INTERNATIONAL STANDARD

ISO 25178-605

First edition
2014-02-01

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

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

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

Partie 605: Caractéristiques nominales des instruments sans contact (capteur autofocus à point)

Reference number
ISO 25178-605:2014(E)

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

Published in Switzerland

Contents

Page

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.

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. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 specifications (GPS) — Surface texture: Areal*:

— *Part 1: Indication of surface texture*

— *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 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 under preparation:

— *Part 72: XML file format x3p*

Calibration and measurement standards for non-contact (confocal chromatic probe) instruments and calibration and measurement standards for non-contact (phase-shifting interferometric microscopy) instruments are to form the subject of future parts 702 and 703.

A part 600 is planned which is intended to contain provisions common with the other 600-level parts of ISO 25178. Once it has been submitted as a Final Draft International Standard, those provisions in the other 600-level parts that are then redundant will be removed from them.

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 the chain link 5 of the chains of standards on roughness profile, waviness profile, primary profile, and areal surface texture.

For more detailed information on the relationship of this standard to the GPS matrix model, see Annex G.

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

The point autofocus optical principle can be implemented in various set-ups. The configuration described in this document comprises three basic elements: an autofocus optical system, an autofocus mechanism, and an electronic controller.

This type of instrument is mainly designed for areal measurements, but it is also able to perform profile measurements.

This part of ISO 25178 describes the metrological characteristics of an optical profiler using a point autofocus probe for the measurement of areal surface texture.

For more detailed information on the point autofocus method, see Annex A. Reading this annex before the main body may lead to a better understanding of this standard.

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

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

1 Scope

This part of ISO 25178 describes the metrological characteristics of a non-contact instrument for measuring surface texture using point autofocus probing.

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 4287:1997, *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 14406:2010, *Geometrical product specifications (GPS) — Extraction*

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

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 25178-601:2010, *Geometrical product specifications (GPS) — Surface texture: Areal — Part 601: Nominal characteristics of contact (stylus) instruments*

ISO 25178-602:2010, *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 4287, ISO 10360-1, ISO 14406, 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*)

Note 1 to entry: In this system (*x,y*) is the plane established by the areal reference of the instrument (Note that there are optical instruments that do not posses a physical areal guide).

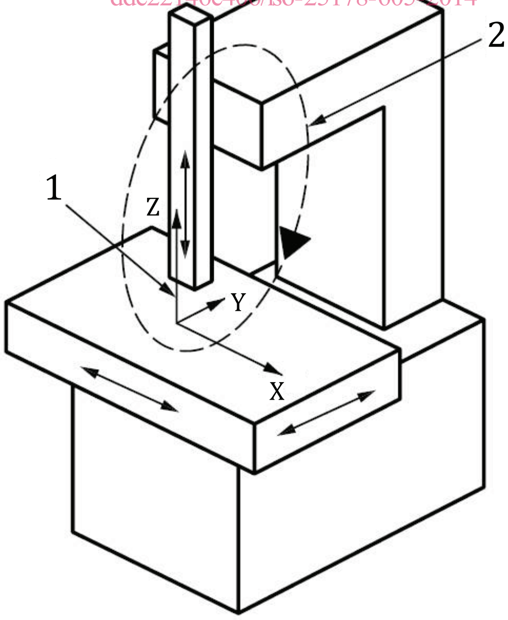
Note 2 to entry: In this system, *z*-axis is mounted parallel to the optical axis and is perpendicular to the (*x,y*) plane for an optical instrument. The *z*-axis is in the plane of the stylus trajectory and is perpendicular to the (*x,y*) plane for a stylus instrument (see Figure 1)

Note 3 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 4 to entry: See also *specification coordinate system* and *measurement coordinate system*, as defined in ISO 25178-2:2012, 3.1.2 and ISO 25178-6:2010, 3.1.1, respectively.

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

Note 1 to entry: See Figure 1. 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 instrument

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

[SOURCE: ISO 14660-1:1999, 2.4]

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*, as defined in ISO 25178-2:2012, 3.1.1.1 or ISO 14406:2010, 3.1.1, and *electromagnetic surface*, as defined in 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 may be different from the electromagnetic surface for other types of optical instruments.

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

Note 1 to entry: In earlier 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,

— 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

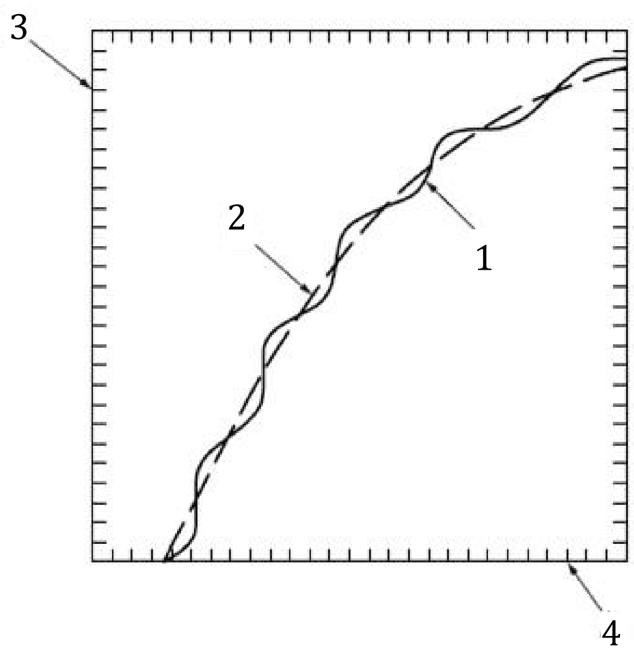
Note 1 to entry: See Figure 3.

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* (VIM, 4.12)[1]

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



Key

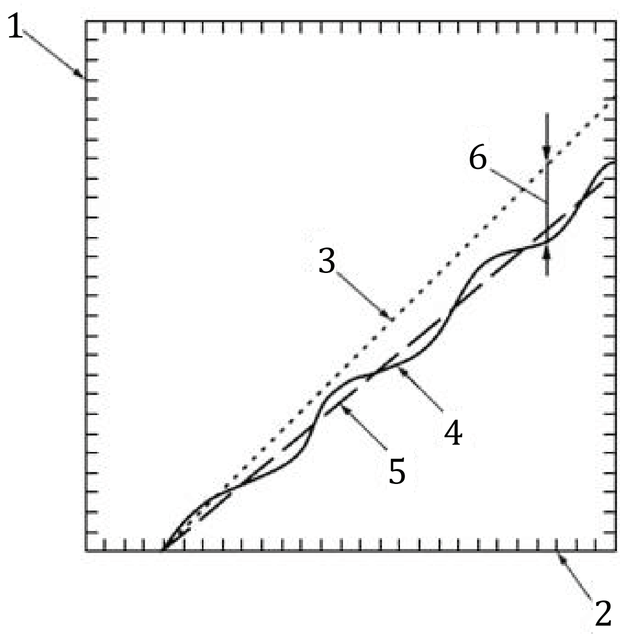
1 response curve

2 assessment of the linearity deviation by polynomial approximation

3 measured quantities

4 input quantities

Figure 2 — Example of nonlinear 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 linearization of 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, as e.g. amplifiers, or to optical noise, as 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 ISO 25178-3 may 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.

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

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

Note 2 to entry: See VIM,[1] 2.15 and 2.21, for a 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.

3.1.12
sampling interval in *x* [*y*]
D_x [D_y]
distance between two adjacent measured points along the *x*- [*y*-] axis

Note 1 to entry: In many microscopy systems the sampling interval is determined 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

Note 1 to entry: Instrument properties such as

— the sampling interval in *x* and *y*,

— the digitisation step in *z*, and

— the short wavelength cut-off filter

should be chosen so that they do not influence the lateral resolution 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.

Note 3 to entry: An example is the measuring of a grid for which the grooves are wider than the width limit for full height transmission. This leads to a correct measurement of the groove depth (see Figures 4 and 5).

