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Micrometer callipers for external measurement

Micromètres d'extérieur

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# INTERNATIONAL STANDARD



# 3611

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

## Micrometer callipers for external measurement

*Micromètres d'extérieur*

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Price based on 6 pages

## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3611 was developed by Technical Committee ISO/TC 3, *Limits and fits*, and was circulated to the member bodies in December 1974.

It has been approved by the member bodies of the following countries :

Australia	Hungary	Romania
Austria	India	South Africa, Rep. of
Belgium	Italy	Sweden
Bulgaria	Japan	Switzerland
Czechoslovakia	Korea, Dem P. Rep. of	Turkey
Finland	Netherlands	United Kingdom
France	New Zealand	
Germany	Poland	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Canada  
U.S.A.  
U.S.S.R.

# Micrometer callipers for external measurement

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the most important dimensional, functional and quality characteristics of micrometer callipers for external measurement. Information concerning values for the error of measurement at any point in the measuring range and recommendations for using the instruments and testing their accuracy are given in annexes.

This International Standard applies to micrometers equipped with a screw having a lead of 0,5 or 1 mm, having a maximum range of 25 mm covering capacities up to 500 mm, and having non-removable anvils with flat measuring faces.

NOTE — This International Standard does not apply to digital reading micrometers but may be used for indicating desirable requirements for such micrometers where appropriate.

## 2 REFERENCE

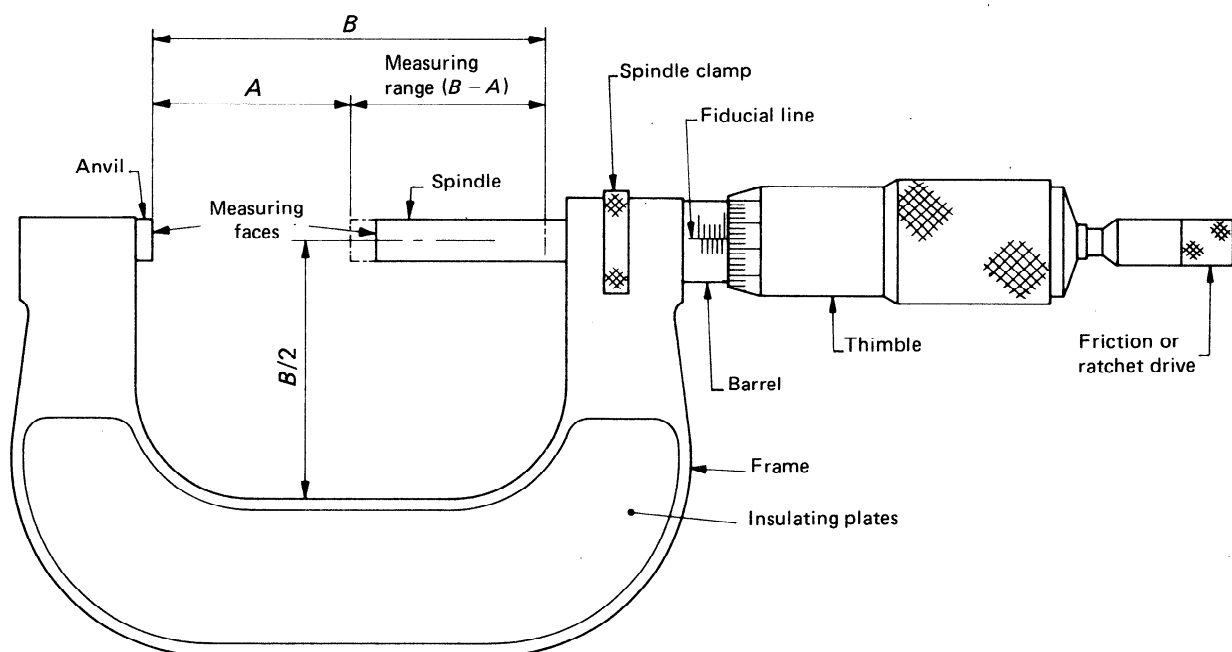
ISO/R 1938, *ISO system of limits and fits — Part II : Inspection of plain workpieces.*

## 3 NOMENCLATURE AND DEFINITIONS

**3.1** For the nomenclature for micrometer callipers, see figure 1.

**3.2 error of measurement:** The algebraical difference between the indicated value and the true value of the quantity measured.

**3.3 deviation of traverse of the micrometer screw:** The maximum difference between the ordinates of the curve for the deviation of the readings obtained along the complete traverse of the screw.



NOTE — The illustration is diagrammatic only and is not intended to show details of design.

FIGURE 1 — Nomenclature for a micrometer calliper for external measurement

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## 4 SPECIFICATION

## 4.1 Design features

## 4.1.1 Frame

The frame shall be so shaped as to permit the measurement of a cylinder of diameter equal to the maximum capacity of the micrometer calliper. The stiffness of the frame shall be such that a force equal to the force of the ratchet or friction drive applied between the measuring faces does not alter the distance between them by more than the amount given in table 1. When no ratchet or friction drive is fitted, the force applied shall be 10 N.

The frame shall be of a suitable material; steel or malleable cast iron is commonly used. It is recommended that heat-insulating plates be fitted to the frame, especially on large micrometers.

## 4.1.2 Spindle and anvil

The screw shall have a lead of 0,5 or 1 mm and the screw thread shall be a good fit in the nut.

There shall be full engagement of the nut and spindle screw throughout the range of travel. The front parallel portion of the spindle shall be a good free-turning fit in its bush but without perceptible shake.

The spindle and anvil shall be of stainless steel having a hardness number of not less than 530 HV or shall be of hardened high grade tool steel having a hardness number of not less than 670 HV. They may be tipped with tungsten carbide or other suitable hard material. Sharp edges shall be slightly chamfered (approximately 0,1 mm).

## 4.1.3 Spindle clamp

If a spindle clamp is fitted, the design shall be such that it effectively locks the spindle without altering the distance between the measuring faces by more than 2  $\mu\text{m}$ .

## 4.1.4 Friction or ratchet drive

The spindle may be fitted with a friction or ratchet drive. When such a drive is fitted, the force exerted by the drive

between the measuring faces shall lie between 5 and 15 N unless otherwise required by the user.

NOTE — Whatever the force employed, it should remain substantially the same throughout the traverse of the instrument.

## 4.1.5 Thimble

The thimble shall be graduated with 50 or 100 divisions, according to whether the pitch of the micrometer screw is 0,5 or 1 mm, each representing 0,01 mm. The graduation lines shall be cleanly cut.

The centre distance between the graduation lines shall be not less than 0,8 mm.

The thickness of the graduation lines shall normally lie between 0,08 and 0,2 mm but the maximum thickness may be up to 0,25 mm when the centre distance between the lines is greater than 1 mm. A variation in line thickness of 0,03 mm is permissible.

If the thimble is bevelled, the angle of the bevel shall be between  $10^\circ$  and  $20^\circ$ .

The distance from the barrel to the graduated face of the thimble shall not exceed 0,4 mm (see figure 2).

## 4.1.6 Barrel

The thickness of the fiducial line on the barrel shall be the same as that of the graduation lines on the thimble and shall be subject to the same permissible variation in thickness of 0,03 mm.

## 4.1.7 Adjustments

4.1.7.1 Each micrometer calliper shall be provided with means for adjusting the zero setting.

4.1.7.2 Each micrometer calliper shall be provided with means for compensating for wear between screw and nut.

## 4.1.8 Marking

Each micrometer calliper shall have legibly and permanently marked upon it the division value, the measuring capacity and the manufacturer's name or trade mark.

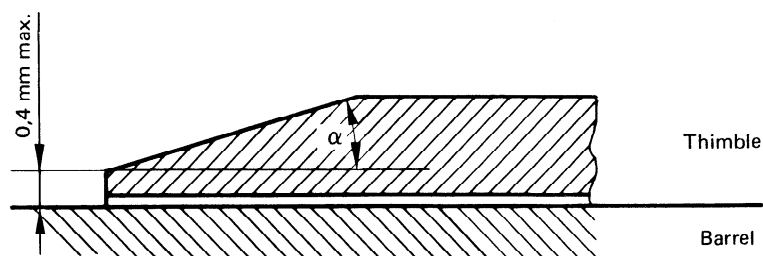


FIGURE 2 — Distance from barrel to graduated face of thimble

## 5 ACCURACY

### 5.1 General

The deviations and tolerances specified below and in tables 1 and 2 apply to measurements made at the standard reference temperature of 20 °C.

### 5.2 Deviations and tolerances

The deviation of traverse of the micrometer spindle over a range of 25 mm shall not exceed 3 µm.

The tolerances  $f$  on the zero setting shall be as given in table 1; they are based on the following formula :

$$f = \pm \left( 2 + \frac{A}{50} \right)$$

where  $A$  is the lower limit (i.e. zero setting) of the measuring range, in millimetres.

### 5.3 Error of measurement

Information concerning the maximum error of measurement to be expected from instruments complying with this International Standard is given in annex A.

### 5.4 Measuring faces

The measuring faces shall be lapped and each face shall be flat to within 1 µm.

When subjected to a measuring force of 10 N, the faces of micrometers not fitted with a friction or ratchet drive shall be parallel to within the amounts given in table 1; when a friction or ratchet drive is fitted, the measuring force that it exerts shall be used (see 4.1.1).

The tolerances are based on the following formula :

$$2 + \frac{A}{50}$$

where  $A$  is the lower limit (i.e. zero setting) of the measuring range, in millimetres.

TABLE 1 — Permissible flexure of frame subject to a force of 10 N, and tolerances on the zero setting and on parallelism of measuring faces

Measuring range of micrometer	Permissible flexure of frame	Tolerance on zero setting, $f$	Tolerance on parallelism of measuring faces
mm	µm	µm	µm
0 to 25	2	± 2	2
25 to 50	2	± 2	2
50 to 75	3	± 3	3
75 to 100	3	± 3	3
100 to 125	4	± 4	4
125 to 150	5	± 4	4
150 to 175	6	± 5	5
175 to 200	6	± 5	5
200 to 225	7	± 6	6
225 to 250	8	± 6	6
250 to 275	8	± 7	7
275 to 300	9	± 7	7
300 to 325	10	± 8	8
325 to 350	10	± 8	8
350 to 375	11	± 9	9
375 to 400	12	± 9	9
400 to 425	12	± 10	10
425 to 450	13	± 10	10
450 to 475	14	± 11	11
475 to 500	15	± 11	11

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## ANNEX A

## ERROR OF MEASUREMENT AT ANY POINT IN THE MEASURING RANGE

As stated in ISO/R 1938, any measuring instrument has its inherent error, independent of the part to be measured and of external conditions of measurement. To enable the user to select the type of instrument most suitable for his purpose and set his inspection limits to ensure that the design limits are respected as far as possible without encroaching too far on the manufacturing tolerances, it is recommended that the manufacturers of measuring instruments should indicate the likely measuring uncertainty of those instruments and this is expressed in terms of the "standard deviation  $S_M$ ", full details of which are given in ISO/R 1938.

It is sufficient to say here that the numerical values given for this uncertainty are statistical values in that they are based on the application of a formula to tests on a complete batch of instruments and apply only to the instruments as supplied.

ISO/R 1938 includes a table giving the maximum values of  $S_M$  that can be regarded as acceptable for instruments intended to check workpieces manufactured to tolerances from IT3 to IT16. The values in table 2 can therefore be compared with those in ISO/R 1938 so that the user can decide whether the micrometer callipers covered by this International Standard are suitable for checking products made to the ISO grade of tolerance concerned. They are "statistical" values in the sense described above and represent the error of measurement  $F$  at any point in the measuring range of micrometers conforming to this International Standard, when checked with a measuring force of 10 N, and are based on the following formula :

$$F_{\max} = 4 + \frac{A}{50}$$

where

$F$  is the error of measurement at any point in the measuring range;

$A$  is the lower limit (i.e. zero setting) of the measuring range in millimetres.

It should be noted that  $F_{\max}$  may be positive or negative.

TABLE 2 — Values of  $F_{\max}$

Measuring range of micrometer	$F_{\max}$
mm	$\mu\text{m}$
0 to 25	4
25 to 50	4
50 to 75	5
75 to 100	5
100 to 125	6
125 to 150	6
150 to 175	7
175 to 200	7
200 to 225	8
225 to 250	8
250 to 275	9
275 to 300	9
300 to 325	10
325 to 350	10
350 to 375	11
375 to 400	11
400 to 425	12
425 to 450	12
450 to 475	13
475 to 500	13



## ANNEX B

## RECOMMENDED PRACTICE FOR USING A MICROMETER CALLIPER

**B.1** The measuring faces should be kept clean by wiping with clean tissue.

**B.2** The micrometer screw should run smoothly throughout its traverse. Jerkiness usually indicates the presence of dirt in the screw. A very little lubrication with a light, high quality oil is recommended to increase smoothness of traverse.

The micrometer screw should move without either tightening or slackening; alternate tightening and slackening indicates a bent spindle.

**B.3** It is usually easier to measure with a micrometer calliper if the weight of the frame is supported independently of the action of the spindle.

**B.4** The micrometer spindle should be gently propelled by the action of the ratchet or friction drive or the thimble.

**B.5** The reading of the micrometer calliper should be checked with a setting gauge of known size and the reading adjusted as necessary. This gauge should preferably have the same geometrical form of measuring faces as the part to be measured by the micrometer calliper.

NOTE — The setting gauges supplied with micrometer callipers are usually made to the minimum capacity of the instrument within certain manufacturing tolerances for size.

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