Micrometers
Part 4: Internal micrometers
Concepts, requirements and testing

DIN 863-4

ICS 01.040.17; 17.040.30

Supersedes
June 1981 edition.

Prüfen geometrischer Größen – Meßschrauben –
Teil 4: Innenmeßschrauben – Begriffe, Anforderungen, Prüfung

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Foreword

This standard has been prepared by the *Normenausschuß Technische Grundlagen* (Fundamentals in Technology Standards Committee).

The DIN 863 series of standards comprises the following:

Part 1: Standard design external micrometers – Concepts, requirements and testing
Part 2: Fixed micrometers and depth micrometers – Concepts, requirements and testing
Part 3: Special design external micrometers – Designs, requirements and testing
Part 4: Internal micrometers – Concepts, requirements and testing

Amendments

The following amendments have been made to the June 1981 edition.

a) The terminology has been harmonized with the relevant international literature [1].
b) Specifications regarding repeatability have been modified.
c) The standard has been editorially revised.

Previous edition

DIN 863-4: 1981-06.

1 Scope

This standard specifies design, dimensional and performance requirements for and the testing of internal micrometers with measuring capacities up to 500 mm, having 0,01 mm scale intervals or digital increments and a span of 25 mm.

2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the titles of the publications are listed below. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 102	Reference temperatures for measuring instruments and workpieces
DIN 878	Dial gauges
DIN 1319-1	Basic concepts in metrology – General concepts
DIN 1319-2	Basic concepts in metrology – Terminology relating to the use of measuring instruments

Continued on pages 2 to 7.

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original should be consulted as the authoritative text.

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DIN 2250-1	GO ring gauges and setting ring gauges from 1 to 315 mm nominal diameter, for general purposes and pneumatic length measuring instruments
DIN 2257-1	Terminology used in dimensional metrology – Units, activities, checking instruments – Metrological concepts
DIN 4768	Determination of surface roughness parameters R_a, R_z, and R_{max}, using electric stylus instruments – Concepts and measuring conditions
DIN EN ISO 3650	Geometrical Product Specifications (GPS) – Length standards – Gauge blocks (ISO 3650 : 1998)

[1] International vocabulary of basic and general terms in metrology (VIM), published by the International Organization for Standardization (ISO), 1993.*)

3 Terminology

3.1 Concepts

For the purposes of this standard, the concepts defined in DIN 1319-1, DIN 1319-2, DIN 2257-1 and [1] apply, in addition to the following:

3.1.1 Internal micrometer

A device with an integrated, threaded material measure, used to measure internal dimensions (such as bores). Internal micrometers with 3-point contact on the object of measurement have retractable contact plungers with conical measuring elements.

3.1.2 Maximum permissible error

Extreme value of an error permitted for micrometers as in this standard (cf. 5.21 in [1]); in this standard, termed 'limit of error' and designated as G.

3.1.3 Repeatability (of a measuring instrument)

Ability of a measuring instrument to provide closely similar indications for repeated applications of the same measurand under the same conditions of measurement (from [1]).

3.2 Nomenclature

See figures 1 to 3 for nomenclature used in this standard.

4 Designation

Designation of a type A2 internal micrometer (A2) in accordance with this standard with a measuring range of 100 to 125 mm (100–125):

Micrometer DIN 863 – A2 – 100–125

5 Requirements

5.1 Scales

5.1.1 Thimble

The thimble should have a scale with 50 or 100 divisions, with scale intervals of 0,01 mm. The scale marks shall be cleanly cut. The scale spacing shall be at least 0,8 mm, and the scale mark thickness at least 0,08 mm but no greater than 0,2 mm. If the thimble is bevelled, the angle of the bevel shall be between 10° and 20° (see figure 4).

The distance between the barrel and the thimble surface should not exceed 0,3 mm (see figure 4).

5.1.2 Barrel

The thickness of the fiducial line and the scale marks on the barrel shall not differ by more than 30 µm from that of the scale marks on the thimble.

For micrometers having a 0,5 mm screw thread pitch, the 0,5 scale marks shall extend both above and below the fiducial line to clearly distinguish them from the 1 mm marks.

5.2 Digital display

Digital displays shall be designed so that the measured value is clearly indicated at any spindle position.

5.3 Design features of internal micrometers with 2-point contact (types A and B)

5.3.1 Spindle

The spindle screw thread should have a pitch of 0,5 or 1 mm. There shall be no perceptible shake between the spindle and the nut. The spindle screw thread shall be fully engaged in the nut thread over the entire measuring range.

*) Obtainable from *Beuth Verlag GmbH*, Burggrafenstraße 6, D-10787 Berlin.

5.3.2 Spindle locking device

If a spindle locking device is provided, it shall be designed so that it locks the spindle without altering the distance between the measuring faces by more than 2 µm.

5.3.3 Anvil

Anvils may be adapted to special measuring purposes, for instance by fitting them with threaded inserts for thread measurement.

In the case of type B micrometers, the measuring force shall be applied to the anvil in the direction of measurement only. The anvil may be interchangeable, allowing measurement outside of the micrometer axis.

5.3.4 Measuring faces

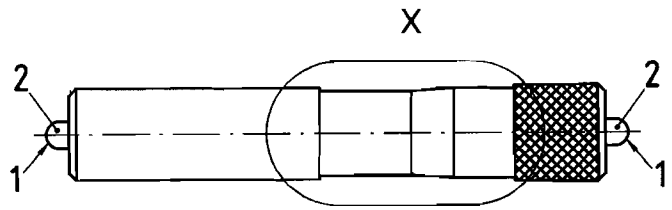
Measuring faces of type A and B micrometers shall be rounded, and their radius shall be less than half the lowest value of the measuring range.

5.3.5 Extensions

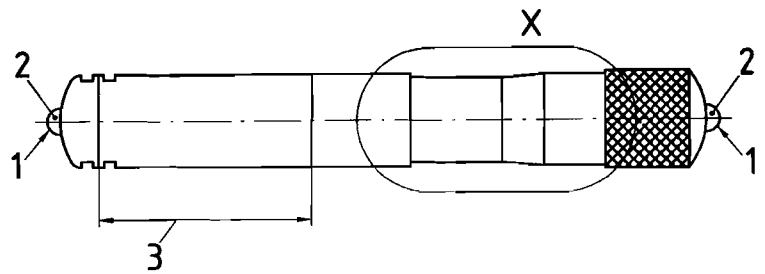
The measuring range of type A2 and B micrometers may be increased by means of extensions, which may have integrated circular gauge blocks as material measures. The measuring faces of the blocks shall be such that, in each case, a rounded measuring face comes in contact with a flat one. Connecting elements which join extensions to each other and to the micrometer shall be designed to ensure a rigid connection.

The designs shown are for illustrative purposes only.

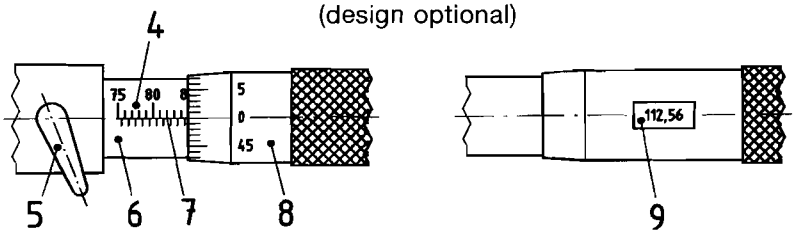
Type A1



Type A2 (with extension)



Detail X
(design optional)



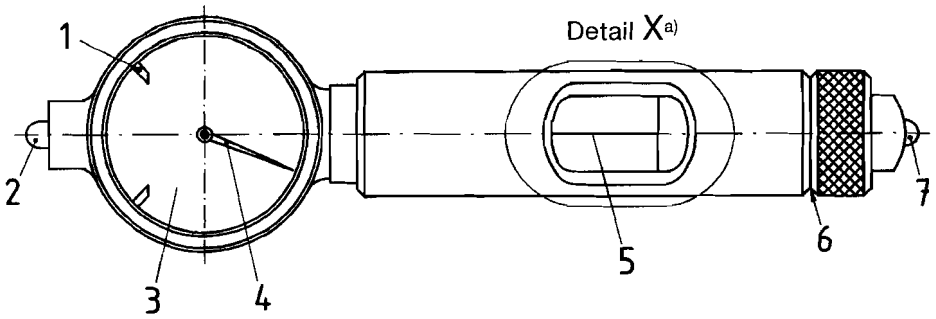
Spindle locking device and indication at manufacturer's discretion.

1 Measuring face
2 Anvil
3 Extension
4 Analogue display
5 Spindle locking device
6 Barrel
7 Fiducial line
8 Thimble
9 Digital display

Figure 1: Internal micrometer with 2-point contact (nomenclature)

The designs shown are for illustrative purposes only.

Type B



1 Adjustable tolerance marks
2 Adjustable anvil
3 Measuring device (e.g. DIN 878 dial gauge)
4 Dial indicator
5 Fiducial line
6 Separation point for extensions
7 Anvil
[a)] Detail X as in figure 1.

Figure 2: Internal micrometer with adjustable anvil and 2-point contact (nomenclature)

5.4 Design features of internal micrometers with 3-point contact (type C)

5.4.1 Measuring faces

For testing cylindrical bores, the three measuring faces of the micrometer shall be cylindrical so that there is linear contact along the face of the object of measurement. The radius of the faces shall be less than half of the lowest value of the measuring range.

For special measuring purposes, measuring heads or contact plungers may be interchangeable. The shape of the measuring faces shall be adapted to the measuring purpose (e.g. thread measurements).

5.4.2 Ratchet drive

Micrometers shall be fitted with a ratchet drive to ensure centring and alignment in every position.

The force acting on the measuring faces shall be specified by the manufacturer. The actual forces for micrometers of the same type, the same measuring range, and produced by the same manufacturer shall not fluctuate by more than 50 %.

5.4.3 Extensions

It should be possible to extend the length of the micrometers in order to reach into deep or deep-level bores. The separation point of the micrometer shall guarantee a reliable connection. Each time an extension is used, the micrometer shall be reset, since extensions for this type of micrometer normally are not material measures, as are the ones described in subclause 5.3.5.

5.5 Material and design

Micrometer elements establishing and registering the dimension shall be of an alloyed tool steel or equivalent material. Measuring faces and other elements subjects to wear within the measuring section may be of hardmetal or another equivalent hard material.

Measuring faces should not have any sharp edges. In terms of surface roughness, the ten point height of irregularities, R_Z, as defined in DIN 4768, shall be 0,8 µm or lower. The hardness of the faces shall be at least 760 HV 1 (equivalent to 62 HRC).

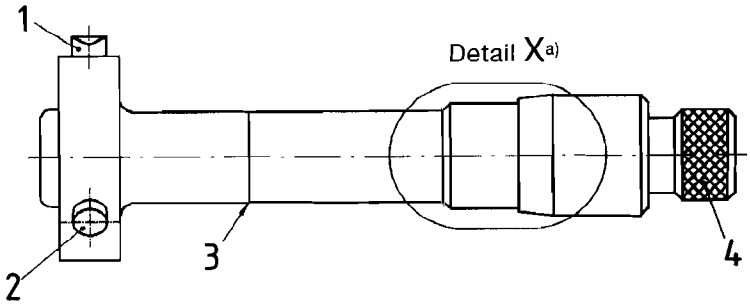
5.6 Adjusting devices

Every micrometer shall be provided with devices to adjust the zero setting and to compensate for wear of the spindle and nut threads. It shall be possible for the user to operate these devices.

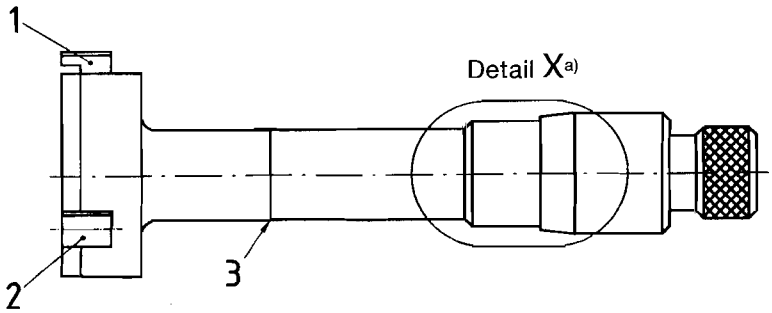
5.7 Setting the reading

The zero and end values of internal micrometers are set by the manufacturer.

Type C1

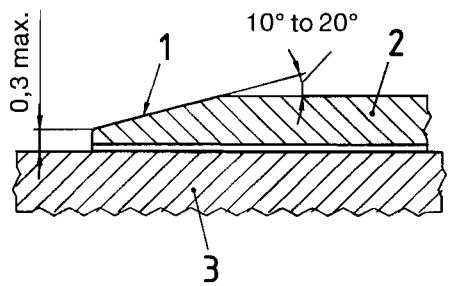


Type C2 (with measuring faces facing forward)



1 Contact plungers
2 Measuring face
3 Separation point for extensions
4 Ratchet drive
[a)] Detail X as in figure 1 (but without locking device).

Figure 3: Internal micrometer with 3-line contact (nomenclature)



1 Scale
2 Thimble
3 Barrel

Figure 4: Barrel and thimble design

5:8 Limits of error and tolerances

The limits of error specified in table 1 shall not be exceeded, and shall be met at any randomly selected setting and – in the case of type A2 micrometers – with any randomly selected extension.

NOTE: Any doubling of the limits of error is precluded because the specified values apply for any setting, including those at an extreme value.

For extensions used with 2-point micrometers, the length tolerance shall be js 2.

For type B micrometers, the repeatability limit, *r*, of the measuring device (e.g. dial gauge) shall be taken into consideration.

5.9 Reference temperature

The reference temperature shall be 20 °C in accordance with DIN 102.

6 Testing

6.1 Limits of error G

In the case of 2-point micrometers, the limits of error may be checked with ring gauges as in DIN 2250-1 or with another type of material measure, such as fixed calipers, gauge blocks or measuring jaws, or checked between the measuring faces of another dimensional measuring instrument.

Ring gauges shall be manufactured to JS 3.

The limits of error of 3-point micrometers may also be checked with setting ring gauges as in DIN 2250-1. Where it is difficult to produce such gauges (e.g. when the gauges are to have a nominal size greater than 200 mm), other material measures may be used, as long as these can ensure a reliable positioning of the micrometer's measuring faces. In any case, the measuring faces shall be completely encompassed by the material measure.

Gauges shall be manufactured to JS 3.

Material measures should be selected which permit testing at points which are integral multiples of the nominal pitch, as well as at intermediate positions. This way, values obtained at different angles of rotation of the spindle can also be used to determine any periodic errors.

6.2 Repeatability of types B and C micrometers

The repeatability of types B and C micrometers can be checked by means of setting gauges as in DIN 2250-1 or with special material measures. It should be noted that, in the latter case, deviations of form of the material measure may influence results.

Repeatability shall be checked at three points distributed over the entire measuring range. Five measurements shall be taken at each point; the maximum difference between the five results shall not be greater than the values specified for repeatability limit, r.

Table 1: Limits of error, G

Measuring range, in mm	Type A and B micrometers[1]	Type C micrometers[2]	
	Limits of error, G, in µm	Limits of error, G, in µm	Repeatability limit, r, in µm
3 to 10	—	4	4
Over 10 up to 50	4	4	4
Over 50 up to 100	5	5	5
Over 100 up to 150	6	6	6
Over 150 up to 200	7	7	7
Over 200 up to 250	8	8	8
Over 250 up to 300	9	9	9
Over 300 up to 350	10	—	—
Over 350 up to 400	11	—	—
Over 400 up to 450	12	—	—
Over 450 up to 500	13	—	—

[1] These values apply only to measurements taken along the instrument axis. For micrometers with an adjustable anvil, the repeatability values for the integrated material measure apply.

[2] Since all other errors are included in the repeatability limit, r and G have the same value.

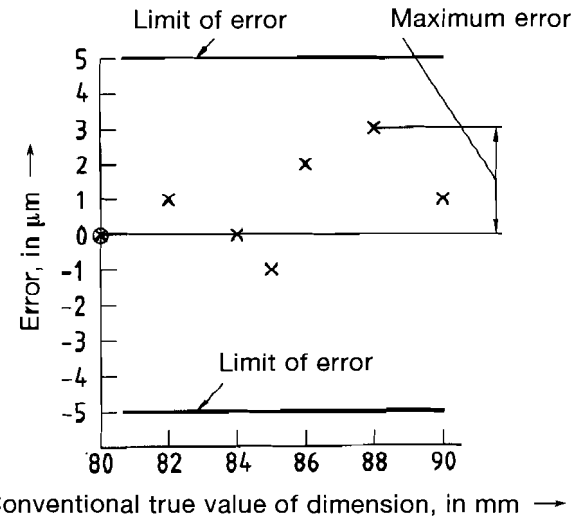


Figure 5: Limits of error for a micrometer with a measuring range of 80 mm to 90 mm, set at the lowest value

6.3 Length of gauge blocks of extensions for types A and B micrometers

The length of gauge blocks for extensions can be checked either using gauge blocks of grade 0 as in DIN EN ISO 3650 or with a suitable length measuring device.

7 Marking

Micrometers complying with this standard shall be legibly and permanently marked with the following information:

- scale interval or digital increment;
- measuring range;
- manufacturer's trademark or name.

Extensions for types A and B micrometers with 2-point contact shall be marked with the nominal length.

Appendix A (informative)

Information on use

A.1 Considerable skill and experience are required to obtain reliable results when using a 2-point micrometer to find a maximum dimension. Internal micrometers with adjustable anvils usually indicate the maximum value without the intervention of the tester.

With 3-point internal micrometers, the measuring head should be placed over the bore, and then the micrometer inserted by quickly rotating it with the help of the ratchet drive.

A.2 When using the 2-point micrometer to take measurements in the horizontal position, support should be provided at the Bessel points, as shown in figure A.1, to limit bending of the instrument as much as possible, especially in the case of large nominal dimensions.

A.3 Internal micrometers with 3-point contact should not be just set to one value and then used in the same way as a plug gauge.

A.4 3-point micrometers should not be left in the bore longer than necessary because it is possible that the object of measurement has become heated during the previous processing stage and the micrometer could become stuck in the bore during the cooling-down stage. The contact plungers should be retracted before the micrometer is removed from the bore.

A.5 Internal micrometers should be checked for wear or defects periodically (the intervals between checks will depend on the frequency and conditions of use).

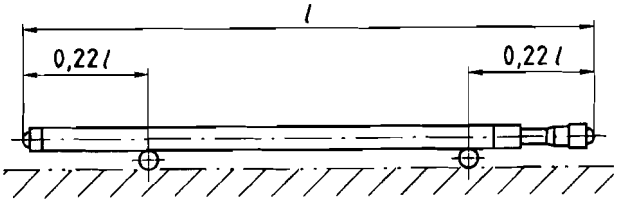


Figure A.1: Supporting micrometer to ensure minimum bending