

---

---

**Geometrical Product Specifications  
(GPS) — Length standards — Gauge blocks**

*Spécification géométrique des produits (GPS) — Étalons de longueur —  
Cales-étalons*

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 3650:1998](https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998)

[https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-  
f206c71ff572/iso-3650-1998](https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998)



Contents

1 Scope ..... 1

2 Normative references ..... 1

3 Definitions ..... 1

4 Nomenclature of faces ..... 3

5 Basis of measurement, traceability, reference condition ..... 4

5.1 Unit of length: metre..... 4

5.2 Traceability of the length of a gauge block..... 4

5.3 Reference temperature and standard pressure..... 4

5.4 Reference orientation of gauge blocks ..... 5

6 General dimensions, material properties, marking ..... 5

6.1 General dimensions..... 5

6.2 Material properties..... 5

6.2.1 Material ..... 5

6.2.2 Coefficient of thermal expansion ..... 6

6.2.3 Hardness..... 6

6.2.4 Dimensional stability ..... 6

6.3 Marking ..... 6

7 Metrological requirements ..... 6

7.1 General..... 6

7.2 Flatness tolerance,  $t_f$  ..... 7

7.2.1 Gauge blocks with nominal lengths exceeding 2,5 mm ..... 7

7.2.2 Gauge blocks with nominal lengths up to 2,5 mm ..... 7

7.3 Measuring faces ..... 7

iteh STANDARD PREVIEW  
(standards.iteh.ai)

ISO 3650:1998  
<https://standards.iteh.ai/catalog/standards/sist/ec0bc700-a1e0-4051-8243-f206c71ff572/iso-3650-1998>

© ISO 1998

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization  
Case postale 56 • CH-1211 Genève 20 • Switzerland  
Internet iso@iso.ch

Printed in Switzerland

7.4 Side faces .....	7
7.4.1 Flatness .....	7
7.4.2 Parallelism .....	8
7.4.3 Perpendicularity .....	8
7.4.4 Edges .....	9
8 Calibration of gauge blocks .....	9
8.1 General .....	9
8.2 Wringing test .....	10
8.3 Measurement by interferometry .....	10
8.3.1 Measured length .....	10
8.3.2 Auxiliary plate .....	10
8.3.3 Corrections to measurements by interferometry .....	10
8.3.4 Calibration certificate .....	10
8.4 Measurement by comparison .....	11
8.4.1 Principle of measurement .....	11
8.4.2 Central length .....	11
8.4.3 Method of determining length by comparison .....	11
8.4.4 Variation in length .....	11
8.4.5 Corrections .....	12
8.4.6 Calibration certificate .....	12
Annex A (informative) Example of a device for the comparison of gauge blocks .....	13
Annex B (informative) Relation to the GPS matrix model .....	14
Annex C (informative) Bibliography .....	15

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

ISO 3650:1998

<https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245->

[806-718572/iso-3650-1998](https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-806-718572/iso-3650-1998)

## 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.

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.

International Standard ISO 3650 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This second edition cancels and replaces the first edition (ISO 3650:1978), which has been technically revised.

Annexes A, B and C of this International Standard are for information only.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 3650:1998](https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998)

<https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998>

## Introduction

This International Standard is a geometrical product specification standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain link 6 (Calibration requirements — Calibration standards) of the chain of standards on size and distance.

For more detailed information on the relation of this standard to the GPS matrix model, see annex B.

Gauge blocks are length standards representing specified fractions of the unit of length, the metre, of the international system of units SI. Depending on the kind of application and the required quality, gauge blocks are offered in several grades. The calibration of the gauge blocks, i.e. the measurement of the length value at a specified point of the measuring face and the evaluation of the measurement uncertainty, is the basis for the application of gauge blocks as length standards.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 3650:1998](https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998)

<https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO 3650:1998

<https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998>

# Geometrical Product Specifications (GPS) — Length standards — Gauge blocks

## 1 Scope

This International Standard specifies the most important design and metrological characteristics of gauge blocks with a rectangular cross section and a nominal length  $l_n$  ranging from 0,5 mm to 1 000 mm.

Limit deviations and tolerances are stated for the calibration grade K and for the grades 0, 1 and 2 for various measuring purposes.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1:1975, *Standard reference temperature for industrial length measurements*.  
<https://standards.iteh.ai/catalog/standards/sis/cc0bc760-a1c0-4051-8245-206c71ff572/iso-3650-1998>

ISO 1101:—<sup>1)</sup>, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Generalities, definitions, symbols, indication on drawings*.

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method*.

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*.

*International vocabulary of basic and general terms in metrology (VIM)*. BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2nd edition, 1993.

## 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 14253-1, VIM and the following apply.

### 3.1

#### **gauge block**

material measure of rectangular section, made of wear-resistant material, with one pair of planar, mutually parallel measuring faces, which can be wrung to the measuring faces of other gauge blocks to make composite assemblies, or to similarly finished surfaces of auxiliary plates for length measurements

<sup>1)</sup> To be published. (Revision of ISO 1101:1983)

**3.2**  
**length of a gauge block**

$l$   
perpendicular distance between any particular point of the measuring face and the planar surface of an auxiliary plate of the same material and surface texture upon which the other measuring face has been wrung

See figure 1.

NOTES

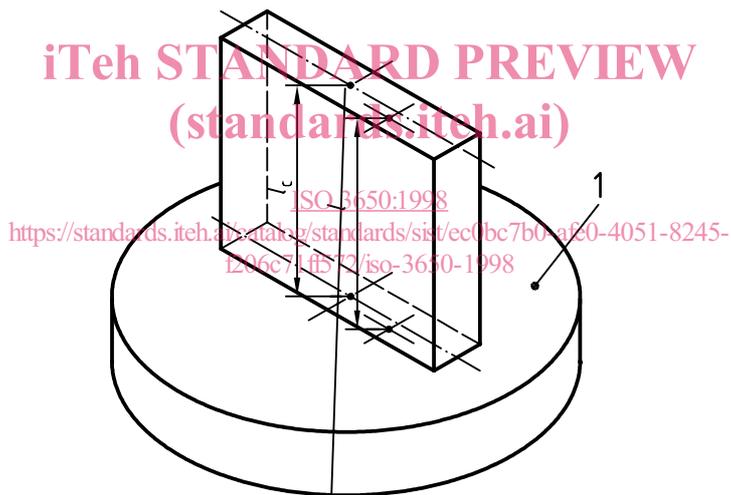
- 1 The length of a gauge block,  $l$ , includes the effect of one-face wringing (see 8.3.1).
- 2 The length,  $l$ , is a physical quantity consisting of a numerical value and a length unit (e.g. metre, millimetre or micrometre). If only the numerical value is treated (e.g. in tables), the units should be stated explicitly.

**3.3**  
**central length of a gauge block**

$l_c$   
length of a gauge block taken at the centre point of the free measuring face

See figure 1.

NOTE — Length  $l_c$  is a special instance of length  $l$ .



**Key**  
1 Auxiliary plate

**Figure 1 — Central length  $l_c$  and another example of length  $l$  at any point of a gauge block wrung to the plane surface of an auxiliary plate**

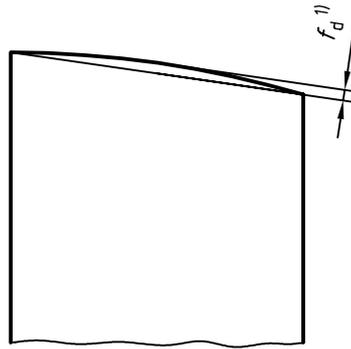
**3.4**  
**deviation of the length at any point from nominal length**

$e$   
algebraic difference  $l - l$

**3.5**  
**deviation from flatness**

$f_d$   
minimum distance between two parallel planes between which all points of the measuring face lie

See figure 2.



1) See 7.1.

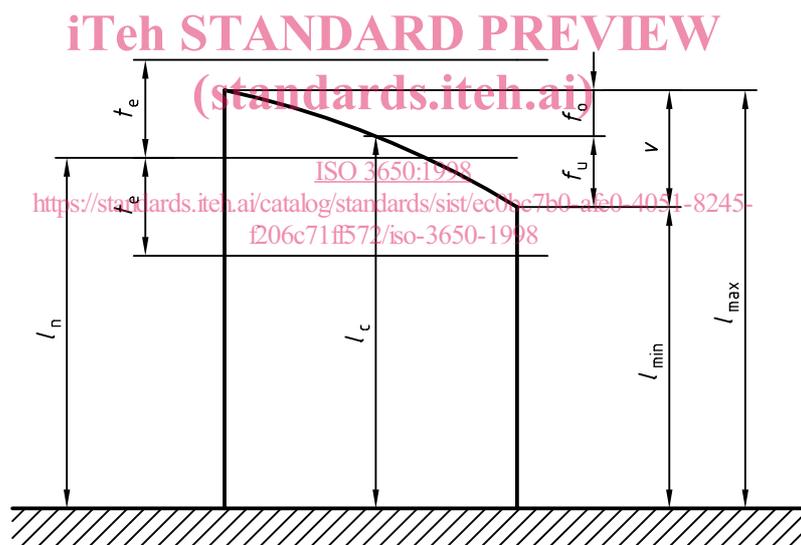
Figure 2 — Deviation  $f_d$  from flatness

### 3.6 variation in length

$v$   
difference between the maximum length  $l_{\max}$  and the minimum length  $l_{\min}$

See figure 3.

NOTE — The variation in length is equal to the sum of the deviations  $f_o$  and  $f_u$  from the central length  $l_c$ .



NOTE — See table 4.

Figure 3 — Nominal length  $l_n$ ; central length  $l_c$ ; variation  $v$  with  $f$  and  $f_u$ ; limit deviations  $t_e$  for the length at any point, proceeding from the nominal length

### 3.7 wringing

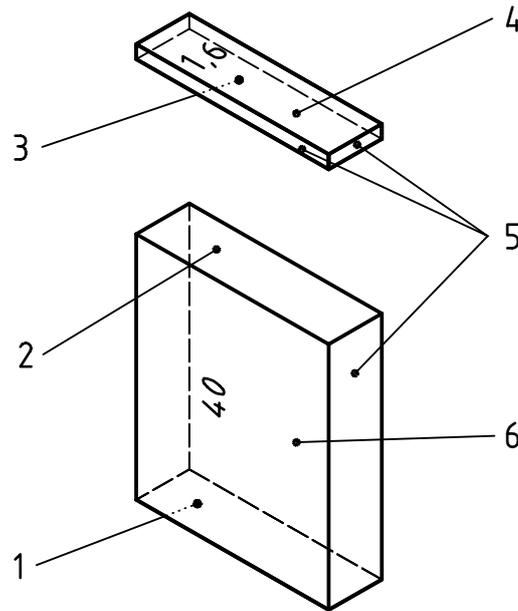
property of the measuring faces of gauge blocks to adhere to other measuring faces or to faces with similar surface finish as a result of molecular forces

## 4 Nomenclature of faces

See figure 4.

a) for nominal lengths  $l_n < 6$  mm

b) for nominal lengths  $l_n \geq 6$  mm



**Key**

- 1 Left hand measuring face
- 2 Right hand measuring face
- 3 Unmarked measuring face
- 4 Marked measuring face
- 5 Side faces
- 6 Marked side face

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

ISO 3650:1998

NOTE — For the complete marking, see 6.3. <https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998>

**Figure 4 — Nomenclature of faces**

**5 Basis of measurement, traceability, reference condition**

**5.1 Unit of length: metre**

The metre is defined as the length of the path travelled by light in vacuum in 1/299 792 458 of a second (17th General Conference of Weights and Measures, 1983).

The definition is realized by working wavelength standards recommended by the International Committee of Weights and Measures (CIPM).

**5.2 Traceability of the length of a gauge block**

The measured length of a gauge block is traceable to national or international length standards, if the measurement result can be related by an unbroken chain of comparison measurements each with stated uncertainties to a gauge block which has been calibrated by interferometry using appropriate wavelength standards.

**5.3 Reference temperature and standard pressure**

The nominal length and the measured lengths of a gauge block apply at the reference temperature of 20 °C (see ISO 1) and the standard pressure 101 325 Pa = 1,013 25 bar.

NOTE — The effect on the length of a gauge block caused by deviations from the standard pressure may be ignored under normal atmospheric conditions.

**5.4 Reference orientation of gauge blocks**

The length of a gauge block up to and including 100 mm nominal length refers to the vertical orientation with the measuring faces horizontal.

The length of a gauge block over 100 mm nominal length refers to the horizontal orientation with the block supported on one of the narrow side faces, without additional stress, by suitable supports each at a distance of 0,211 times the nominal length from the ends. When such a gauge block is measured by interferometry in horizontal orientation, the weight of the auxiliary plate wrung to one of the measuring faces shall be compensated.

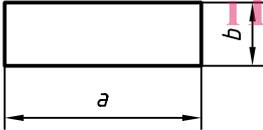
**6 General dimensions, material properties, marking**

**6.1 General dimensions**

The nominal dimensions of the cross section and their limit deviations are given in table 1.

**Table 1 — Cross section**

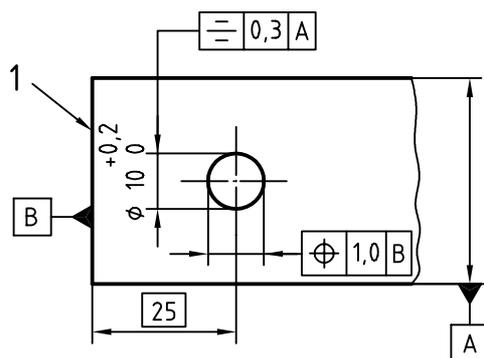
Dimensions in millimetres

Cross section	Nominal length, $l_n$	a		b	
		nominal	limit deviation	nominal	limit deviation
	$0,5 \leq l_n \leq 10$	30	0 -0,3	9	-0,05 -0,20
	$10 < l_n \leq 1000$	35			

<https://standards.iteh.ai/catalog/standards/sist/ec0bc7b0-afe0-4051-8245-f206c71ff572/iso-3650-1998>

If gauge blocks with nominal lengths over 100 mm are provided with coupling holes, the dimensions and location of holes shall be as shown in figure 5. Gauge blocks of grade K shall not be combined with coupling devices.

Dimensions in millimetres



**Key**  
1 Measuring face

**Figure 5 — Dimensions of coupling holes in mm**

**6.2 Material properties**

**6.2.1 Material**

Gauge blocks shall be made of high grade steel or of other similarly wear-resistant material capable of being finished with surfaces that will wring readily, and which will be stable for length within the tolerances in table 2.