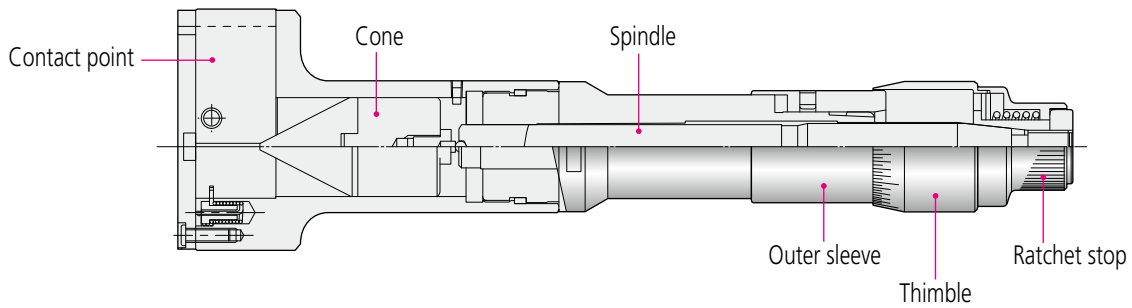


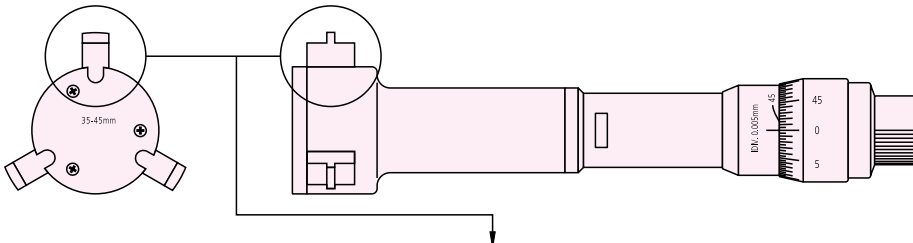
# Internal Micrometers

## Nomenclature



## Custom-ordered Products (Holtest/Borematic)

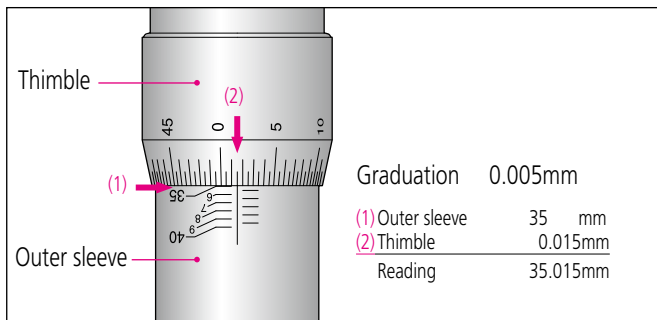
Mitutoyo can custom-build an internal micrometer best-suited to your special application. Please feel free to contact Mitutoyo about the possibilities - even if only one custom-manufactured piece is required. Please note that, depending on circumstances, such a micrometer will usually need to be used with a master setting ring for accuracy assurance. (A custom-ordered micrometer can be made compatible with a master ring supplied by the customer. Please consult Mitutoyo.)



Type of feature	Workpiece profile (example)	Contact point tip profile (example)	Remarks
Square groove			<ul style="list-style-type: none"> <li>● Allows measurement of the diameter of variously shaped inside grooves and splines.</li> <li>● Minimum measurable groove diameter is approximately 16mm (differs depending on the workpiece profile.)</li> <li>● Dimension <math>\ell</math> should be as follows: For <math>W = \text{less than } 2\text{mm}</math>: <math>\ell = \text{less than } 2\text{mm}</math> For <math>W = 2\text{mm}</math> or more: <math>\ell = 2\text{mm}</math> as the standard value which can be modified according to circumstances.</li> <li>● The number of splines or serrations is limited to a multiple of 3.</li> <li>● Details of the workpiece profile should be provided at the time of placing a custom-order.</li> <li>● If your application needs a measuring range different from that of the standard internal micrometer an additional initial cost for the master ring gage will be required.</li> </ul>
Round groove			
Spline			
Serration			
Threaded hole			

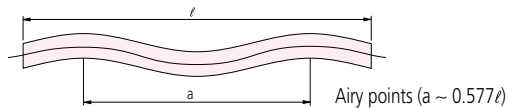
\* Mitutoyo can manufacture other custom designs of internal micrometer according to the application. Cost and delivery depends on the order terms and conditions. To place a custom order please contact the nearest Mitutoyo Sales Center.

## How to Read the Scale

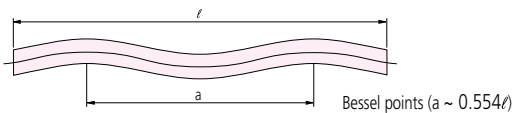


## Airy and Bessel Points

When a length standard bar or internal micrometer lies horizontally, supported as simply as possible at two points, it bends under its own weight into a shape that depends on the spacing of those points. There are two distances between the points that control this deformation in useful ways, as shown below.

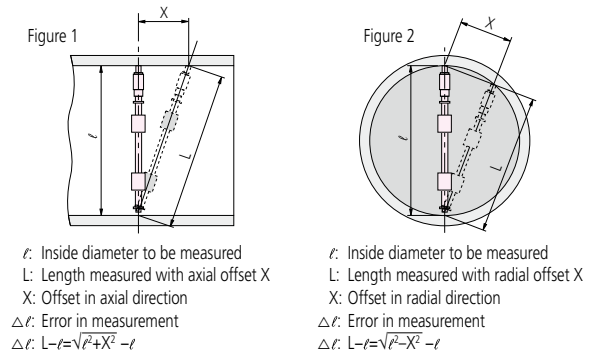


The ends of a bar (or micrometer) can be made exactly horizontal by spacing the two supports symmetrically as shown above. These points are known as the 'Airy Points' and are commonly used to ensure that the ends of a length bar are parallel to one another, so that the length is well defined.

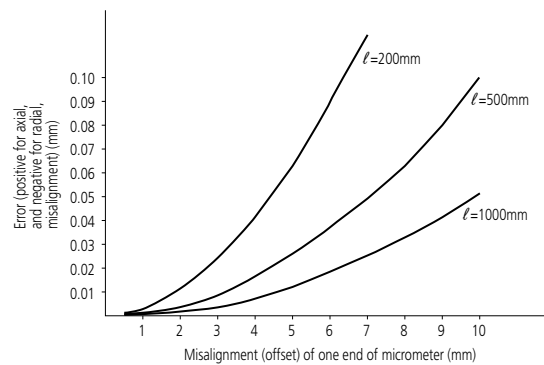


The change in length of a bar (or micrometer) due to bending can be minimized by spacing the two supports symmetrically as shown above. These points are known as the 'Bessel Points' and may be useful when using a long inside micrometer.

## Misalignment Errors

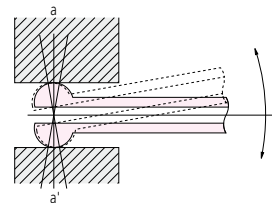


If an inside micrometer is misaligned in the axial or radial direction by an offset distance  $X$  when a measurement is taken, as in Figures 1 and 2, then that measurement will be in error as shown in the graph below (constructed from the formulae given above). The error is positive for axial misalignment and negative for radial misalignment.



## Bore Gages

- Mitutoyo bore gages for small holes feature contact elements with a large curvature so they can be easily positioned for measuring the true diameter (in the direction a-a') of a hole. The true diameter is the minimum value seen on the dial gage while rocking the bore gage as indicated by the arrow.



- The spring-loaded guide plate on a Mitutoyo two-point bore gage automatically ensures radial alignment so that only an axial rocking movement is needed to find the minimum reading (true diameter).

