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

Part 601: Nominal characteristics of contact (stylus) instruments

Spécification géométrique des produits (GPS) — État de surface: Surfacique —
Partie 601: Caractéristiques nominales des instruments à contact (à palpeur)

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 25178-601 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

ISO 25178 consists of the following parts, under the general title *Geometrical product specifications (GPS) — Surface texture: Areal*:

— *Part 2: Terms, definitions and surface texture parameters*

— *Part 3: Specification operators*

— *Part 6: Classification of methods for measuring surface texture*

— *Part 7: Software measurement standards*

— *Part 601: Nominal characteristics of contact (stylus) instruments*

— *Part 602: Nominal characteristics of non-contact (confocal chromatic probe) instruments*

— *Part 603: Nominal characteristics of non-contact (phase-shifting interferometric microscopy) instruments*

— *Part 701: Calibration and measurement standards for contact (stylus) instruments*

The following parts are under preparation:

— *Part 604: Nominal characteristics of non-contact (coherence scanning interferometry) instruments*

— *Part 605: Nominal characteristics of non-contact (point autofocusing) instruments*

Introduction

This part of ISO 25178 is a geometrical product specification standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain link 5 of the chain of standards on roughness profile, waviness profile, primary profile and areal surface texture.

For more detailed information of the relation of this standard to the GPS matrix model, see Annex C.

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

Part 601: Nominal characteristics of contact (stylus) instruments

1 Scope

This part of ISO 25178 defines the metrological characteristics of contact (stylus) areal surface texture measuring instruments.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the cited editions apply. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3274:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 10360-1, *Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) — Part 1: Vocabulary*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3274, ISO 4287, ISO 10360-1 and ISO/IEC Guide 99 and the following apply.

3.1 General terms and definitions

3.1.1
coordinate system of the instrument
right hand orthonormal system of axes (X,Y,Z) defined as:

— (X,Y) is the plane established by the areal reference guide of the instrument;

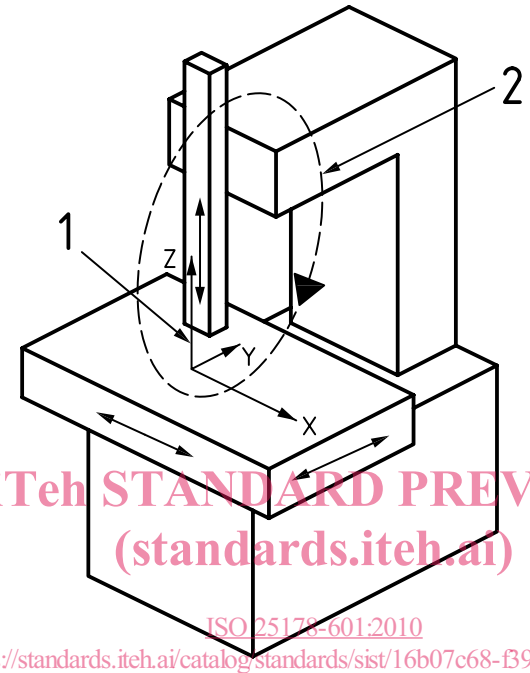
— Z-axis is in the plane of the stylus trajectory and is perpendicular to the (X,Y) plane (see Figure 1)

NOTE Normally, the X-axis is the tracing direction and the Y-axis is the stepping axis.

3.1.2
measurement loop
closed chain which comprises all components connecting workpiece and the stylus tip, e.g. the means of positioning, the workholding fixture, the measuring stand, the drive unit, the probing system (pick-up)

See Figure 1.

NOTE The measurement loop will be subjected to external and internal disturbances which influence the measurement uncertainty.



Key
1 coordinate system of the instrument
2 measurement loop

Figure 1 — Coordinate system and measurement loop of the instrument

3.1.3
user adjustment
⟨of a measuring instrument⟩ adjustment employing only the means available to the user

NOTE This is an operation normally carried out by the user. It involves the use of a material measure, usually supplied with the instrument. The result of this operation automatically or manually adjusts certain parameters in order that the instrument operates correctly.

3.1.4
residual correction error
difference between the value of a quantity obtained after correcting the systematic error and the real value of this quantity

NOTE The residual error is composed of random errors and uncorrected systematic errors.

3.2 Terms and definitions relative to lateral scanning system

3.2.1
lateral scanning system
system that performs the scanning of the surface to be measured in the (X,Y) plane

NOTE Typically, the lateral scanning system is composed of the **drive unit X** (3.2.3) and **drive unit Y** (3.2.4).

3.2.2
areal reference guide
component of the instrument that generates the reference surface, in which the **probing system** (3.3.1) moves relative to the surface being measured according to a theoretically exact trajectory

NOTE In the case of areal surface texture measuring instruments, the reference guide establishes a reference surface (see ISO 25178-2). It can be achieved through the use of two perpendicular reference guides (see ISO 3274:1996, 3.3.2) or one reference surface guide.

3.2.3
drive unit X
component of the instrument that moves the **probing system** (3.3.1) or the surface to be measured along the reference guide on the X-axis and provides the horizontal position of the stylus tip in terms of the lateral X coordinate of the profile

3.2.4
drive unit Y
component of the instrument that moves the **probing system** (3.3.1) or the surface to be measured along the reference guide on the Y-axis and provides the horizontal position of the stylus tip in terms of the lateral Y coordinate of the profile

3.2.5
lateral position sensor
component of the drive unit that provides the lateral position of the pivot

NOTE 1 See Figure 2 for the definition of the pivot.

NOTE 2 The lateral position can be measured using, for example, a linear encoder, a laser interferometer, or a counting device coupled with a micrometer screw.

3.3 Terms and definitions relative to the probing system

3.3.1
probing system
⟨surface texture⟩ component of the instrument consisting of the **stylus** (3.3.4), the pivot, the **probe** (3.3.2) and the **digitizing system** (3.3.3)

NOTE 1 The axis of rotation around the pivot is parallel to the Y axis.

NOTE 2 The probing system is commonly called a “pick up”.

3.3.2
probe
⟨surface texture⟩ device that converts the height into a signal during measurement

NOTE In earlier standards this was termed a “transducer”.

3.3.3
digitizing system
device which converts analogue signals into digital ones

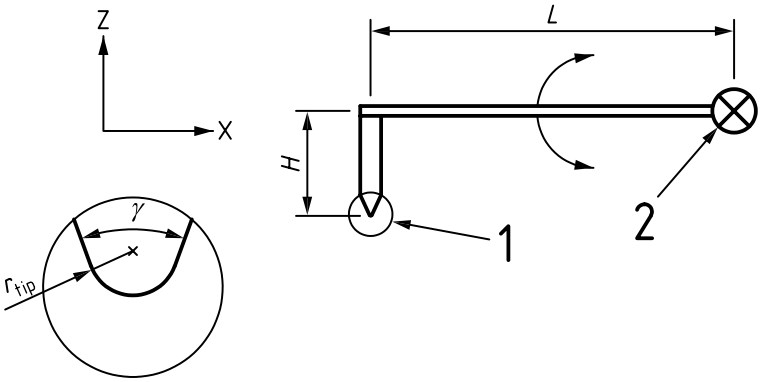
NOTE 1 The digital signal as a function of the x and y coordinates forms the extracted mechanical surface.

NOTE 2 The digitizing system should not cause any intentional surface modification.

NOTE 3 In a typical system, the digitizing system is usually an analogue to digital converter.

3.3.4
stylus
mechanical device consisting of a tip and an arm

NOTE The typical stylus is shown in Figure 2.



Key

1	stylus tip	H	height of the stylus
2	pivot	r_{tip}	radius of the tip
L	length of the arm	γ	cone angle of the tip

NOTE The above design is the most common. Other designs are also used, e.g. flexures, linear probes, etc.

Figure 2 — Characterization of the typical stylus

3.3.5
error due to arcuate motion
vector error generated by the rotation of the **stylus** (3.3.4) around the pivot

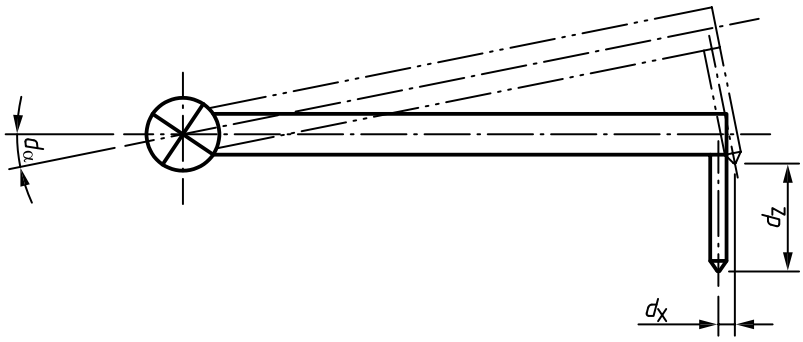
See Figure 3.

NOTE 1 The vector error consists of a lateral and horizontal component.

NOTE 2 The arcuate motion generates an error of the measured profile.

NOTE 3 The horizontal error which results from the arcuate motion is a function of the vertical displacement and may be neglected depending on the required accuracy.

NOTE 4 The probe only measures one quantity (typically Z or the angle of the stylus arm) which does not give enough information for the assessment of both X and Z quantities. The knowledge of the stylus geometry and either X or Z quantity allows this assessment by using a mathematical adjustment.



Key

d_α rotation angle around the pivot
d_X horizontal error function of d_Z and stylus geometry
d_Z vertical displacement

Figure 3 — Arcuate motion

3.4 Metrological characteristics of the instrument

3.4.1
measuring volume
range of the instrument stated in terms of the limits on all three coordinates measured by the instrument

NOTE For areal surface texture measuring instruments, the measuring volume is defined by

— the measuring range of the **drive unit X** (3.2.3) and the **drive unit Y** (3.2.4),

— the measuring range of the **probing system** (3.3.1).

3.4.2
response curve
F_x, F_y, F_z
graphical representation of the function that describes the relation between the actual quantity and the measured quantity

See Figure 4.

NOTE 1 An actual quantity in X (respectively Y or Z) corresponds to a measured quantity x_m (respectively y_m or z_m).

NOTE 2 The response curve can be used for adjustments and error corrections.

3.4.3
amplification coefficient
α_x, α_y, α_z
slope of the linear regression curve obtained from the **response curve** (3.4.2)

See Figure 5.

NOTE 1 There will be amplification coefficients applicable to the X, Y and Z quantities.

NOTE 2 The ideal response is a straight line with a slope equal to 1 which means that the values of the measurand are equal to the values of the input quantities.