BS ISO 11093-4:2016

BSI Standards Publication

Paper and board — Testing of cores

Part 4: Measurement of dimensions

bsi.

National foreword

This British Standard is the UK implementation of ISO 11093-4:2016. It supersedes BS ISO 11093-4:1997 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PAI/11, Methods of test for paper, board and pulps.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected

BS ISO 11093-4:2016

INTERNATIONAL STANDARD

ISO 11093-4

Second edition
2016-06-01

Paper and board — Testing of cores —

Part 4: Measurement of dimensions

Papier et carton — Essais des mandrins —

Partie 4: Mesurage des dimensions

Reference number
ISO 11093-4:2016(E)

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Contents

Page

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Foreword

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 6, *Paper, board and pulps*.

This second edition cancels and replaces the first edition (ISO 11093-4:1997), which has been technically revised.

ISO 11093 consists of the following parts, under the general title *Paper and board — Testing of cores*:

— *Part 1: Sampling*

— *Part 2: Conditioning of test samples*

— *Part 3: Determination of moisture content using the oven drying method*

— *Part 4: Measurement of dimensions*

— *Part 5: Determination of characteristics of concentric rotation*

— *Part 6: Determination of bending strength by the three-point method*

— *Part 7: Determination of flexural modulus by the three-point method*

— *Part 8: Determination of natural frequency and flexural modulus by experimental modal analysis*

— *Part 9: Determination of flat crush resistance*

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INTERNATIONAL STANDARD ISO 11093-4:2016(E)

Paper and board — Testing of cores —

Part 4: Measurement of dimensions

1 Scope

This part of ISO 11093 specifies test methods for the determination of the internal diameter, the external diameter, the wall thickness and the length, of paper and board cores.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Callipers; Design and metrological characteristics*

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 11093-1, *Paper and board — Testing of cores — Part 1: Sampling*

ISO 11093-2, *Paper and board — Testing of cores — Part 2: Conditioning of test samples*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
internal diameter
d
dimension of the internal width of the cylindrical core

Note 1 to entry: See Figure 1.

3.2
external diameter
D
dimension of the external width of the cylindrical core

Note 1 to entry: See Figure 1.

3.3
wall thickness
s
distance between the inner and outer surfaces of the core

Note 1 to entry: See Figure 1.

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3.4
length
l
distance between the two ends of the core

Note 1 to entry: See Figure 1.

3.5
deformation
visual surface changes which can affect test results

EXAMPLE Seams, lab joints and cutting burrs.

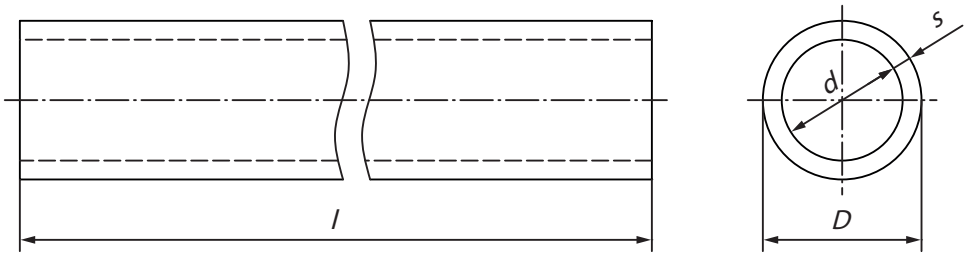

Figure 1 — Diagram of a core showing dimension lines

4 Sampling

Samples shall be taken in accordance with ISO 11093-1.

NOTE For the purpose of measuring the length, the specimen constitutes the test piece.

5 Conditioning

Test pieces shall be conditioned in accordance with ISO 11093-2.

6 Measurement of internal diameters

6.1 General

Four methods of measuring and calculation the internal diameter are available. They are of differing accuracy and speed. The method used shall be compatible with the type of core being measured and shall be specified.

— Method A: Internal tri-point micrometer (see Figure A.1).

— Method B: Internal vernier calliper (see Figure B.1 and Figure B.2).

— Method C: Calibrated step mandrel.

— Calculation.

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6.2 Method A

6.2.1 Apparatus

An internal tri-point micrometer equipped with a ratchet and accurate to at least 0,025 mm. The instrument shall also be fitted with a slip arrangement such that the measuring force cannot exceed the following:

— internal diameter up to 100 mm: (4,5 ± 0,2) N;

— internal diameter over 100 mm: (9,0 ± 0,3) N.

6.2.2 Procedure

Before using, the device should be calibrated with the help of a calibration ring. To get accurate results, use, if possible, a measurement plate or a centring ring. Avoiding any obvious deformation, insert the tri-point micrometer at least 10 mm from one end of the test piece in a way that device is accurately in core direction. Take two measurements, to the nearest 0,025 mm, approximately 60° apart. Repeat the procedure at the other end of the test piece. Average the four readings and report to the nearest 0,025 mm.

6.3 Method B

6.3.1 Apparatus

A vernier calliper accurate to at least 0,1 mm (see ISO 13385-1).

6.3.2 Procedure

Avoiding any obvious deformations, insert the calliper into the test piece such that the measuring faces are aligned axially and radially. Take two measurements, to the nearest 0,1 mm, 90° apart. Repeat the procedure at the other end of the test piece. Average the four readings and report to the nearest 0,1 mm.

6.4 Method C

6.4.1 Apparatus

A solid round mandrel with external diameters spanning the accuracy range for the diameter to be measured. The mandrel is stepped over its length and graduated in increasing diameters of 0,1 mm with a diameter tolerance of ±0,01 mm and each step having a minimum length of 50 mm.

An example of a solid mandrel is given in Figure 2.

6.4.2 Procedure

Insert the mandrel into the test piece until a push fit is obtained and note the graduation at this point. Repeat this procedure at the other end of the test piece. Average the two results and report to the nearest 0,1 mm.

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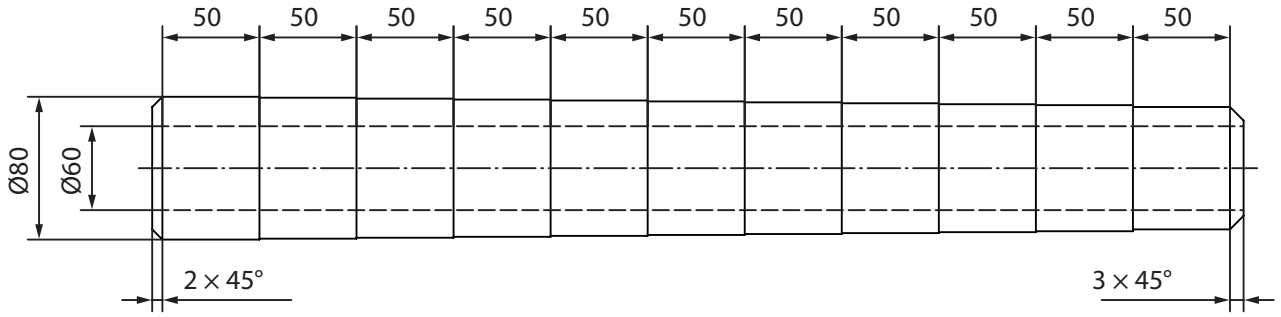

Figure 2 — Example of a calibrated step mandrel

6.5 Calculation

Measure the external diameter, *D*, and the wall thickness *s* of the test piece as detailed in Clause 7 and Clause 8. Calculate the internal diameter, *d*, using Formula (1):

$$d = D - 2s \tag{1}$$

7 Measurement of external diameters

7.1 General

Three methods of measuring the external diameter are available. They are of differing accuracy and speed. The method used shall be reported and should be compatible with the type of core being measured.

— Method D: External micrometer (see Figure C.1).

— Method E: External vernier calliper (see Figure B.1 and Figure B.2).

— Method F: Flexible tape.

7.2 Method D

7.2.1 Apparatus

A micrometer accurate to at least 0,025 mm (see ISO 3611). In addition, the micrometer anvil and spindle faces shall be flat and parallel and have a diameter between 6,00 mm and 8,00 mm. The ratchet drive should allow a measuring force between the following values:

— external diameter up to 150 mm: 4 N to 12 N;

— external diameter over 150 mm: 4 N to 14 N.

7.2.2 Procedure

In order to avoid any obvious deformations, position the micrometer round the test piece at least 10 mm from the end. Ensure that the faces of the measuring anvil and the measuring spindle are radially aligned to the test piece. The measurement shall be made by means of the external micrometer and recorded to the nearest 0,025 mm. The micrometer shall be rotated along the circumference in order to determine the minimum and maximum values. Repeat the procedure at the other end of the core. Average the four readings and report the result to the nearest 0,025 mm.

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7.3 Method E

7.3.1 Apparatus

A vernier caliper accurate to at least 0,1 mm (see ISO 13385-1).

7.3.2 Procedure

In order to avoid any obvious deformations, position the vernier caliper at one end of the test piece as shown in Figure 3 ensuring that no deformation of the test piece surface is caused. Measure and record results to the nearest 0,1 mm.

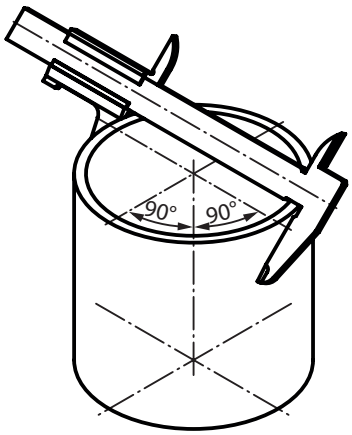

Figure 3 — Position of vernier caliper

Rotate the test piece through 180°. The vernier caliper shall be rotated along the circumference in order to determine the minimum and maximum values. Repeat the procedure at the other end of the winding core. Average the four readings and report the result to the nearest 0,1 mm.

7.4 Method F

7.4.1 Apparatus

A flat, fully flexible, metal tape graduated in millimetres.

NOTE A more accurate result can be obtained using a circumferential tape with a vernier scale with 0,1 mm graduations.

7.4.2 Procedure

Wrap the tape around the test piece at least 10 mm from the end, ensuring that the tape is flat on the surface and avoiding any obvious deformations. The tape shall be perpendicular to the axis of the cylindrical core. Record the measurement to the nearest millimetre.

If the tape used does not allow a direct reading of the diameter, Formula (2) shall be used:

$$D = \frac{C}{\pi} \tag{2}$$

where

C is the circumference, in millimetres;

D is the external diameter, in millimetres.

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8 Measurement of wall thickness

8.1 General

Three methods of measuring the wall thickness are available. They are of differing accuracy and speed. The method used shall be compatible with the type of core being measured and shall be reported.

— Method G: Wall-thickness micrometer (see Figure C.2).

— Method H: External vernier calliper (see Figure B.2).

— Calculation.

8.2 Method G

8.2.1 Apparatus

A micrometer accurate to at least 0,025 mm (see ISO 3611). In addition, the anvil shall be replaced by a cylindrical anvil where the length of the anvil shall be parallel to the spindle face. The dimensions of the anvil and spindle shall be in the following ranges:

— anvil diameter: 8,0 mm to 9,5 mm;

— anvil length: 7,0 mm to 9,0 mm;

— spindle face diameter: 6,0 mm to 8,0 mm.

The ratchet drive shall allow a measuring force in the range 4 N to 14 N.

8.2.2 Procedure

Avoiding any obvious deformations, position the micrometer anvil inside one end of the test piece at least 10 mm from the end and ensure that the spindle face is parallel to the axis of the cylindrical test piece. Close the micrometer and record the measurement to the nearest 0,025 mm. Rotate the test piece through 90° and repeat the measurement. Repeat the procedure at the other end of the core. Average the four measurements and record to the nearest 0,025 mm.

8.3 Method H

8.3.1 Apparatus

A vernier caliper accurate to at least 0,1 mm (see ISO 13385-1).

8.3.2 Procedure

Avoiding any obvious deformations, position the vernier calliper with one face inside the test piece. Ensure that the faces of the vernier calliper are parallel to the lengthwise axis of the test piece. Close the faces, ensuring no deformation of the test piece surface, and record the measurement to the nearest 0,1 mm. Rotate the test piece through approximately 120° and repeat the measurement. Rotate through a further 120° and repeat the measurement. Repeat the procedure at the other end of the core. Average the six readings and record to the nearest 0,1 mm.

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8.4 Calculation

Measure the external diameter, *D*, and the internal diameter, *d*, of the test piece as detailed in Clause 6 and Clause 7. Calculate the wall thickness *s* using Formula (3):

$$s = \frac{D - d}{2} \tag{3}$$

9 Measurement of length

9.1 Apparatus

A flexible metal tape graduated in millimetres and fitted with a hook at one end. The hook shall be at a right angle to the tape face and not less than 10 mm high. For lengths of less than 500 mm, it is permissible to use an external vernier calliper according to ISO 13385-1.

9.2 Procedure

Avoiding any obvious deformations, insert the tape into the test piece. With the hook held firmly against the end face of the test piece and ensuring that the tape is parallel to the longitudinal axis, record the measurement to the nearest millimetre. Rotate the test piece through 120° and repeat the measurement. Rotate through a further 120° and repeat the measurement. Repeat the above procedure at the other end of the core. Average the six measurements and record to the nearest millimetre.

Where it is not practical to measure the inside length, the outside length may be measured, the procedure being the same.

10 Test report

The test report shall include the following information:

a) reference to this part of ISO 11093, i.e. ISO 11093-4;

b) type and designation of the sample tested;

c) date of testing;

d) measurement method used for each dimension;

e) individual values, in millimetres, separately for internal diameter, external diameter, wall thickness and length; values being recorded in ascending order with any mean or standard deviation, if calculated;

f) date and signature;

g) any departure from this part of ISO 11093 or any other circumstances that might have affected the results.

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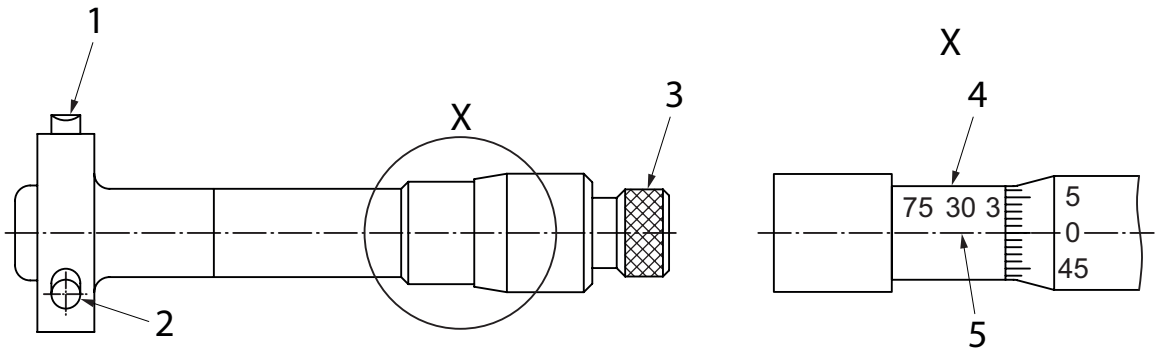
Annex A
(informative)

Example of an internal-tri-point micrometer



Key

1 measuring bolt
2 face for internal measurements
3 coupling (ratchet)
4 barrel
5 fiducial line

Figure A.1 — Example of an internal tri-point micrometer

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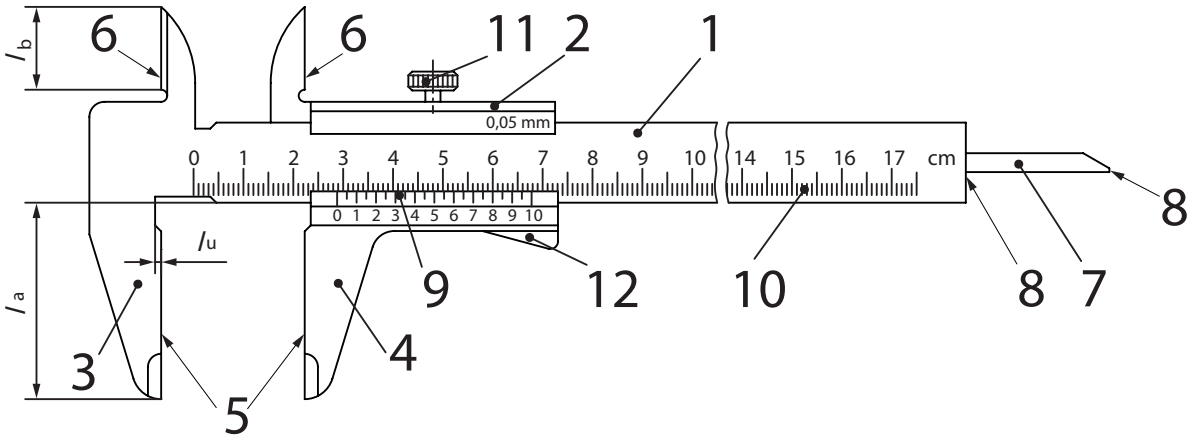
Annex B
(informative)

Examples of vernier callipers



Key

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

Figure B.1 — Example for a design of a calliper for external internal and depth measurement (slider with locking screw or with clamping device)

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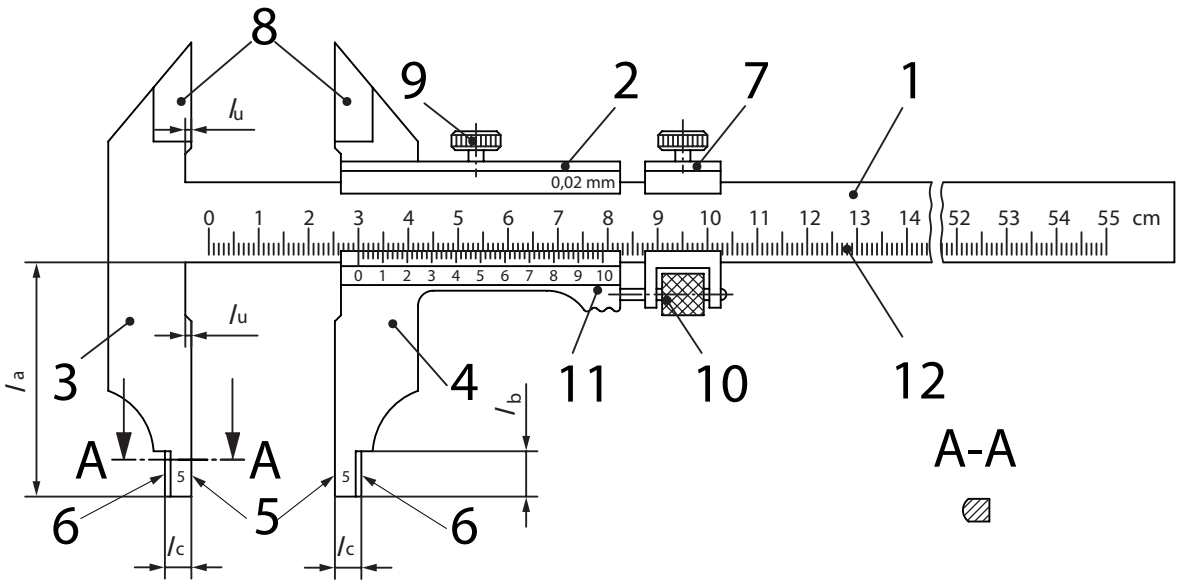

Key

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

Figure B.2 — Example for a design of callipers for external and internal measurement with a fine adjustment device

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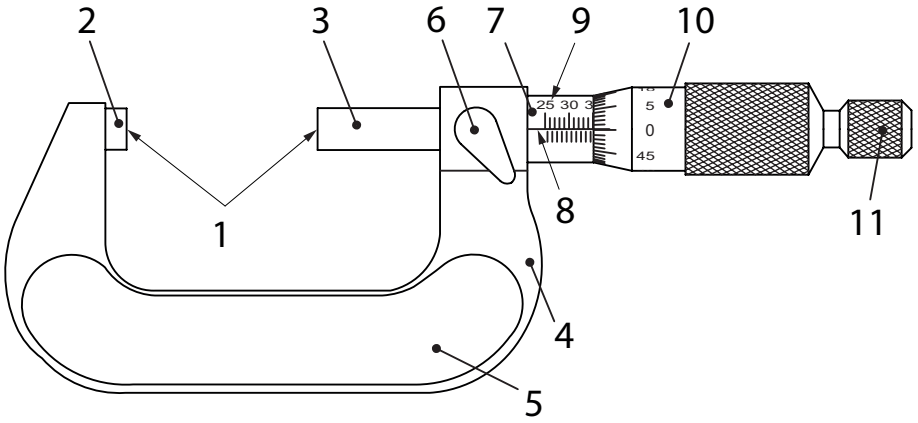
Annex C
(informative)

Other examples

C.1 External micrometer equipment



Key

1 measuring faces
2 anvil
3 measuring spindle
4 frame
5 thermally insulating plate
6 spindle clamp
7 sleeve
8 fiducial line
9 analogue indication
10 thimble
11 fast drive

Figure C.1 — Example of nomenclature and general design of a micrometer for external measurements

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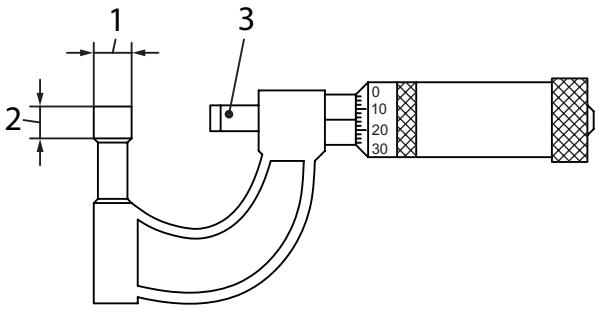
C.2 Wall thickness micrometer equipment



Key

1 anvil diameter
2 anvil length
3 spindle diameter

Figure C.2 — Example of wall-thickness micrometer

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