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**Geometrical Product Specifications
(GPS)—Surface texture :
Profile method—
Nominal characteristics of
contact (stylus) instruments**

ICS 17.040.20; 17.040.30

Descriptors : surface-roughness measurement, roughness (surface), smoothness
(surface), surface treatment

Reference number : JIS B 0651 : 2001 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by the Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law. Consequently **JIS B 0651 : 1996** is replaced with this Standard.

As the original International Standard does not contain descriptions on inspections, some part of the previous version of **JIS B 0651 : 1996** has been modified and attached as annex 3 (informative).

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Geometrical Product Specifications (GPS)— Surface texture : Profile method— Nominal characteristics of contact (stylus) instruments

Introduction This Japanese Industrial Standard has been prepared based on **ISO 3274 Geometrical Product Specifications (GPS)—Surface texture : Profile method—Nominal characteristics of contact (stylus) instruments** published in 1996 without modifying the technical contents.

This Standard is a Geometrical Product Specification (GPS) standard and is to be regarded as a General GPS standard (see **TR B 0007**). It influences chain link 5 of the chain of standards for roughness profile, waviness profile and primary profile.

For more detailed information of the relation of this Standard to other standards and the GPS matrix model, see annex C.

Filters for profile meters according to **ISO 3274 : 1975** were realized as a series connection of two analog RC filters. This led to considerable phase shifts in the transition of the profile and therefore to asymmetrical profile distortions. The influence of this distortion on the parameters R_a and R_z are normally negligible if the sampling lengths (cut-off wavelength) according to **ISO 4288 : 1985** are used. Therefore, analog instruments according to **ISO 3274 : 1975** or instruments using 2RC filters may be used for assessment of R_a and R_z (see annex A). However, for other parameters the distortion is relevant.

As the original International Standard does not contain description on inspections, some part of the previous version of **JIS B 0651 : 1996** has been modified and attached as annex 3 (informative).

The portions sidelined or underlined with dots in this Standard are the matters not stated in the original International Standard.

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

1 Scope This Standard defines profiles and the general structure of contact (stylus) instruments for measuring surface roughness and waviness, enabling existing International Standards to be applied to practical profile evaluation. It specifies the properties of the instrument which influence profile evaluation and it provides the basics of the specification of contact (stylus) instruments (profile meter and profile recorder).

- Notes
- 1 A data sheet dealing with characteristics of contact (stylus) instruments to be completed by the instrument makers is under preparation and will be introduced in a future standard on calibration procedures.
 - 2 The relationships between the waviness cut-off λ_f , tip radius and waviness cut-off ratio are under consideration and will be added to this Standard as an amendment.
 - 3 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 3274 : 1996 *Geometrical Product Specifications (GPS)—Surface texture : Profile method—Nominal characteristics of contact (stylus) instruments (IDT)*

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 publication 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 0633 *Geometrical Product Specifications (GPS)—Surface texture : Profile method—Rules and procedures for the assessment of surface texture*

Remarks : **ISO 4288** : 1996 *Geometrical Product Specifications (GPS)—Surface texture : Profile method—Rules and procedures for the assessment of surface texture* is identical with the said standard.

JIS B 0632 *Geometrical Product Specification (GPS)—Surface texture : Profile method—Metrological characteristics of phase correct filters*

Remarks : **ISO 11562** : 1996 *Geometrical Product Specifications (GPS)—Surface texture : Profile method—Metrological characterization of phase correct filters* is identical with the said standard.

JIS B 0631 *Geometrical Product Specification (GPS)—Surface texture : Profile method—Motif parameters*

Remarks : **ISO 12085** : 1996 *Geometrical Product Specifications (GPS)—Surface texture : Profile method—Motif parameters* is identical with the said standard.

ISO 5436 : 1985 *Calibration specimens—Stylus instruments—Types, calibration and use of specimens*

ISO 13565-1 : 1996 *Geometrical Product Specifications (GPS)—Surface texture : Profile method ; Surfaces having stratified functional properties—Part 1 : Filtering and general measurement conditions*

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*

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*

Information : As **ISO 13565-3** was published in 1998 after the publication of **ISO 3274 : 1996**, the publication year was added.

3 Definitions For the purposes of this Standard, the following definitions apply.

3.1 Profiles

Information : “Profile” is a generic term for total profile, primary profile, roughness profile and waviness profile.

3.1.1 traced profile Locus of the centre of a stylus tip which features an ideal geometrical form (conical with spherical tip) and nominal dimensions with nominal tracing force, as it traverses the surface within the intersection plane.

Note : This is the profile from which all other profiles defined in this Standard are derived.

3.1.2 reference profile Trace on which the probe is moved within the intersection plane along the guide.

Note : The shape of the reference profile is the practical realization of a theoretical exact profile. Its nominal deviations depend on the deviations of the guide as well as on external and internal disturbances.

3.1.3 total profile Digital form of the traced profile relative to the reference profile, with the vertical and horizontal coordinates assigned to each other.

Note : The total profile is characterized by the vertical and horizontal digital steps.

3.1.4 primary profile Total profile after application of the short wavelength filter, λ_s .

Notes 1 The primary profile represents the basis for digital profile processing by means of a profile filter and calculation of the profile parameters according to **JIS B 0601**. It is characterized by the vertical and horizontal digital steps which may be different from those of the total profile.

2 The best fit least squares form of the type indicated in the specification is not part of the primary profile and should be excluded before filters are applied. For a circle, the radius should also be included in the least squares optimization and not held fixed to the nominal value.

3 The nominal form is removed before the primary profile is obtained.

Information : The meaning of “the radius should also be included in the least mean squares optimization” is to determine the radius itself of the circle by the best fit least squares.

3.1.5 residual profile Primary profile obtained by tracing an ideally smooth and flat surface (optical flat).

Note : The residual profile is composed of the deviations of the guide, external and internal disturbances, as well as deviations in profile transmission (see 3.4.16). The determination of the causes of the deviations is not normally possible without special equipment and a suitable environment.

3.2 stylus instrument Measuring instrument which explores surfaces with a stylus and acquires deviations in the form of a surface profile, calculates parameters and can record the profile (see figure 1).

Note : The diagram as shown represents only the essential operators required in a theoretically exact measuring system. The specific inter-relationship of operators may be subject to design considerations. Therefore figure 1 should not be considered as the only form of theoretically exact configuration.

3.2.1 displacement sensitive, digitally storing stylus instrument Stylus instrument whose profile presentation contains deviations including long-wave components and set-up deviations.

Note : The profile is digitally stored and, if filtered, is phase-correct filtered. Parameters are digitally calculated and the profile is recorded by means of a graphics system excluding deformation.

3.3 Stylus instrument components

3.3.1 measurement loop Closed chain which comprises all mechanical components connecting workpiece and the stylus tip, e.g. positioning means, workholding fixture, measuring stand, drive unit, probe (pick-up). (See figure 2).

3.3.2 reference guide Component which generates the intersection plane and guides the probe in it on a theoretically exact geometrical trace (reference profile), generally in a straight line.

Note : The guide is an essential part of the drive unit; it can be partially included in the probe. For the use of skids, see annex A.

3.3.3 drive unit Component which moves the probe along the reference guide and transmits the horizontal position of the stylus tip in the form of a horizontal profile coordinate.

Note : Drive units are characterized by the longest selectable tracing length.

3.3.4 probe (pick-up) Component which contains the tracing element with the stylus tip and the transducer.

3.3.5 tracing element Element which transmits the stylus tip displacement to the transducer.

3.3.6 stylus tip Element which consists of a nominally right, circular cone of defined cone angle and of a nominally spherical tip of defined radius.

Note : It is a very important element in profile acquisition when employing stylus instruments.

3.3.7 transducer Device which converts the vertical coordinates of the traced profile referred to the reference profile into the signal form used in the instrument.

Note : The transducer does not cause an intentional profile modification.