INTERNATIONAL STANDARD

ISO 13385-1

Second edition
2019-08

Geometrical product specifications (GPS) — Dimensional measuring equipment —

Part 1: Design and metrological characteristics of callipers

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

Partie 1: Caractéristiques de conception et caractéristiques métrologiques des pieds à coulisse

Reference number
ISO 13385-1:2019(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

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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 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*.

This second edition cancels and replaces the first edition (ISO 13385-1:2011), which has been technically revised.

The main changes compared 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 the 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 1:
Design and metrological characteristics of callipers

1 Scope

This document provides the most important design and metrological characteristics of callipers

— 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
measuring instrument which evaluates a dimensional quantity of an internal or external feature on the basis of opposing contact from the movement of a slider with a measuring jaw, moving relative to a measuring scale on a rigid beam and to a fixed jaw

Note 1 to entry: See examples in Figures 1, 2 and 3.

Note 2 to entry: Callipers can be equipped for additional measurements, such as depth and step measurements (see Figures 1 and 2).

Note 3 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

3.2.3
measuring face line contact
contact between a line, nominally perpendicular to the length of the jaws, on the measuring face and an integral feature of a workpiece

4 Design characteristics

4.1 General design and nomenclature

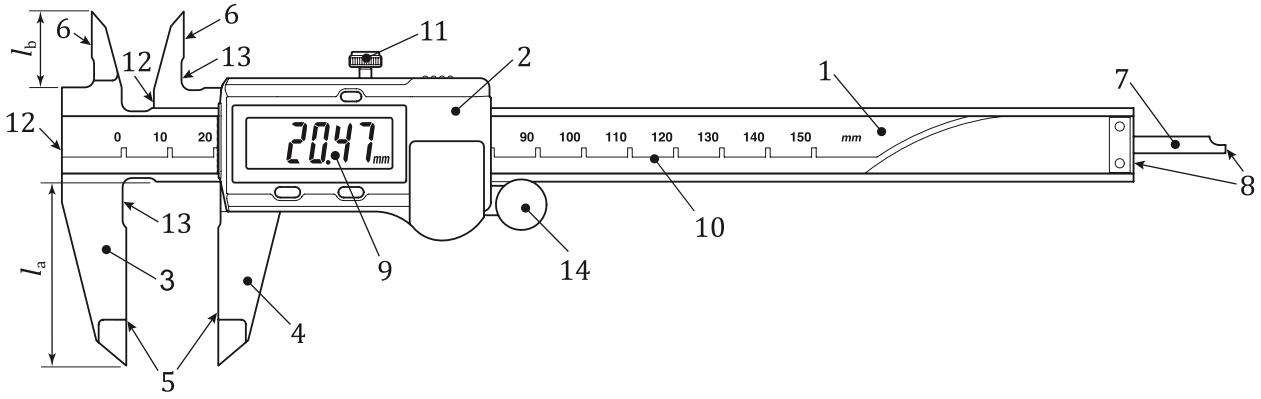
The design shall follow the general guidelines in ISO 14978, including the common design characteristics in ISO 14978:2018, Annex C. Examples of the general design of callipers are shown in Figures 1, 2 and 3.

The scale interval of the main scale on the beam of a calliper 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.

4.2 Dimensions

The manufacturer shall state important calliper design dimensions, such as those shown in Table 1. The values shown in Table 1 are typical dimensions of the elements of callipers and are not requirements of this document. Table 1 does not include the length of the undercut, which is typically kept as small as practicable.

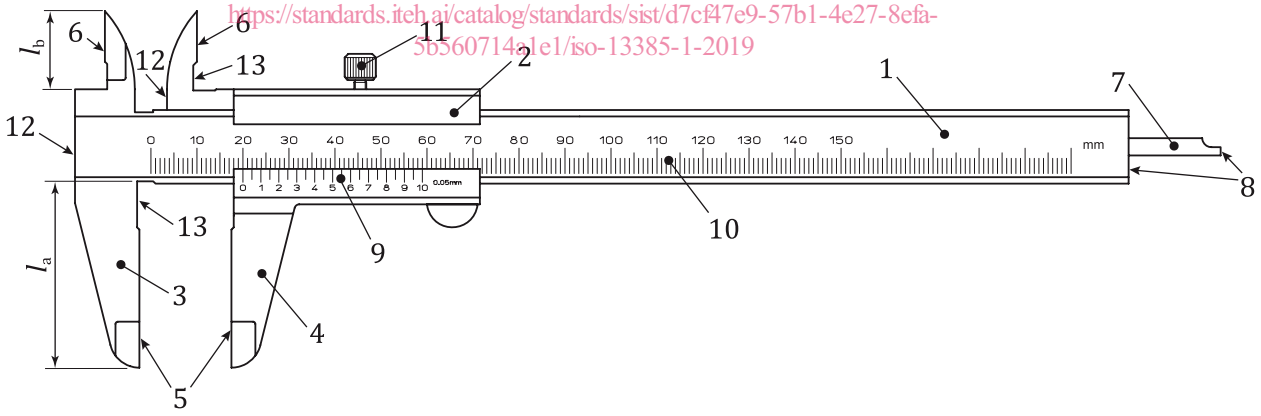
For callipers equipped with a depth measuring rod, the manufacturer shall state the cross-sectional dimensions of the rod, for example Ø 1,5 mm for round section or 1,2 mm × 3 mm for rectangular section.



Key

1	beam	9	digital display
2	slider	10	main scale
3	fixed (measuring) jaw	11	locking screw
4	sliding (measuring) jaw	12	measuring faces for step measurement
5	measuring faces for external measurements	13	undercut
6	measuring faces for internal measurements (crossed knife-edge faces)	14	thumb roller
		l_a	length of jaw for external measurements
7	depth measuring rod	l_b	length of jaw for internal measurements
8	measuring faces for depth measurement		

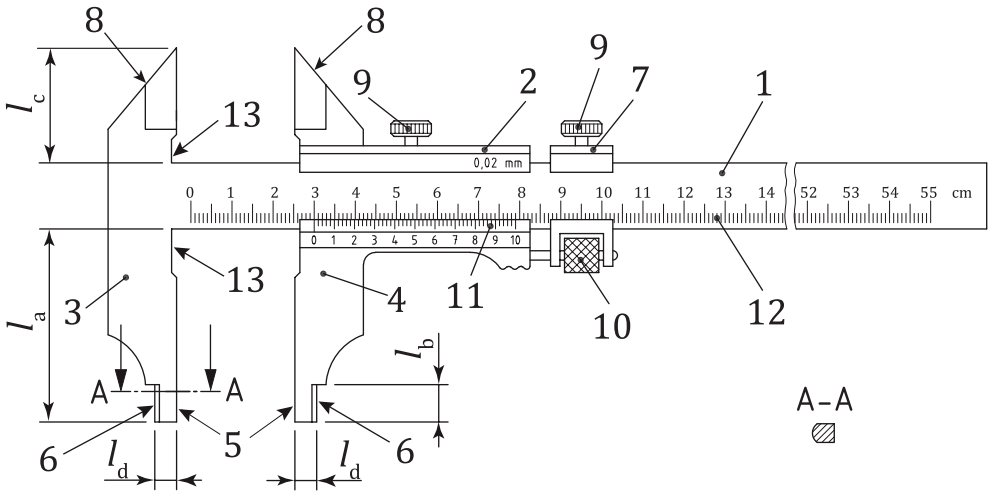
Figure 1 — Example design of callipers with digital display for external, internal, depth and step measurement



Key

1	beam	8	measuring faces for depth measurement
2	slider	9	vernier scale
3	fixed (measuring) jaw	10	main scale
4	sliding (measuring) jaw	11	locking screw
5	measuring faces for external measurements	12	measuring faces for step measurement
6	measuring faces for internal measurements (crossed knife-edge faces)	13	undercut
		l_a	length of jaw for external measurements
7	depth measuring rod	l_b	length of jaw for internal measurements

Figure 2 — Example design of vernier callipers for external, internal, depth and step measurement



Key

1	beam	10	fine adjustment device
2	slider	11	vernier scale
3	fixed (measuring) jaw	12	main scale
4	sliding (measuring) jaw	13	undercut
5	measuring faces for external measurements	l_a	length of jaw for external measurements
6	measuring faces for internal measurements	l_b	length of jaw for internal measurements
7	fine adjustment clamp	l_c	length of knife-edge jaw for external measurements
8	knife edges for external measurements	l_d	width of measuring faces
9	locking screw		

Figure 3 — Example design of vernier callipers for external and internal measurements and with a fine adjustment device

Table 1 — Typical dimensions of callipers

Dimensions in millimetres

Measuring range less than or equal to	Lengths l_a, l_b and l_c of the jaws					Width l_d of the faces for internal measurement
	Calliper according to Figure 1 or 2		Calliper according to Figure 3			
	l_a	l_b	l_a	l_b	l_c	
150	40	8 to 20	50	8 to 10	25 to 35	5
200	40 to 50	8 to 25	60 to 80	8 to 10	25 to 35	5
300	60 to 65	10 to 30	70 to 100	10 to 12	35 to 45	5
500	70 to 95	15 to 40	100 to 150	15 to 20	50 to 60	5 or 10
750	70 to 95	15 to 40	100 to 150	15 to 20	50 to 60	5 or 10
1 000	100 to 130	20 to 60	125 to 150	20 to 30	50 to 60	10 to 20
1 500	100 to 130	20 to 60	150 to 200	20 to 30	50 to 60	10 to 20
2 000	100 to 130	20 to 60	150 to 200	20 to 30	50 to 60	10 to 20

NOTE The measuring range refers to external measurements for the callipers in Figures 1, 2 and 3.

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 as defined by the manufacturer and when used in accordance with the manufacturer's recommendations. 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 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 (see 6.2).

A calliper is a manually operated measuring instrument, and the user of the calliper 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.

5.3 Reference point

Callipers with a digital display or a circular scale shall have an adjustable zero point. Callipers with a digital display shall be able to be set to zero in any position within the measuring range; callipers with a circular scale shall be able to be set to zero within the range of the circular scale.

For callipers with an adjustable zero point, the metrological characteristics described in this document apply when the measuring faces for external measurements are properly brought into contact for zero setting, and therefore the reference point is considered fixed at this point when evaluating the metrological characteristics.

For callipers without an adjustable zero point, there can be an error when the external measuring faces are brought into contact with each other. 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 with an appropriate measurement uncertainty, for example with gauge blocks according to ISO 3650, step gauges or setting ring gauges. 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 design and operating conditions that might indicate the presence of short-length cyclic or local errors. For callipers with circular scales or vernier scales, the chosen test points shall cover the range of the circular or vernier scale. For example, for callipers 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 using the external measuring faces. This error