outlying peaks in the data (profile) (labelled 3) ;
- deep scratches or outlying valleys in the data (profile) (labelled 4) ; and
- unstable region (curvature) introduced at the plateau to valley transition point based on the combination of two distributions (labelled 5).

These exclusions are intended to keep the parameters more stable for repeated measurements of a given surface. Figure 2 shows a profile with its corresponding material probability curve and its plateau and valley regions and the parts of the surface that defines the two regions. The profile has a peak that is outlying and the figure shows how it does not influence the parameters. Figure 2 also shows how the bottom parts of the deepest grooves, which will vary significantly depending on where the measurements are made on a surface, are disregarded when determining the parameters.

Information “s” at the abscissa of the right side figure of figure 2 means standard deviations.

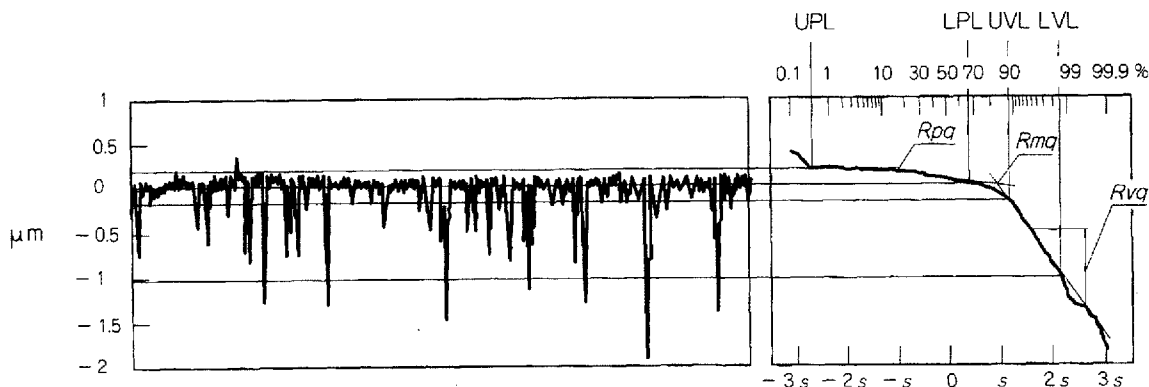


Figure 2 Roughness profile with its corresponding material probability curve and the regions used in the definitions of the parameters Rpq , Rvq , and Rmq

5 Measurement process requirements The following criteria are designed to ensure that the profile represents a proper two-process surface and that the measuring process is adequate for calculating a stable material probability curve resulting in reliable parameter values. These criteria shall be met in order for the parameters R_{pq} , R_{vq} , and R_{mq} (P_{pq} , P_{vq} , and P_{mq}) to be defined:

- The instrument shall be capable of measuring a value of R_q (P_q) from an optical flat that is less than 30 % of the nominal value of R_{pq} (P_{pq}).
- The vertical resolution of the material probability curve shall be such that at least 40 classes fall within the linear plateau and linear valley regions respectively.
- The digital data density of the material probability curve shall be such that at least 100 profile ordinates fall within the linear plateau and linear valley regions respectively.
- The ratio $R_{vq} : R_{pq}$ ($P_{vq} : P_{pq}$) shall be at least 5.
- The conic section regressions result in a hyperbolic solution (see annex A).

If the profile does not satisfy the above criteria, a suitable warning message shall give the reason for the failure.

Information.....The conic section is a section that appears when a cone is cut in random direction.

6 Drawing indications The parameters specified in this part of JIS B 0671 shall be indicated on drawings in accordance with ISO 1302.

Annex A (normative) Procedures for determining the limits of the linear regions

Clauses A.1 through A.3 specify the procedures for determining the upper plateau limit, UPL, and the lower valley limit, LVL. Clauses A.4 through A.6 specify the procedures for determining the lower plateau limit, LPL, and the upper valley limit, UVL. Clause A.7 specifies the procedure for determining the calculation of parameters.

A.1 Initial conic fit A conic section is initially fitted through the material probability curve since it is a very good approximation of the expected form of the material probability curve of surfaces consisting of two vertical random components. This initial conic fit provides a framework for subsequent operations on the material probability curve.

Fit a conic section

$$z = Ax^2 + Bxz + Cz^2 + Dx + E$$

where

z is the profile height ;

x is the material probability expressed in standard deviations;
through the entire curve (see figure A.1).

Information The original point, z in a roughness profile is positioned on the reference line obtained in JIS B 0671-1.

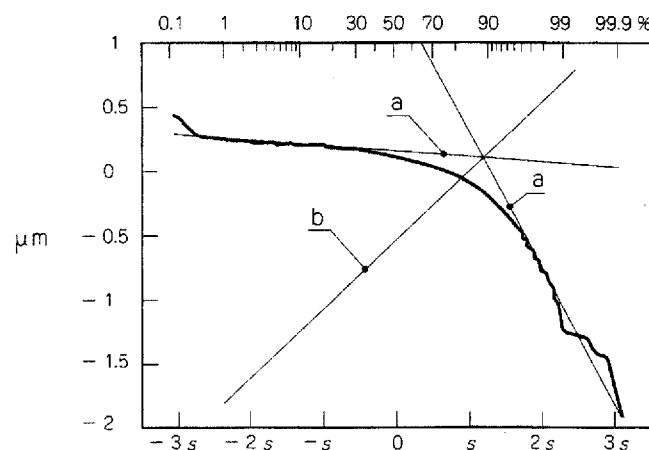


Figure A.1 Conic section based on the entire material probability curve

A.2 Estimation of plateau to valley transition Determine the asymptotes of the conic section (lines designated “a” in figure A.1). Bisect the asymptotes with a line (line designated “b” in figure A.1). The intersection of this line with the conic section serves as an initial estimate of the plateau to valley transition [see a) in figure A.2].

NOTE Graphically the bisector line may appear to be at an improper angle (see figure A.1). This is because of the different scaling of the two axis on figure A.1. See also clause A.4 and annex D for the normalized material probability curve, where the bisector line appears consistent.