INTERNATIONAL STANDARD

ISO 25178-6

First edition
2010-02-01

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

Part 6: Classification of methods for measuring surface texture

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

Partie 6: Classification des méthodes de mesurage de l'état de surface

Reference number
ISO 25178-6:2010(E)

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.

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 25178-6 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 (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638[2]). It influences the chain link 5 of the chain of standards on roughness profile, waviness profile, primary profile and areal surface texture.

This part of ISO 25178 describes a classification system for methods used primarily for the measurement of surface texture. The classification system provides a context for the development of other parts of ISO 25178 that describe characteristics and measurement standards for some of the individual methods. Such a classification is also intended to aid in choosing and understanding various types of methods and in determining which standards apply to their application. The classification system is aimed to be as general as possible. However, instruments may exist that do not clearly fit within any single method class.

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

Part 6: Classification of methods for measuring surface texture

1 Scope

This part of ISO 25178 describes a classification system for methods used primarily for the measurement of surface texture. It defines three classes of methods, illustrates the relationships between the classes, and briefly describes specific methods.

2 Normative references

The following referenced documents are indispensable for the application 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 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 25178-2:—[1]), *Geometrical product specifications (GPS) — Surface texture: Areal — Part 2: Terms, definitions and surface texture parameters*

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

3 Terms and definitions

3.1 General terms

For the purposes of this document, the terms and definitions given in ISO 4287, ISO 25178-2, ISO/IEC Guide 99 and the following apply.

3.1.1
measurement coordinate system
system of coordinates in which surface texture parameters are measured

NOTE 1 If the nominal surface is a plane (or portion of a plane), it is usual to use a rectangular coordinate system in which the axes form a right-handed Cartesian set, the X-axis being the direction of tracing co-linear with the mean line and the Y-axis also lying on the nominal surface, and the Z-axis being in an outward direction (from the material to the surrounding medium). The rectangular coordinate system is adopted in this part of ISO 25178 except for 3.2.1, Note 3, and 3.3.3, where a cylindrical coordinate system is described.

NOTE 2 See also *specification coordinate system* [ISO 25178-2:—].

1) To be published.

3.1.2
surface profile
profile that results from the intersection of the real surface by a specified plane

NOTE In practice, it is usual to choose a plane with a normal that nominally lies parallel to the real surface and in a suitable direction.

[ISO 4287:1997, definition 3.1.4]

3.1.3
ordinate value
$z(x, y)$
height of the surface at position (x, y)

3.2 Definitions for classification of surface texture measurement methods

3.2.1
line-profiling method
surface topography measurement method that produces a two-dimensional graph or profile of the surface irregularities as measurement data, which may be represented mathematically as a height function $z(x)$

NOTE 1 By contrast, **areal-topography** (3.2.2) and **area-integrating** (3.2.3) methods are used to quantify the surface texture over a selected area of a surface instead of over single profiles.

NOTE 2 Examples of instruments that were developed specifically to measure line profiles include contact stylus scanning[1], early versions of the phase-shifting interferometer[3], and the optical differential profiler[4][5].

NOTE 3 Certain methods have rotational scanning within a cylindrical coordinate system and measure circular profiles, that is, z as a function of angle θ. One example is the circular interferometric profiler[6].

3.2.2
areal-topography method
surface measurement method that produces a topographical image of a surface, which may be represented mathematically as a height function $z(x, y)$ of two independent variables (x, y)

NOTE 1 Examples of methods that have been developed or adapted for areal-topography measurements include contact stylus scanning[7], phase-shifting interferometric microscopy[8], coherence scanning interferometry[9][10], confocal microscopy[11], confocal chromatic microscopy[12], structured light projection[13][14] (including triangulation), focus variation microscopy[15], optical differential profiler[4][5], digital holography microscopy[16], point autofocus profiling[17][18], angle-resolved scanning electron microscopy (SEM)[19][20], SEM stereoscopy[21][22], scanning tunnelling microscopy[23], and atomic force microscopy[24][25]. The areal measurement capability of these methods is often derived from a set of parallel profiles scanned sequentially or from manipulation of 2D images in microscope cameras. All of these methods may also be used to produce line-profiling results as well.

NOTE 2 For methods that form a surface topography image $z(x, y)$ from sequential profiles such as a set of parallel profiles $z(x)$, care should be taken to ascertain the accuracy of measurement along the slow axis $z(y)$. Although $z(x, y)$ topographic images may be displayed for an areal texture method, in some cases the method may not actually be sensitive to $z(y)$ topography changes, or the accuracy of $z(y)$ profiling may be limited by the drift of the instrument.

3.2.3
area-integrating method
surface measurement method that measures a representative area of a surface and produces numerical results that depend on area-integrated properties of the surface texture

NOTE 1 These methods do not produce line-profile data $z(x)$ or areal-topography data $z(x, y)$.

NOTE 2 Examples of instruments that have been developed as area-integrating methods include those that use the techniques of total integrated light scatter[26], angle-resolved light scatter[27], parallel-plate capacitance[28] and pneumatic (flow) measurement[29].

NOTE 3 Area-integrating methods have been used in conjunction with calibrated roughness comparison specimens or calibrated pilot specimens as comparators to distinguish the surface texture of parts manufactured by similar processes or to perform repetitive surface texture assessments.

3.3 Terms and descriptions for specific methods

3.3.1
contact stylus scanning
surface topography measurement method whereby the probing system uses a contacting stylus whose motion is converted into a signal as a function of position

NOTE See ISO 25178-601 for more information.

3.3.2
phase-shifting interferometric microscopy
PSI
surface topography measurement method whereby an optical microscope with illumination of a known effective wavelength is integrated with an interferometric attachment and produces multiple successive optical images with interferometric fringes from which the profile or areal surface topography image is calculated

NOTE 1 Bands of light and dark interferometric fringes are produced in images when two or more mutually coherent optical beams are combined.

NOTE 2 See ISO 25178-603 for more information.

3.3.3
circular interferometric profiling
surface profiling method whereby the local surface height is sensed with an interferometric probe having a scanned beam on the circumference of a circle and the reference beam at the centre, thus generating a circular profile $z(\theta)$ within a cylindrical coordinate system rather than a line profile or areal-topography image

3.3.4
optical differential profiling
surface topography measurement method whereby height differences between two closely spaced points on a surface are measured in close succession along the direction of traverse and a surface profile is obtained by integration of these local height differences

NOTE Also called “Nomarski differential profiling”.

3.3.5
coherence scanning interferometry
CSI
surface topography measurement method wherein the localization of interference fringes during a scan of optical path length provides a means to determine a surface topography map

NOTE A variation of this technique, known as optical coherence tomography[30], is widely used for three-dimensional imaging through transparent materials, particularly for medical and biological applications.

3.3.6
confocal microscopy
surface topography measurement method whereby a pinhole object illuminated by the light source is imaged by a lens onto the surface being studied and the light is reflected back through the lens to a second pinhole placed in front of a detector and acting as a spatial filter

NOTE See ISO 25178-602 for more information.

3.3.7
confocal chromatic microscopy
surface topography measurement method consisting of a confocal microscope with chromatic objective integrated with a detection device (e.g. spectrometer) whereby the surface height at a single point is sensed by the wavelength of light reflected from the surface

NOTE See ISO 25178-602 for more information.