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

Part 606: Nominal characteristics of non-contact (focus variation) instruments

Spécification géométrique des produits (GPS) — État de surface: Surfacique —
Partie 606: Caractéristiques nominales des instruments sans contact (à variation de focale)

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 213, *Dimensional and geometrical product specifications and verification.*

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

— *Part 1: Indication des états de surface*

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

— *Part 3: Specification operators*

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

— *Part 70: Material measures*

— *Part 71: Software measurement standards*

— *Part 72: Format de fichier XML x3p*

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

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

— *Part 606: Nominal characteristics of non-contact (focus variation) instruments*

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

The following parts are planned:

— *Part 73: Defects on material measures — Terms and definitions*

— *Part 600: Metrological characteristics for areal-topography measuring methods*

— *Part 607: Nominal characteristics of non-contact (imaging confocal microscopy) instruments*

Introduction

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

The ISO/GPS Masterplan given in ISO/TR 14638 gives an overview of the ISO/GPS system of which this part of ISO 25178 is a part of. The fundamental rules of ISO/GPS given in ISO 8015 apply to this part of ISO 25178 and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this part of ISO 25178, unless otherwise indicated.

For more detailed information of the relation of this part of ISO 25178 to other standards and the GPS matrix model, see Annex B.

This part of ISO 25178 describes the metrological characteristics of focus variation microscopes designed for the measurement of surface topography maps.

For more detailed information on the focus variation technique, see Annex A.

NOTE Portions of this part of ISO 25178, particularly the informative sections, describe patented systems and methods. This information is provided only to assist users in understanding the operating principles of focus variation. This part of ISO 25178 is not intended to establish priority for any intellectual property, nor does it imply a license to proprietary technologies described herein.

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

Part 606:
Nominal characteristics of non-contact (focus variation) instruments

1 Scope

This part of ISO 25178 defines the metrological characteristics of a particular non-contact method measuring surface texture using a focus variation (FV) sensor.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. 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 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 10934-2:2007, *Optics and optical instruments — Vocabulary for microscopy — Part 2: Advanced techniques in light microscopy*

ISO 14978:2006, *Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment*

ISO 17450-1, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

ISO 25178-2:2012, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 2: Terms, definitions and surface texture parameters*

ISO 25178-3:2012, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 3: Specification operators*

ISO 25178-6:2010, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 6: Classification of methods for measuring surface texture*

ISO 25178-601, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 601: Nominal characteristics of contact (stylus) instruments*

ISO 25178-602, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 602: Nominal characteristics of non-contact (confocal chromatic probe) instruments*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3274, ISO 4287, ISO 10934-2 ISO 17450-1, ISO 14978, ISO 25178-2, ISO 25178-3, ISO 25178-6, ISO 25178-601, ISO 25178-602, and the following apply.

3.1 Terms and definitions related to all areal surface texture measurement methods

3.1.1
areal reference
component of the instrument that generates a reference surface with respect to which the surface topography is measured

3.1.2
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* (3.1.1) of the instrument (note that there are optical instruments that do not posses a physical areal guide);

— *z*-axis is mounted parallel to the optical axis and is perpendicular to the (*x, y*) plane for an optical instrument

Note 1 to entry: See Figure 1.

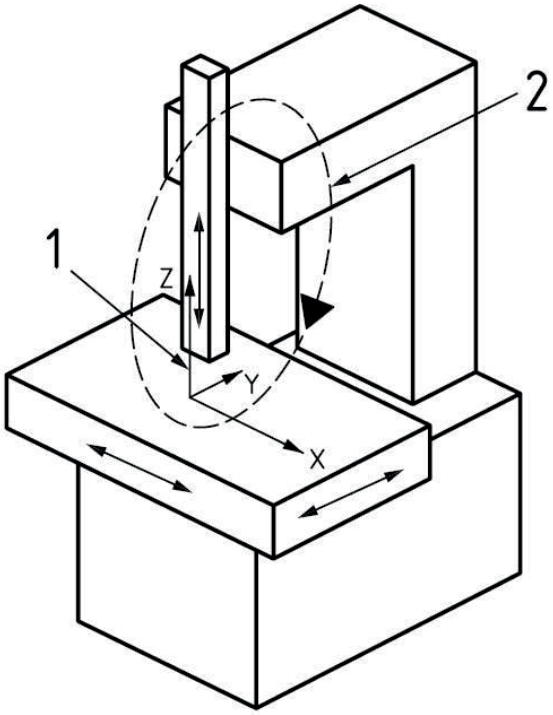
Note 2 to entry: Normally, the *x*-axis is the tracing axis and the *y*-axis is the stepping axis (this note is valid for instruments that scan in the horizontal plane).

Note 3 to entry: See also specification coordinate system [ISO 25178-2:2012, 3.1.2] and measurement coordinate system [ISO 25178-6:2010, 3.1.1].

3.1.3
measurement loop
closed chain which comprises of all the components connecting the workpiece and the probe, e.g. the means of positioning, the work holding fixture, the measuring stand, the drive unit, and the *probing system* (3.5.3)

Note 1 to entry: See Figure 1.

Note 2 to entry: The measurement loop will be subjected to external and internal disturbances that influence the measurement uncertainty.



Key

1 coordinate system of the instrument

2 measurement loop

Figure 1 — Coordinate system and measurement loop of the instrument

3.1.4
real surface of a workpiece
set of features which physically exist and separate the entire workpiece from the surrounding medium

Note 1 to entry: The real surface is a mathematical representation of the surface that is independent of the measurement process.

Note 2 to entry: See also mechanical surface [ISO 25178-2:2012, 3.1.1.1 or ISO 14406:2010, 3.1.1] and electromagnetic surface [ISO 25178-2:2012, 3.1.1.2 or ISO 14406:2010, 3.1.2].

Note 3 to entry: The electromagnetic surface considered for one type of optical instrument can be different from the electromagnetic surface for other types of optical instruments.

[SOURCE: ISO 17450-1:2011]

3.1.5
surface probe
device that converts the surface height into a signal during measurement

Note 1 to entry: In earlier International Standards, this was termed transducer.

3.1.6
measuring volume
range of the instrument stated in terms of the limits on all three coordinates measured by the instrument

Note 1 to entry: For areal surface texture measuring instruments, the measuring volume is defined by the measuring range of the *x*- and *y*- drive units and the measuring range of the *z*-probing system.

[SOURCE: ISO 25178-601:2010, 3.4.1]

3.1.7
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

Note 1 to entry: See Figure 2.

Note 2 to entry: An actual quantity in x (respectively y or z) corresponds to a measured quantity x_M (respectively y_M or z_M).

Note 3 to entry: The response curve can be used for adjustments and error corrections.

[SOURCE: ISO 25178-601:2010, 3.4.2]

3.1.8
amplification coefficient
α_x, α_y, α_z
slope of the linear regression curve obtained from the *response curve* (3.1.7)

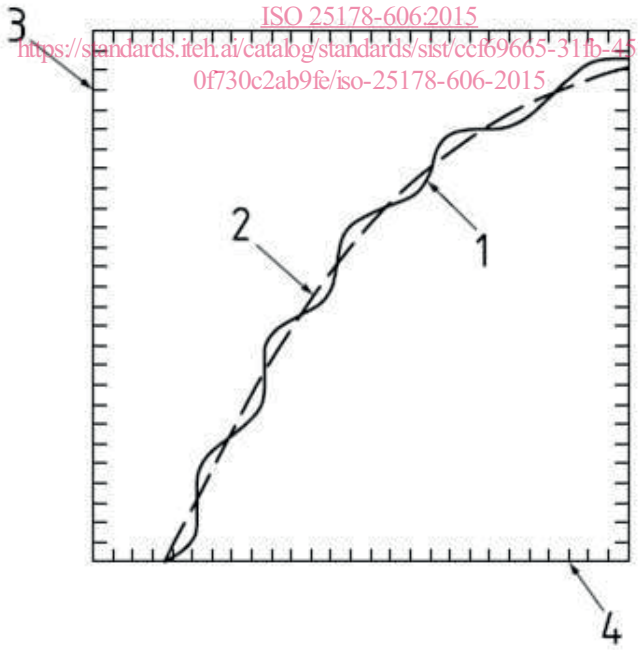
Note 1 to entry: See Figure 3.

Note 2 to entry: There will be amplification coefficients applicable to the x, y, and z quantities.

Note 3 to entry: 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.

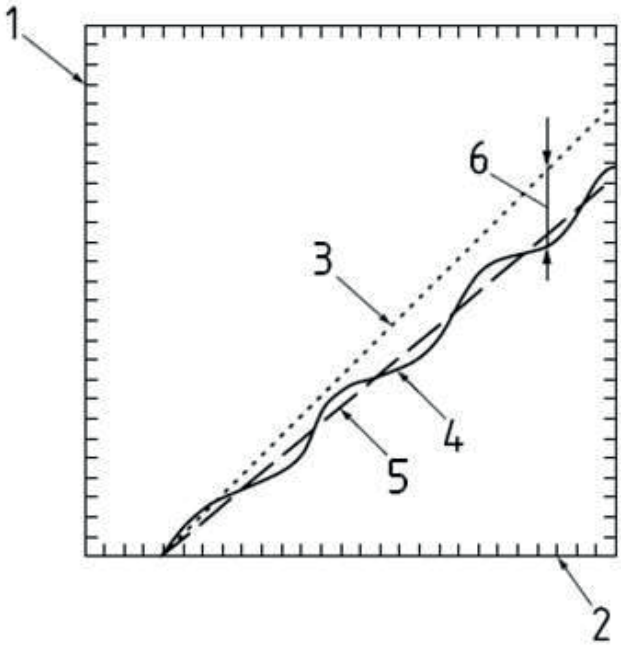
Note 4 to entry: See also *sensitivity of a measuring system* (ISO/IEC Guide 99:2007, 4.12).

[SOURCE: ISO 25178-601:2010, 3.4.3, modified — Note 4 to entry has been added.]



Key
1 response curve
2 assessment of the linearity deviation by polynomial approximation
3 measured quantities
4 input quantities

Figure 2 — Example of a non-linear response curve



Key

1 measured quantities
2 input quantities
3 ideal response curve
4 linearization of the response curve of Figure 2
5 line from which the amplification coefficient α (slope) is derived
6 local residual correction error

Figure 3 — Example of the linearization of a response curve

3.1.9
instrument noise
N_I
internal noise added to the output signal caused by the instrument, if ideally placed in a noise-free environment

Note 1 to entry: Internal noise can be due to electronic noise, e.g. amplifiers, or to optical noise, e.g. stray light.

Note 2 to entry: This noise typically has high frequencies and it limits the ability of the instrument to detect small scale spatial wavelengths of the surface texture.

Note 3 to entry: The S-filter, according to ISO 25178-3:2012, can reduce this noise.

Note 4 to entry: For some instruments, instrument noise cannot be estimated because the instrument only takes data while moving.

3.1.10
measurement noise
N_M
noise added to the output signal occurring during the normal use of the instrument

Note 1 to entry: Notes 2 and 3 of 3.1.9 apply as well to this definition.

Note 2 to entry: Measurement noise includes the *instrument noise* (3.1.9).

3.1.11
surface topography measurement repeatability
repeatability of topography map in successive measurements of the same surface under the same conditions of measurement

Note 1 to entry: Surface topography measurement repeatability provides a measure of the likely agreement between repeated measurements normally expressed as a standard deviation.

Note 2 to entry: See ISO/IEC Guide 99:2007, 2.15, and 2.21 for the general discussion of repeatability and related concepts.

Note 3 to entry: Evaluation of surface topography repeatability is a common method for determining the *measurement noise* (3.1.10).

3.1.12
sampling interval in *x* (respectively *y*)
D_x (D_y)
distance between two adjacent measured points along the *x*-axis (respectively *y*-axis)

Note 1 to entry: In many microscopy systems, the sampling interval is determined through the optical magnification by the distance between sensor elements in a camera called pixels. For such systems, the terms pixel pitch and pixel spacing are often used interchangeably with the term sampling interval. Another term, pixel width, indicates a length associated with one side (*x* or *y*) of the sensitive area of a single pixel and is always smaller than the pixel spacing. Yet another term, sampling zone, may be used to indicate the length or region over which a height sample is determined. This quantity could either be larger or smaller than the sampling interval.

3.1.13
digitisation step in *z*
D_Z
smallest height variation along the *z*-axis between two ordinates of the extracted surface

3.1.14
lateral resolution
R_l
smallest distance between two features which can be detected

[SOURCE: ISO 25178-601:2010, 3.4.10]

3.1.15
width limit for full height transmission
W_l
width of the narrowest rectangular groove whose measured height remains unchanged by the measurement

[SOURCE: ISO 25178-601:2010, 3.4.11]

Note 1 to entry: Instrument properties such as the sampling interval in *x* and *y*, the digitization step in z, and the short wavelength cut-off filter can influence the *lateral resolution* (3.1.14) and the width limit for full height transmission.

Note 2 to entry: When determining this parameter by measurement, the depth of the rectangular groove should be close to that of the surface to be measured.

EXAMPLE 1 Measuring a grid, for which the grooves are wider than the width limit for full height transmission, leads to a correct measurement of the groove depth (see Figure 4 and Figure 5).