



**International
Standard**

ISO 25178-605

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

Part 605:

**Design and characteristics of non-
contact (point autofocus probe)
instruments**

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

*Partie 605: Conception et caractéristiques des instruments sans
contact (capteur autofocus à point)*

**Second edition
2025-02**

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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.

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 document 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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 25178-605:2014), which has been technically revised.

The main changes are as follows:

- 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 [Clause 5](#) on metrological characteristics;
- addition of [Clause 6](#) on design features, which clarifies the types of instruments relevant to this document;
- addition of an information flow concept diagram in [Clause 4](#);
- revision of [Annex A](#) describing the principles of instruments addressed by this document;
- addition of [Annex B](#) on 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 the metrological characteristics in ISO 25178-600.

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 C](#).

This document includes terms and definitions relevant to the point autofocus probe (PAP) instruments for the measurement of areal surface topography. [Annex A](#) briefly summarizes PAP 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 PAP.

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 PAP instruments. This document is not intended to establish priority for any intellectual property, nor does it imply a license to proprietary technologies described herein.

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

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

1 Scope

This document specifies the design and metrological characteristics of point autofocus probe (PAP) 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 25178-600:2019, *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 probing system

<point autofocus probe> component of the instrument consisting of an autofocus optical system, an *autofocus mechanism* (3.6) and an electronic controller

3.2 point autofocus probe PAP

device that converts the height of a point on a surface into a signal during measurement using the autofocus function

3.3 point autofocus profiling

surface topography measurement method whereby the local surface height is measured by automatically centring a focused light beam reflected from the sample on a position sensitive detector as a function of surface height

[SOURCE: ISO 25178-6:2010, 3.3.11]

3.4

objective

lens that focuses the light source image on the workpiece surface

3.5

autofocus sensor

optical sensor that detects a focal position using the light reflected from the workpiece surface

3.6

autofocus mechanism

autofocus driving mechanism that positions optical elements or the whole optical system

3.7

z-position sensor

sensor that measures the vertical position of the measured point

3.8

working distance

<point autofocus probe> distance along the optical axis between the element closest to the surface and the focus point on the surface

Note 1 to entry: Maximum measurable step height is related to working distance.

3.9

spot size

W_{SPOT}

<point autofocus probe> size of the light source image focused on the workpiece surface

Note 1 to entry: See [Clause B.2](#).

3.10

focus range

range of z heights, within which it is possible to achieve adequate focus

3.11

vertical range

R_{VERT}

<point autofocus probe> measuring range of the autofocus probe in z heights within which it is possible to output reliable data

3.12

measurable minimum reflection ratio

M_{REF}

minimum ratio of the reflected light intensity to the incident light intensity for a measurable workpiece surface

3.13

autofocus repeatability

R_{AF}

measurement repeatability of the autofocus function, excluding the effect of environmental noise

3.14

speckle noise

N_{SPC}

noise due to non-uniform intensity of reflected light generated by irregular micro-scale geometry of the workpiece surface within the *spot size* ([3.9](#))

Note 1 to entry: Refer to Reference [\[10\]](#).

3.15

temperature drift deviation

$D_{\text{TEM}x}$, $D_{\text{TEM}y}$, $D_{\text{TEM}z}$

form deviation caused by changes in temperature

Note 1 to entry: This deviation is typically managed by increasing measurement speed and reducing the rate or range of temperature variation.

Note 2 to entry: Refer to Reference [14].

3.16

beam offset direction

direction of the offset of the light source optical axis from the optical axis of the *objective* (3.4)

Note 1 to entry: See [Clause B.4](#).

4 Instrument requirements

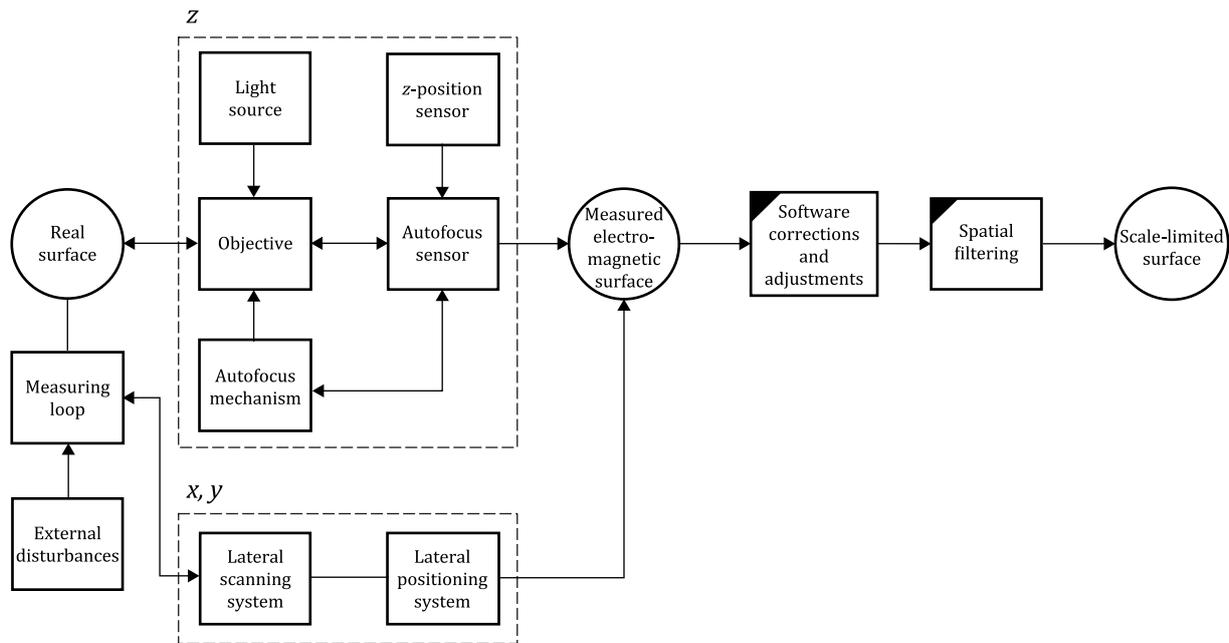
An instrument according to this document shall perform an areal surface topography measurement of a surface using point autofocus profiling. The instrument shall comprise a PAP and a lateral scanning system. The PAP instrument shall comprise an objective, an autofocus sensor, a z-position sensor and an autofocus mechanism for automatically measuring a local height of the surface. The instrument shall acquire data by scanning the surface in *x*- and *y*-directions while autofocusing on it. The instrument shall save acquired point cloud data in order to generate an areal topography.

[Figure 1](#) shows the information flow between these elements for a PAP instrument, flowing from a workpiece surface to a primary surface. Examples of PAP instrument hardware, techniques and error sources are given in [Annexes A](#) and [B](#).

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Key

x, y scanning systems
 z probing system



measurand



operator with intended modification



operator without intended modification

Figure 1 — Information flow concept diagram for a PAP instrument

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5 Metrological characteristics

The standard metrological characteristics for areal surface texture measuring instruments specified in ISO 25178-600 shall be considered when designing and calibrating the instrument. Additional metrological characteristics or error sources, or both, for an instrument according to this document consist of working distance, spot size, focus range, vertical range, measurable minimum reflection ratio, autofocus repeatability, speckle noise, temperature drift deviation and beam offset direction. 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

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

[Annex A](#) provides examples of specific design features of PAP instruments.

7 General information

The relationship between this document and the GPS matrix model is given in [Annex C](#).