

English Version

**Geometrical product specifications (GPS) - Flatness - Part 2:  
Specification operators (ISO/TS 12781-2:2003)**

Spécification géométrique des produits (GPS) - Planéité -  
Partie 2: Opérateurs de spécification (ISO/TS 12781-  
2:2003)

Geometrische Produktspezifikation (GPS) - Ebenheit - Teil  
2: Spezifikationsoperatoren (ISO/TS 12781-2:2003)

This Technical Specification (CEN/TS) was approved by CEN on 8 October 2007 for provisional application.

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## Foreword

The text of ISO/TS 12781-2:2003 has been prepared by Technical Committee ISO/TC 213 “Dimensional and geometrical product specifications and verification” of the International Organization for Standardization (ISO) and has been taken over as CEN ISO/TS 12781-2:2007 by Technical Committee CEN/TC 290 “Dimensional and geometrical product specification and verification” the secretariat of which is held by AFNOR.

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### Endorsement notice

The text of ISO/TS 12781-2:2003 has been approved by CEN as a CEN ISO/TS 12781-2:2007 without any modification.

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## Introduction

This part of ISO/TS 12781 is a geometrical product specification (GPS) Technical Specification and is to be regarded as a general GPS document (see ISO/TR 14638). It influences chain link 3 of the chain of standards on form of a surface (independent of a datum).

For more detailed information on the relation of this part of ISO/TS 12781 to other standards and the GPS matrix model, see Annex C.

This part of ISO/TS 12781 specifies the specification operators according to ISO/TS 17450-2 for flatness of integral features.

At the current state of development, ISO TC 213 has not been able to reach a consensus on defaults for filter UPR, probe tip radius and method of association (reference plane). This means that a flatness specification must explicitly state which values are to be used for these specification operations in order for it to be unique.

Consequently, if a specification does not explicitly state which values are to be used for one or more of these operators, the specification is uncertain (see ISO/TS 17450-2) and a supplier can use any value for the operator(s) not specified when proving conformance.

Extracting data will always involve applying a certain filtering process. An additional filtering of the extracted data may or may not be applied. This additional filter can be a mean line filter (Gaussian, spline, wavelet, etc.) or a non-linear filter (e.g. morphological filter). The type of filtering will influence the definition of flatness and the specification operators and, therefore, needs to be stated unambiguously.

**NOTE 1** Stylus filtering is not sufficient on its own to smooth a profile. In certain circumstances it can create spurious high-frequency content, thus giving incorrect values. To correct this, a longwave-pass filter is employed. A Gaussian filter is used, since this is the current state-of-the-art in ISO standards. This filter has some shortcomings, e.g. it can distort, rather than eliminate some roughness features and it can distort, rather than transmit correctly some waviness features. It is envisioned that new filters under development within ISO will provide better solutions for several of these issues.

**NOTE 2** If a smaller tip radius than the one specified is used for a given cut-off length, the resulting measured value will generally be higher. This effect is usually insignificant. If a larger tip radius is used, the resulting measured value will generally be lower. The amount of change is heavily dependent on the surface measured.

**NOTE 3** The measuring force of 0 N is chosen to eliminate effects of elastic deformation of the workpiece from the specification operator. On metal surfaces with adequate thickness, the effect of normally occurring measuring forces will be negligible.

**NOTE 4** Aliasing and other problems during extraction (see Annex A) due to the higher harmonic content of the skin model, in the straightness directions, can cause specification uncertainty.

This part of ISO/TS 12781 is not intended to disallow any means of measuring flatness.

# Geometrical Product Specifications (GPS) — Flatness —

## Part 2: Specification operators

### 1 Scope

This part of ISO/TS 12781 specifies the complete specification operator for flatness of complete integral features only, i.e. geometrical characteristics of individual features of type plane.

### 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/TS 12781-1:2003, *Geometrical Product Specifications (GPS) — Flatness — Part 1: Vocabulary and parameters of flatness*

ISO 14253-1:1998, *Geometrical Product Specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for proving conformance or non-conformance with specifications*

ISO/TS 17450-2:2002, *Geometrical Product Specifications (GPS) — General concepts — Part 2: Basic terms, specifications, operators and uncertainties*

### 3 Terms and definitions

For the purposes of this part of ISO/TS 12781, the terms and definitions given in ISO/TS 12781-1 and ISO/TS 17450-2 apply.

### 4 Complete specification operator

#### 4.1 General

The complete specification operator (see ISO/TS 17450-2) is a full ordered set of unambiguous specification operations in a well-defined order. The complete specification operator defines the transmission band for the flatness surface, together with an appropriate stylus tip geometry.

**NOTE** In practice it is unrealistic to achieve comprehensive coverage of the flatness feature given by the theoretical minimum density of points (see Annex B) within an acceptable time span using current technology. Therefore more limited extraction strategies are employed that give specific rather than general information concerning the deviations from flat form.