International Standard

# ISO 25178-601

Second edition
2025-02

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

## Part 601:
## Design and characteristics of contact (stylus) instruments

*Spécification géométrique des produits (GPS) — État de surface: Surfacique —*

*Partie 601: Conception et caractéristiques des instruments à contact (palpeur)*

Reference number
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# Foreword

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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 second edition cancels and replaces the first edition (ISO 25178-601:2010), which has been technically revised, and cancels and replaces ISO 3274:1996, whose contents have been revised and incorporated into this document and others, see Annex C for more information.

The main changes are as follows:

— removal of information about the general metrological characteristics for the areal topography measuring method, which are specified in ISO 25178-600;

— removal of the terms and definitions now specified in ISO 25178-600;

— revision of all terms and definitions for clarity and consistency with other ISO standards documents;

— addition of Clause 4 for instrument requirements, which summarizes normative features and characteristics;

— addition of an information flow concept diagram in Clause 4;

— addition of Clause 5 on metrological characteristics;

— addition of Clause 6 on design features, which clarifies the types of instruments relevant to this document;

— revision of Annex A describing the principles of instruments addressed by this document;

— addition of Annex B on the metrological characteristics and influence quantities; replacement of the normative table of influence quantities with an informative description of common error sources and how these relate to the metrological characteristics in ISO 25178-600;

— inclusion of nominal characteristics of a contact stylus instrument, which have been transferred from ISO 3274 to this document.

A list of all parts in the ISO 25178 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 F of the chains of standards on profile and areal 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 on the relation of this document to other standards and the GPS matrix model, see Annex D.

This document includes terms and definitions relevant to contact stylus instruments for the measurement of areal surface topography. Annex A briefly summarizes contact stylus instruments and methods to clarify the definitions and to provide a foundation for Annex B, which describes common sources of uncertainty and their relation to the metrological characteristics of contact stylus instruments.

The stylus instrument for the profile method was previously defined in ISO 3274. Based on this, this document was published in 2010. Since this is the more modern instrument standard and stylus instruments for the profile method and the areal method differ only in the presence of a *y*-axis (drive unit *y*), this edition of this document replaces not only the previous version of ISO 25178-601 but also ISO 3274:1996 (and the Technical Corrigendum of 1998), see Annex C for more details.

NOTE Portions of this document, particularly the informative sections, describe patented systems and methods. This information is provided only to assist users in understanding the operating principles of contact stylus instruments. This document is not intended to establish priority for any intellectual property, nor does it imply a license to proprietary technologies described herein.

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

# Part 601: Design and characteristics of contact (stylus) instruments

## 1 Scope

This document specifies the design, metrological characteristics and nominal characteristics of contact stylus instruments for the areal measurement of surface topography. Because surface profiles can be extracted from areal surface topography data, the methods described in this document are also applicable to profiling measurements.

## 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 25178-600, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 600: Metrological characteristics for areal topography measuring methods*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 25178-600 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**contact stylus instrument**
measuring instrument that explores surfaces using a *stylus* (3.5) that physically moves along the surface to acquire a representation of the surface and provide the data for further computation (analytics)

Note 1 to entry: The method of using a contact stylus instrument is defined in ISO 25178-6, and is called "contact stylus scanning".

Note 2 to entry: See Figure 2 for an information flow concept diagram for a contact stylus instrument.

**3.2**
**probing system**
<surface texture> component of the instrument consisting of a *probe* (3.3), a *stylus* (3.5) and an optional *stylus changing interface* (3.7)

Note 1 to entry: See Figures A.2 to A.4 for examples of probing systems.

**3.3**
**probe**
<surface texture> device that generates the signals during *scanning* (3.4)

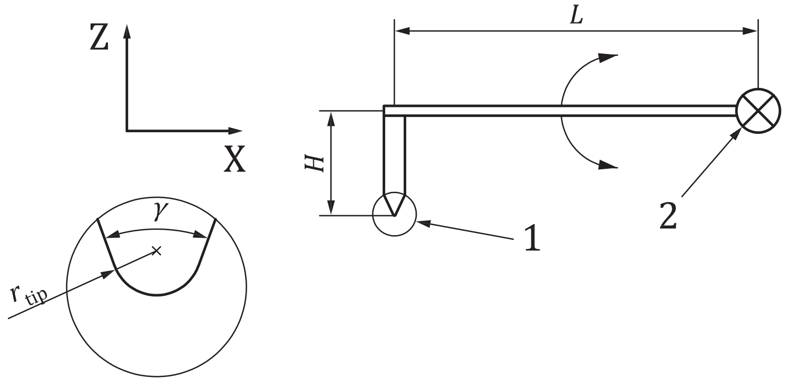
Note 1 to entry: In earlier standards, “transducer” was a separate term and a part of the probe.

**3.4**
**scanning**
<surface texture> moving the *probe* (3.3) over the surface to be measured while the *stylus tip* (3.6) contacts the surface

**3.5**
**stylus**
<surface texture> mechanical device consisting of a *stylus tip* (3.6) and a *probe* (3.3) arm

Note 1 to entry: For coordinate measuring machines, the term “shaft” is used instead of “probe arm”, see ISO 10360-1:2000, 4.1.

Note 2 to entry: A typical stylus is shown in Figure 1. Other designs are also used, e.g. flexures, linear probes.




**Key**

| | | | |
|---|---|---|---|
| 1 | stylus tip | *H* | height of the probe arm |
| 2 | pivot | $r_{tip}$ | tip radius |
| *L* | length of the probe arm | γ | cone angle of the tip |

**Figure 1 — Characterization of the typical stylus**

**3.6**
**stylus tip**
<surface texture> element that consists of a nominally right circular cone of defined cone angle and of a nominally spherical tip of defined radius

**3.7**
**stylus changing interface**
<surface texture> element that enables the change of the *stylus* (3.5)

Note 1 to entry: There are *probing systems* (3.2) without a stylus changing interface.

**3.8**
**linear reference guide**
component of the instrument that generates the intersection plane and the reference profile, in which the *probing system* (3.2) moves relative to the surface being measured according to a theoretically exact trajectory

**3.9**
**areal reference guide**
component(s) of the instrument that generate(s) the reference surface, in which the *probing system* (3.2) moves relative to the surface being measured according to a theoretically exact trajectory

Note 1 to entry: In the case of *x*- and *y*-scanning areal surface texture measuring instruments, the areal reference guide establishes a reference surface (see ISO 25178-2:2021, 3.1.10).

Note 2 to entry: The areal reference guide can be achieved through the use of two perpendicular *linear reference guides* (3.8) or one reference surface guide.

[SOURCE: ISO 25178-600:2019, 3.2.1, modified — Note 1 to entry has been modified and Note 2 to entry has been added.]

**3.10**
**lateral scanning system**
system that performs the *scanning* (3.4) of the surface to be measured in the ($x$, $y$) plane

Note 1 to entry: There are essentially four components to a surface texture scanning instrument system: the *x*-axis drive, the *y*-axis drive, the *z*-measurement *probe* (3.3) and the surface to be measured.

[SOURCE: ISO 25178-600:2019, 3.2.2. modified — Note 2 to entry has been deleted.]

**3.11**
**drive unit *x***
component of the instrument that moves the *probing system* (3.2) or the surface being measured along the reference guide on the *x*-axis and returns the horizontal position of the measured point in terms of the lateral *x*-coordinate

[SOURCE: ISO 25178-600:2019, 3.2.3, modified — "*x*-drive unit" has been replaced by "drive unit *x*" as the term and "of the profile" has been deleted from the definition. Note 1 to entry has been deleted.]

**3.12**
**drive unit *y***
component of the instrument that moves the *probing system* (3.2) or the surface being measured along the reference guide on the *y*-axis and returns the horizontal position of the measured point in terms of the lateral *y*-coordinate

[SOURCE: ISO 25178-600:2019, 3.2.3, modified — "*x*-drive unit" has been replaced by "drive unit *y*" as the term, "*x*-axis" has been replaced by "*y*-axis", " *x*-coordinate" has been replaced by "*y*-coordinate" and "of the profile" has been deleted from the definition. Note 1 to entry has been deleted.]

**3.13**
**lateral position sensor**
component of the drive unit that provides the lateral position of the measured point

Note 1 to entry: The lateral position is customarily measured or inferred by using, for example, a linear encoder, a laser interferometer or a rotary encoder coupled with a micrometer screw.

[SOURCE: ISO 25178-600:2019, 3.2.4]

**3.14**
**critical dynamic of the probing system**
$v_{\mathrm{dyn,c}}$
maximum value of the *scanning* (3.4) speed above which the output signal is distorted

Note 1 to entry: : The critical dynamic of the probing system depends on the mechanical inertia of the moving parts and the surface to be measured.

Note 2 to entry: Below the critical dynamic of the probing system, a range of measurement speeds is generally acceptable.

## 4 Instrument requirements

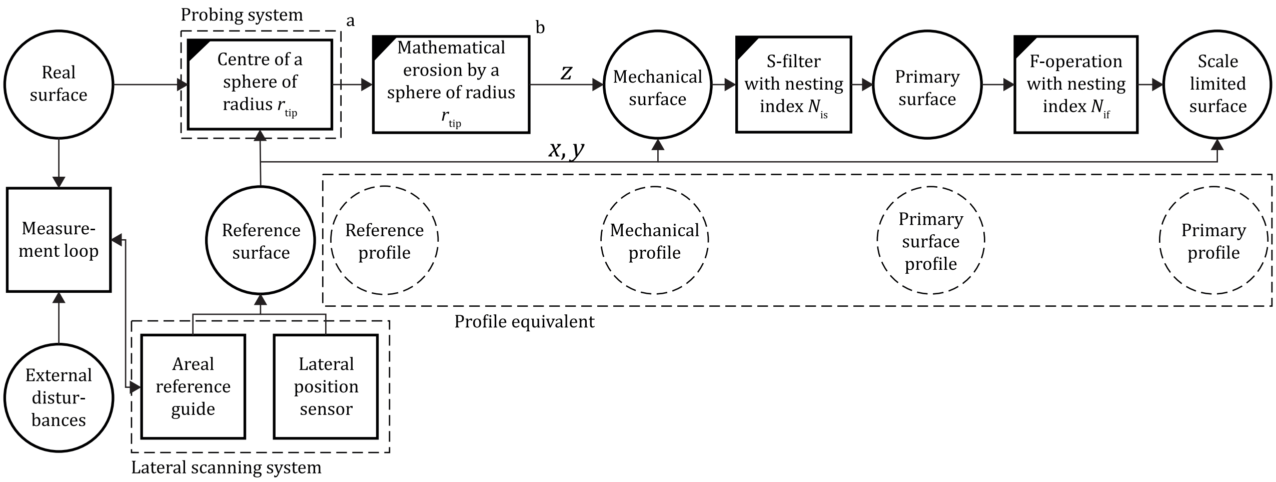
To perform surface topography measurements of a sample surface according to the method of contact stylus scanning, a contact stylus instrument shall be used.

The instrument shall comprise a probing system, an areal reference guide, a lateral scanning system, a drive unit *x*, a drive unit *y*, and a lateral position sensor.

NOTE In instruments for profiling measurements, the drive unit *y* is optional and the areal reference guide can be replaced by a linear reference guide.

The instrument shall acquire data by moving the stylus tip in contact over the surface and generating height data relative to the areal reference guide.

Figure 2 shows the information flow between these elements for a contact stylus instrument, from the real surface to a scale-limited surface. Example contact stylus instrument hardware, techniques and error sources are given in Annexes A and B.




**Key**

| | |
|---|---|
| (circle) | measurand (surface or profile) |
| (box with marked corner) | operator with intended modification |
| (box) | operator without intended modification |
| a | This acts as a “dilation” operator. |
| b | In the profile method, the erosion is performed by a circular disk. |

NOTE The sequence of the “dilation” and “erosion” operators represents a morphological closing filter.

**Figure 2 — Information flow concept diagram for a contact stylus instrument**

## 5 Metrological characteristics

The standard metrological characteristics for areal surface texture measuring instruments are listed and explained in ISO 25178-600. Additional metrological characteristics or error sources for an instrument, or both, according to this document consist of stylus tip, areal reference guide, lateral scanning system, drive unit *x*, drive unit *y*, and lateral position sensor. All shall be considered when designing and calibrating the instrument.

Annex B describes sources of measurement error that can influence the calibration result.

# 6 Design features

## 6.1 General

Standard design features described in ISO 25178-600 shall be considered in the design.

Annex A provides examples of specific design features of contact stylus instruments.

## 6.2 Nominal values for characteristics of a contact stylus instrument

### 6.2.1 Stylus tip geometry

The ideal stylus shape is a cone with a spherical tip.

The nominal dimensions are as follows:

— tip radius: $r_{\text{tip}}$ = 2 µm, 5 µm, 10 µm;

— cone angle: $\gamma$ = 60°, 90°.

If not otherwise specified for the “ideal” instrument, a cone angle of 60° applies.

### 6.2.2 Static measuring force

The nominal value of the static measuring force at mean position of the stylus is 0,000 75 N.

The nominal rate of change of measuring force is 0 N/m.

# 7 General information

The relationship between this document and the GPS matrix model is given in Annex D.

# Annex A
(informative)

# Principles of contact stylus instruments for areal surface topography measurement

## A.1 General

Contact stylus instruments are based on mature technology and there are substantial resources in the published literature regarding instrument design and theory of operation.[16][17][18][19][20] Additional information can also be found in the bibliography of ISO 25178-6.

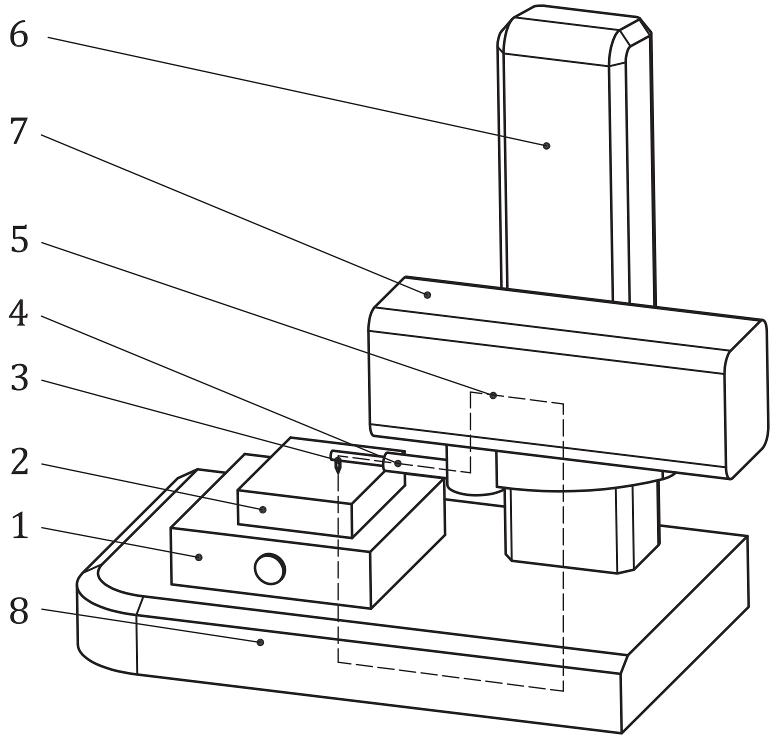
This annex provides a summary with the goal of clarifying terms and definitions as well as some of the influence quantities that contribute to the metrological characteristics of contact stylus instruments.

## A.2 Instrument design

The main components of contact stylus instruments are the lateral scanning system including the reference guide, the probing system and the software [mathematical erosion by a sphere (areal case) or a circular disc (profile case) of radius $r_{tip}$, S-filter, F-operation and compensations of systematic errors].

The coordinate system and the measurement loop of a contact stylus instrument for areal surface topography measurements are given in ISO 25178-600.

The widely used stylus instruments for profiling measurement are a subgroup of the contact stylus instruments for areal surface topography measurement. Figure A.1 shows an example of a contact stylus instrument for profiling measurement.

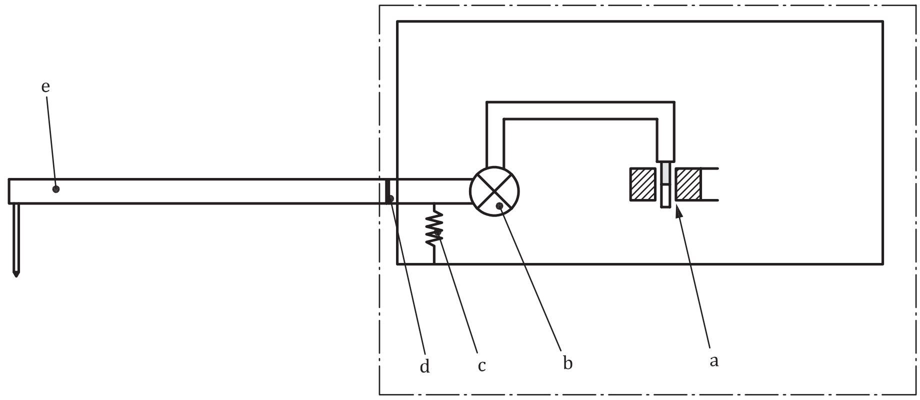



**Key**

| | |
|---|---|
| 1 | fixture |
| 2 | workpiece |
| 3 | stylus |
| 4 | probe |
| 5 | measurement loop |
| 6 | column |
| 7 | drive unit x |
| 8 | base |

**Figure A.1 — Example of a contact stylus instrument for profiling measurement**

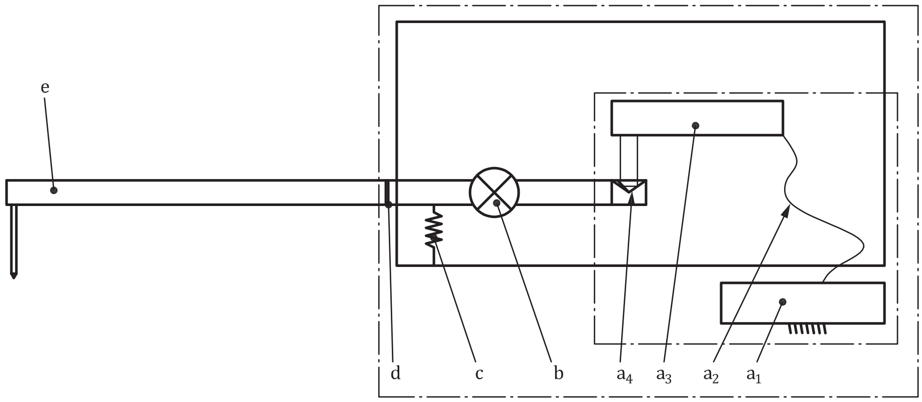
There are various designs for the probing system. Figures A.2 to A.4 show the different basic concepts.




**Key**

| | |
|---|---|
| a | inductive probe |
| b | pivot |
| c | measuring force generation |
| d | stylus changing interface |
| e | stylus |

**Figure A.2 — Example of an inductive probing system**




**Key**

$a_1$ laser

$a_2$ optical fiber

$a_3$ interferometer optics

$a_4$ retroreflector

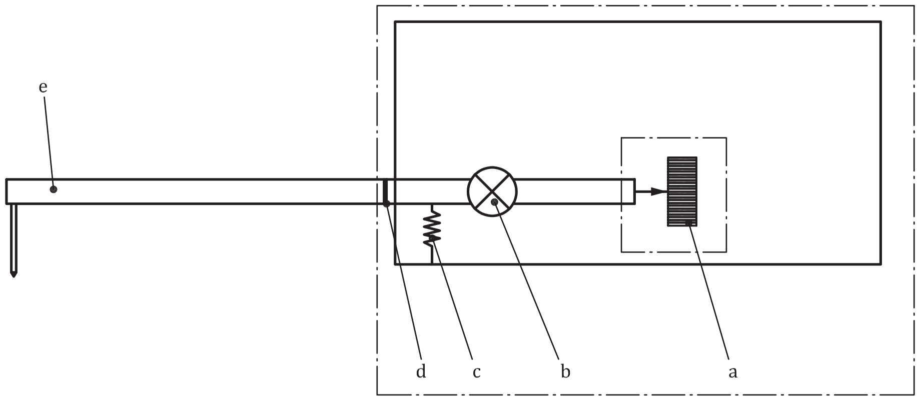
b pivot

c measuring force generation

d stylus changing interface

e stylus

**Figure A.3 — Example of an interferometric probing system**




**Key**

a scale system

b pivot

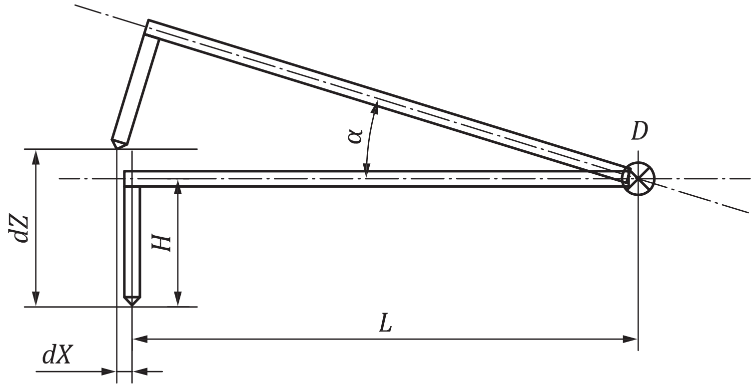
c measuring force generation

d stylus changing interface

e stylus

**Figure A.4 — Example of a scale probing system**

In all designs of the probing system according to Figures A.2 to A.4, the stylus tip does not move purely vertically, but it moves along an arc called “arcuate motion”, see Figure A.5.




**Key**

| | |
|---|---|
| $D$ | pivot |
| $\alpha$ | angular deflection of the stylus |
| $L$ | length of the probe arm |
| $H$ | height of the probe arm |
| $dX$ | displacement of the stylus tip in the $x$-direction according to the deflection $\alpha$ |
| $dZ$ | displacement of the stylus tip in the $z$-direction according to the deflection $\alpha$ |

**Figure A.5 — Arcuate motion of a stylus**

In a contact stylus instrument with a typical roughness probing system that cannot measure contour due to its limited vertical measuring range, usually only small deflections of the stylus occur. In this case, the distortion due to the arcuate motion of the stylus is small and can be neglected.

In a contact stylus instrument with a probing system capable of measuring contour and roughness simultaneously, the arcuate motion of the stylus shall be considered when detecting the surface.

## A.3 Measurement process

A typical areal surface texture measuring instrument uses the following measurement process (see Figure A.6).

— The probing system performs profile acquisition through continuous measurement along the $x$-axis over a length $l$x.

— After the profile has been measured, the probing system returns to its starting position.

— The perpendicular drive unit (along the $y$-axis) steps by one sampling distance along the $y$-axis.

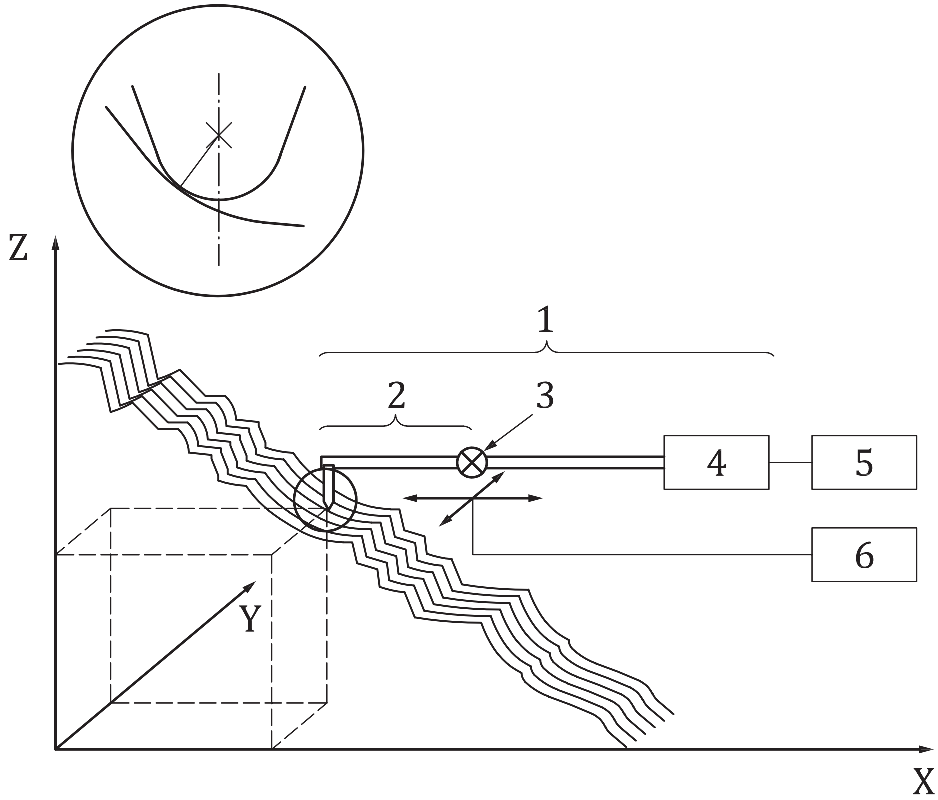
— The above three steps are repeated until the measurement is completed.

— The extracted surface is then obtained. It contains $n$ profiles separated from each other by the $y$ sampling distance, each profile containing $m$ points separated by the $x$ sampling distance.

It is also possible to perform the measurement without returning the probe back to the starting position after each profile. The next profile can be scanned in the opposite direction compared to the previous scan. In this case, it is recommended to check that the repositioning hysteresis is compatible with the acceptable measurement uncertainty. Nevertheless, a typical probing system is generally designed for measuring in only one direction.

Recommendations for choosing evaluation areas and sampling distances are found in ISO 25178-3.

NOTE The terms “sampling interval” and “sampling distance” are used synonymously.




**Key**

| | | | |
|---|---|---|---|
| 1 | probing system | 4 | probe |
| 2 | stylus | 5 | signal processing |
| 3 | pivot | 6 | drive units (including areal reference guide and lateral position sensors) |

NOTE 1 The contact point can occur at any position on the spherical portion of the stylus tip.

NOTE 2 The measurement of the surface using a sphere is equivalent to applying a morphological operation as defined in ISO 16610-40.

**Figure A.6 — Visualization of the scanning**

# Annex B
(informative)

# Sources of measurement error for contact stylus instruments

## B.1 Metrological characteristics and influence quantities

ISO 25178-600 defines a specific set of metrological characteristics for areal surface topography measuring instruments. These metrological characteristics capture influence quantities, factors that can influence a measurement result and can be propagated through an appropriate measurement model to evaluate measurement uncertainty.[21] See ISO 25178-700 and ISO 12179 for methods for calibration, adjustment and verification of the metrological characteristics.

In this annex, influence quantities are described that affect the metrological characteristics. Knowledge of these influence quantities is not needed for uncertainty analysis if it is feasible to perform a direct calibration of the corresponding metrological characteristics. However, knowledge of influence quantities can be useful for optimizing measurements and minimizing sources of error.

Table B.1 summarizes the influence quantities discussed in this annex.

**Table B.1 — Summary of influence quantities and related metrological characteristics**

| Item | Influence quantity | Relevant metrological characteristic | |
|---|---|---|---|
| B.2 | Stylus tip | $W_l$<br>$D_{LIM}$<br>$\Phi_{MS}$<br>$T_{FI}$ | width limit for full height transmission<br>lateral period limit<br>maximum measurable local slope<br>topography fidelity |
| B.3 | Probing system | $\alpha_z$<br>$l_z$<br>$z_{HYS}$ | amplification coefficient<br>linearity deviation<br>hysteresis |
| B.4 | Areal reference guide | $z_{FLT}$ | flatness deviation |
| B.5 | Drive unit *x*, drive unit *y* | $N_I$ | instrument noise |
| B.6 | Lateral position sensor | $\alpha_x$, $\alpha_y$<br>$l_x$, $l_y$<br>$x_{HYS}$<br>$y_{HYS}$ | amplification coefficient<br>linearity deviation<br>hysteresis<br>hysteresis |

## B.2 Stylus tip

Diamond probe tips with a nominal cone angle of 60° and a tip radius of 2 µm are widely used. A probe tip with a larger cone angle and larger tip radius can be more durable but is less able to detect the finest profile structures. The cone angle of the stylus tip and the inclination of the workpiece relative to the *x*-axis determine the greatest local slope of a surface feature that can be assessed with the probing system.

The smaller the tip radius, the higher the Hertzian contact pressure, is due to the measuring force with which the probe tip contacts the workpiece which can lead to scratches or incorrect results in the case of surfaces with varying hardness.

NOTE In the representation of a topography or profile, the magnification in the *z*-direction is usually much higher than in the *x*- and *y*-direction; if the probe tip radius is represented in the same way, the probe tip is not a sphere or circle, but an ellipsoid or an ellipse, respectively.

The stylus tip is an influence quantity for:

— the width limit for full height transmission $W_\mathrm{I}$ (defined in ISO 25178-600:2019, 3.1.23);

— lateral period limit $D_\mathrm{LIM}$ (defined in ISO 25178-600:2019, 3.1.21);

— the maximum measurable local slope $\Phi_\mathrm{MS}$ (defined in ISO 25178-600:2019, 3.1.24);

— the topography fidelity $T_\mathrm{FI}$ (defined in ISO 25178-600:2019, 3.1.26).

## B.3 Probing system

There are different designs of the probing system (for examples, see Figures A.2 to A.4). Each has an individual transfer function. Regardless of the design of the probing system, whether a pivot, a flexure or a linear system is used, hysteresis can occur in the $z$-direction during signal generation.

The critical dynamic of the probing system is important for optimizing the scanning speed. It depends on both, the design of the probing system and the scanning speed at which the surface is measured. The critical dynamic can be estimated by repeating a measurement at different scanning speeds: It is reached when the output signal is noticeably distorted when the measuring speed is increased further.

The probing system is an influence quantity for the amplification coefficient $\alpha_z$ (defined in ISO 25178-600:2019, 3.1.10), the linearity deviation $l_z$ (defined in ISO 25178-600:2019, 3.1.11) and the hysteresis $z_\mathrm{HYS}$ (defined in ISO 25178-600:2019, 3.1.25).

## B.4 Areal reference guide

The areal reference guide is characterized by its flatness deviation. The flatness deviation causes a height component that is superimposed on the topography during scanning. If the areal reference guide consists of two reference guides perpendicular to each other (in $x$-direction and in $y$-direction), they can be characterized by the straightness deviation in $x$-direction and $y$-direction.

NOTE In instruments for profiling measurements, only the straightness deviation of reference guide in $x$-direction is relevant.

The areal reference guide is an influence quantity for the flatness deviation $z_\mathrm{FLT}$ (defined in ISO 25178-600:2019, 3.1.12).

## B.5 Drive unit *x*, drive unit *y*

The drive unit $x$ (respectively $y$) is an important component of the measurement loop. It generates the movement of the probing system but can possibly include some noise that is superimposed on the measurement signal.

The drive unit $x$ (respectively $y$) is an influence quantity for the instrument noise $N_\mathrm{I}$ (defined in ISO 25178-600:2019, 3.1.14).

## B.6 Lateral position sensor

The lateral position sensor $x$ (respectively $y$) is characterized by the response function $F_x$ (respectively $F_y$). Typically, hysteresis can occur during signal generation for the $x$-position (respectively the $y$-position).

The lateral position sensor $x$ (respectively $y$) is an influence quantity for the amplification coefficient $\alpha_x$ [respectively $\alpha_y$ (defined in ISO 25178-600:2019, 3.1.10)], the linearity deviation $l_x$ [respectively $l_y$ (defined in ISO 25178-600:2019, 3.1.11)] and the hysteresis $x_\mathrm{HYS}$ [respectively $y_\mathrm{HYS}$ (defined in ISO 25178-600:2019, 3.1.25)].

# Annex C
(informative)

# Background regarding changes from ISO 3274

Table C.1 shows the most important changes compared to ISO 3274, regarding the new profile standards.

**Table C.1 — Major changes from ISO 3274**

| Clause/subclause in ISO 3274:1996 | Explanation/comment | Appearance in this document |
|---|---|---|
| 3.1.1 traced profile,<br>3.1.3 total profile | At the time ISO 3274 was created, there was no general definition of the profile, so the profile was defined by the instrument. ISO 14406 introduced the terms “skin model (of a work piece)” and “mechanical surface”, and based on this, ISO 21920-2 introduced the terms “profile trace” and “mechanical profile”. | Not adopted, as not required. |
| 3.1.2 reference profile | The term “trace on which the probe is moved” is not needed anymore. | Not adopted, as not required. |
| 3.1.4 primary profile | Now defined in ISO 21920-2. | Not included. |
| 3.1.5 residual profile | The term “measurement noise” in ISO 25178-600:2019, 3.1.15, is a more general definition of this. | Not included. |
| 3.2.1 displacement sensitive, digitally storing stylus instruments | The wording in ISO 3274 is not easy to understand: “Stylus instruments whose profile presentation contains deviation including long-wave components and set-up deviations”. What is meant is that the probe provides a signal even in the case of static deflection from the zero line. In contrast, piezo probes, for example, provide only dynamic signals. | Not adopted, as all contact stylus instruments according to this document are deflection-sensitive, digitally storing stylus instrument. |
| 3.3.7 transducer<br>3.3.8 amplifier<br>3.3.9 analog-to-digital converter (ADC) | These terms are only applicable to certain designs of a probing system. | Not adopted, as not required. The definition of “probe” in this document is more general. |
| 3.4.4 hysteresis | Now defined in ISO 25178-600:2019, 3.1.25. | Not included. |
| 3.4.5 transmission function for sine waves | In ISO 25178-600:2019, 3.1.19 is replaced by the more general term “instrument transfer function”. | Not included. |
| 3.4.6 measuring range of the probe<br>3.4.7 measuring range of the instrument | In ISO 25178-600:2019, 3.1.8 is replaced by “measuring volume”. | Not adopted, as not required. |
| 3.4.8 quantization step of the ADC | This term is only applicable to certain designs of a probing system. In ISO 25178-600:2019, 3.1.18, the more general term “digitization step in $z$” is included. | Not adopted, as not required. |
| 3.4.9 instrument resolution | In ISO 25178-600:2019, 3.1.18 is replaced by “digitization step in z”. | Not included. |
| 3.4.10 range-to-resolution ratio | Not adopted in ISO 25178-600, as it is not generally required. | Not adopted, as not required. |
| 3.4.11 probe linearity deviation | In ISO 25178-600:2019, 3.1.11 “generalized”, is replaced by “linearity deviation $l_x$, $l_y$, $l_z$”. | Not included. |
| 3.4.12 short-wave transmission limitation | Now defined in ISO 21920-2 and the default $N_{is}$ values are specified in ISO 21920-3. | Not included. |

**Table C.1** *(continued)*

| Clause/subclause in ISO 3274:1996 | Explanation/comment | Appearance in this document |
|---|---|---|
| 3.4.13 vertical profile component transmission | In ISO 25178-600:2019, 3.1.9 "generalized", is replaced by "response function $F_x$, $F_y$, $F_z$". | See the path "$z$" in Figure 2. |
| 3.4.14 horizontal profile position transmission | In ISO 25178-600:2019, 3.1.9 "generalized", is replaced by "response function $F_x$, $F_y$, $F_z$". | See the path "$x$, $y$" in Figure 2. |
| 3.4.15 deviation of the horizontal position transmission | In ISO 25178-600:2019, 3.1.10 and 3.1.11 "generalized", is replaced by "amplification coefficient $\alpha_x$, $\alpha_y$, $\alpha_z$" and "linearity deviation $l_x$, $l_y$, $l_z$". | Not included. |
| 3.4.16 deviations of the profile transmission of the primary profile | In ISO 25178-600:2019, 3.1.9 "generalized", is replaced by "response function $F_x$, $F_y$, $F_z$". | Not included. |
| 3.4.17 zero point drift | In ISO 25178-600:2019, 3.1.16 "generalized", is replaced by "surface topography repeatability". | Not included. |
| 3.4.18 vertical linearity deviation | In ISO 25178-600:2019, 3.1.11 "generalized", is replaced by "linearity deviation $l_x$, $l_y$, $l_z$". | Not included. |
| 3.4.19 profile filter deviation | This is not specific to a contact stylus instrument. It is not included in ISO 25178-600. | Not adopted, not a part of this document. |
| 3.4.20 profile evaluation deviation | This is not specific to a contact stylus instrument. It is not included in ISO 25178-600. | Not adopted, not a part of this document. |
| 3.4.21 total deviation of the stylus instrument | In ISO 25178-600:2019, 3.1.26 "generalized", is replaced by "topography fidelity". There is the note: "When the concept of topography fidelity is applied to profiles, the term *profile fidelity* is sometimes used." | Not included. |
| 3.4.22 deviation of the profile recording | This is not specific to a contact stylus instrument. It is not included in ISO 25178-600. | Not adopted, as not required. |
| 4.3 Profile filter cut-off wavelength | The nominal values of the cut-off wavelengths ($N_{ic}$) are defined in ISO 21920-3. | Not included. |
| 4.4 Relationship between the roughness cut-off wavelength $\lambda_c$, tip radius and roughness cut-off ratio | Now specified in ISO 21920-3. | Not included. |

# Annex D
(informative)

# Relationship to the GPS matrix model

## D.1 General

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 specifications made in accordance with this document unless otherwise indicated.

## D.2 Information about this document and its use

This document specifies the methods, specific terminology and exemplary influence quantities for contact stylus instruments used to measure profile and areal surface texture.

## D.3 Position in the GPS matrix model

This document is a general ISO GPS standard which influences chain link F of the chains of standards on profile and areal surface texture in the GPS matrix model, as shown in Table D.1. The rules and principles given in this document apply to all segments of the ISO GPS matrix which are indicated with a filled dot (•).

**Table D.1 — Relationship to the ISO GPS matrix model**

| | Chain links | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| | Symbols and indications | Feature requirements | Feature properties | Conformance and non-conformance | Measurement | Measurement equipment | Calibration |
| Size | | | | | | | |
| Distance | | | | | | | |
| Form | | | | | | | |
| Orientation | | | | | | | |
| Location | | | | | | | |
| Run-out | | | | | | | |
| Profile surface texture | | | | | | • | |
| Areal surface texture | | | | | | • | |
| Surface imperfections | | | | | | | |

## D.4 Related International Standards

The related International Standards are those of the chains of standards indicated in Table D.1.

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[3] ISO 8015, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

[4] ISO 10360-1:2000, *Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) — Part 1: Vocabulary*

[5] ISO 12179, *Geometrical product specifications (GPS) — Surface texture: Profile method — Calibration of contact (stylus) instruments*

[6] ISO 14253-1, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for verifying conformity or nonconformity with specifications*

[7] ISO 14406, *Geometrical product specifications (GPS) — Extraction*

[8] ISO 14638, *Geometrical product specifications (GPS) — Matrix model*

[9] ISO 16610-40, *Geometrical product specifications (GPS) — Filtration — Part 40: Morphological profile filters: Basic concepts*

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

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

[12] ISO 25178-2:2021, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 2: Terms, definitions and surface texture parameters*

[13] ISO 25178-3, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 3: Specification operators*

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1) Withdrawn standard.

2) Withdrawn standard.

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