INTERNATIONAL STANDARD

ISO 13385-2

Second edition
2020-05

Geometrical product specifications (GPS) — Dimensional measuring equipment —

Part 2: Design and metrological characteristics of calliper depth gauges

Spécification géométrique des produits (GPS) — Équipement de mesurage dimensionnel —

Partie 2: Caractéristiques de conception et caractéristiques métrologiques des jauges de profondeur

Reference number
ISO 13385-2:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: 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 (see 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 (see 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 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 13385-2:2011), which has been technically revised.

The main changes to the previous edition are as follows:

— figures have been updated to show more modern technology;

— general design characteristics have been removed and reference to ISO 14978:2018 included;

— metrological characteristics have been clarified and modified;

— requirements for test methods have been included;

— default values for maximum permissible errors have been added.

A list of all parts in the ISO 13385 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 links F and G of the chain of standards on size and distance in the general GPS matrix (see Annex C).

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 specifications made in accordance with this document, unless otherwise indicated; see ISO/TR 14253-6 for additional information on the selection of alternative decision rules.

For more detailed information on the relation of this document to other standards and the GPS matrix model, see Annex C.

Geometrical product specifications (GPS) — Dimensional measuring equipment —

Part 2:
Design and metrological characteristics of calliper depth gauges

1 Scope

This document specifies the most important design and metrological characteristics of calliper depth gauges

— with analogue indication: vernier scale or circular scale (dial); and

— with digital indication: digital display.

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 14253-1, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for verifying conformity or nonconformity with specifications*

ISO 14253-5, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 5: Uncertainty in verification testing of indicating measuring instruments*

ISO/TR 14253-6, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 6: Generalized decision rules for the acceptance and rejection of instruments and workpieces*

ISO 14978:2018, *Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14978 and ISO/IEC Guide 99 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org

3.1
calliper depth gauge
measuring instrument which gives the evaluation of a dimensional quantity of a step or depth of a feature corresponding to the distance between the end of a beam and the face of a measuring base on the basis of the movement of a slider, moving relative to a measuring scale on a rigid beam

Note 1 to entry: See examples in Figures 1 and 2.

Note 2 to entry: The indication can be either analogue (vernier scale or circular scale) or digital.

3.2
measuring face contact
contact between the measuring face and an integral feature of a workpiece

3.2.1
full measuring face contact
contact between the full area of the measuring face and an integral feature of a workpiece

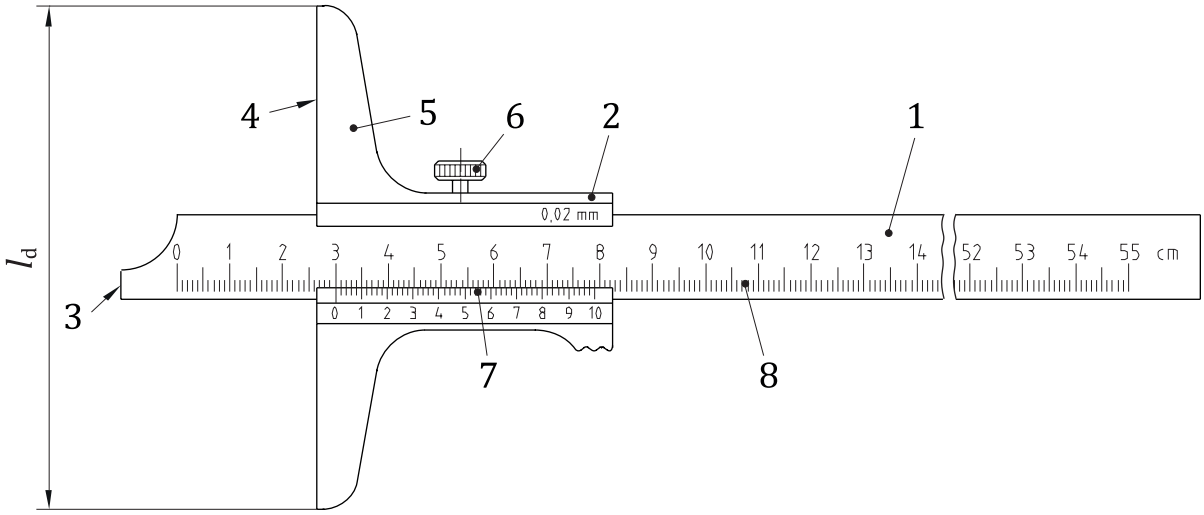
3.2.2
partial measuring face contact
contact between a partial area of the measuring face and an integral feature of a workpiece

4 Design characteristics

4.1 General design and nomenclature

The design shall follow the general guidelines in ISO 14978, including the common design characteristics in ISO 14978:2018, Annex C. Examples of the general design of calliper depth gauges are shown in Figures 1 and 2.

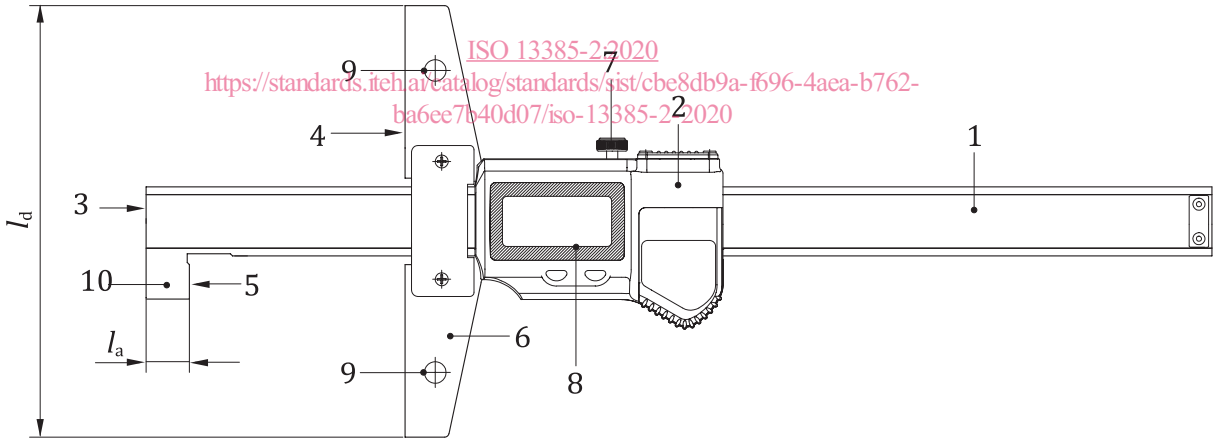
The scale interval of the main scale on the beam of a calliper depth gauge with a vernier scale shall be 1 mm. In the case of callipers with circular scales, the scale interval on the beam shall be either 1 mm or 2 mm.



Key

1	beam	6	locking screw
2	slider	7	vernier scale
3	depth measuring face	8	main scale
4	base measuring face	l_d	length of measuring base
5	measuring base		

Figure 1 — Example design of a vernier calliper depth gauge (slider with locking screw)



Key

1	beam	7	locking screw
2	slider	8	digital display
3	depth measuring face	9	fixing holes for extension measuring base
4	base measuring face	10	hook
5	hook measuring face	l_d	length of measuring base
6	measuring base	l_a	width of hook

Figure 2 — Example design of a digital calliper depth gauge with a hook end and with fixing holes for an extension measuring base

4.2 Dimensions

The manufacturer shall state important calliper depth gauge design dimensions, such as those shown in Table 1. The values shown in Table 1 are typical dimensions of the elements of calliper depth gauges and are not requirements of this document.

For calliper depth gauges with a hook end, the manufacturer shall state the dimensions of the hook.

Table 1 — Typical dimensions of calliper depth gauges

Dimensions in millimetres

Measuring range less than or equal to	Length, l_d, of the measuring base
150	100
200	100
250	100
300	100 to 150
350	100 to 150
500	150 to 250
1 000	150 to 250

5 Metrological characteristics

5.1 General

The metrological characteristics and associated maximum permissible error (MPE) values apply to any indications permitted for use of the calliper depth gauge as defined by the manufacturer and when used in accordance with the manufacturer's recommendations. See Annex A for additional information. The MPE values cannot be smaller than the digital step or the scale interval on the circular scale or vernier scale.

5.2 Rated operating conditions

The manufacturer shall state any rated operating conditions that apply to the MPE values. All MPE values apply at a rated operating condition for a temperature of 20 °C exactly, unless otherwise stated.

Test values shall therefore be corrected to 20 °C to obtain the error of indication that the calliper depth gauge would have produced had the test been performed at 20 °C. If temperature correction to 20 °C is not performed, this document allows the consequences to be included in the evaluation of the measurement uncertainty of the test values (see 6.2).

A calliper depth gauge is a manually operated measuring instrument, and the user of the calliper depth gauge is therefore necessarily included in the measuring system that is specified in accordance with this document. The user shall be reasonably skilled in the operation of the calliper depth gauge.

5.3 Reference point

Calliper depth gauges with a digital display or a circular scale shall have an adjustable zero point. It shall be possible to set calliper depth gauges with a digital display to zero in any position within the measuring range; it shall be possible to set calliper depth gauges with a circular scale to zero within the range of the circular scale.

For calliper depth gauges with an adjustable zero point, the metrological characteristics described in this document apply when the measuring faces are properly pressed against a flat surface for zero or offset setting, and therefore the reference point is considered fixed at this point when evaluating the metrological characteristics.

For calliper depth gauges without an adjustable zero point, there can be an error when the depth measuring face is brought into contact with a flat surface. This error shall be included in the evaluation of the metrological characteristics without applying any correction for it.

5.4 Test methods

The errors of indication shall be tested with suitable instruments or measurement standards for example with gauge blocks according to ISO 3650 and a surface plate. When testing conformity to specification, sufficient testing shall be used to establish confidence in the results.

For acceptance testing, the customer is free to choose the test points; however, unless otherwise specified, the acceptance testing shall conform to the requirements in this document.

When considering test points, appropriate consideration shall be given to the calliper depth gauge design and operating conditions that might indicate the presence of short-length cyclic or local errors. For calliper depth gauges with circular scales or vernier scales, the chosen test points shall cover the range of the circular or vernier scale. For example, for calliper depth gauges with circular scales, test points shall be chosen that orient the pointer at various angles within the circular scale.

5.5 Partial surface contact error, E (limited by E_{MPE})

The partial surface contact error is the error of indication when partial measuring face contact is employed to measure a measurement standard. This error is calculated as the signed difference between the calliper depth gauge indication and the reference value of the measurement standard.

The partial surface contact error shall be tested by measuring a measurement standard whose physical interface with the base has a relatively small surface, for example a pair of gauge blocks according to ISO 3650 standing on a suitable surface plate at multiple test points located across the measuring range of the calliper depth gauge and located on different positions along the base measuring face (see Figure 3).

The test points shall be distributed as evenly as practicable across the measuring range of the calliper depth gauge with the minimum number of test points according to Table 2. At least one test point shall be at 90 % or greater of the measuring range. The reference point does not count towards satisfying the minimum test points in Table 2. Two test points, one near the beam and one as far as possible from the beam, shall be taken for both the longest and shortest measurement standards in the test for partial surface contact error (see Figure 3).

The averaging of multiple indications is not permitted when calculating the partial surface contact error. As such, the influence of repeatability is included in the test for partial surface contact error.

NOTE The partial surface contact error is intended to detect a combination of calliper depth gauge errors, for example scale errors, the effect of the applied measuring force, the play between the beam and the slider, the deflection of the beam and the influence of the flatness of the measuring base.