DEFINITION OF DIAL TEST INDICATOR

Measuring instrument in which the displacement of a pivoting stylus is transmitted and magnified by a suitable mechanical means to a pointer which rotates in front of a circular scale.

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STYLUS AND STYLUS TIP

The stylus of a dial test indicator is exchangeable. Its length has direct impact on the displayed measurement reading on the dial (measuring signal ratio). Hence, each dial test indicator a matching contact point is assigned. Incorrect stylus lengths result in vast measurement errors.

Styli with same length but different tip diameter (based on the tip center)

Use a stylus with the proper length for accurate measurement

Test Indicator with different stylus lengths

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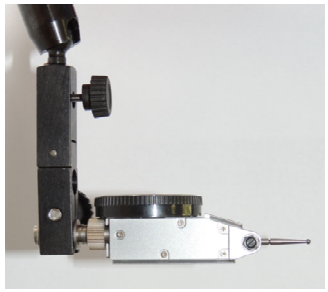
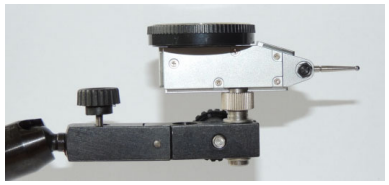
HOW TO CLAMP A DIAL TEST INDICATOR

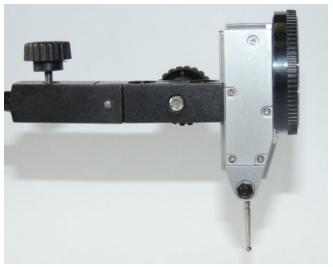
Various options to clamp a dial test indicator are available.
Minimizing the measuring error requires a stable and reliable clamping device.

Dial test indicator in
a magnetic stand





Use Ø=8 mm stem for clamping



Use of dovetail mounting
The dimension of the dovetail segment is not standarized

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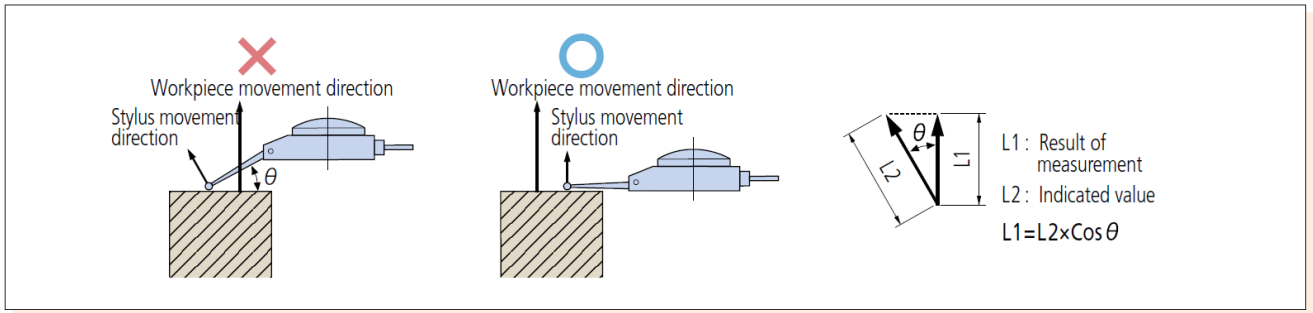
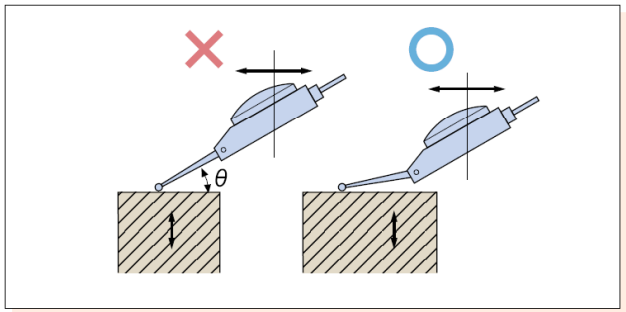
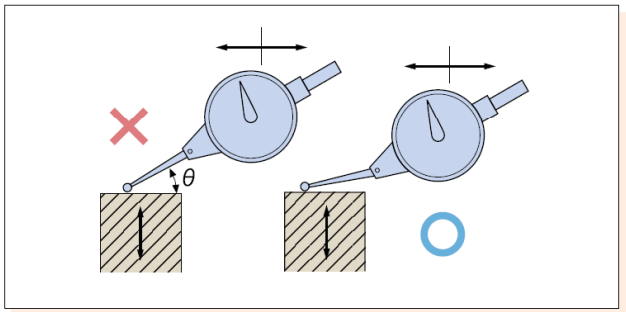
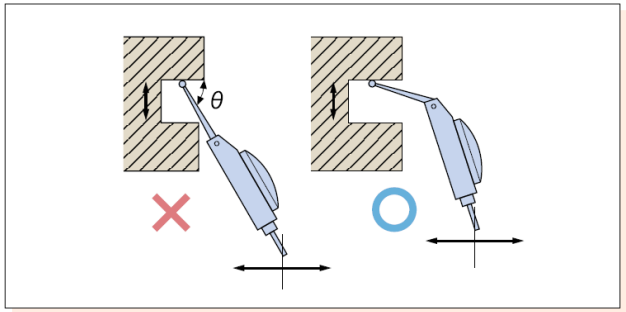
Dial Test Indicators and the Cosine Effect

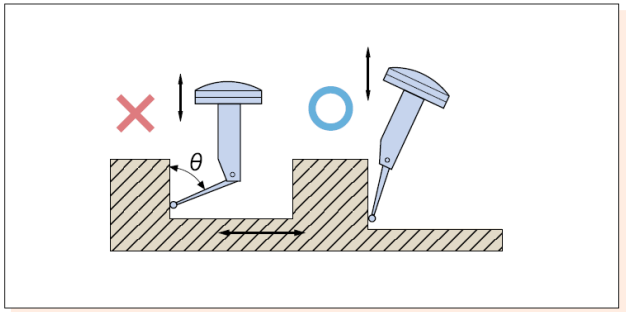
Always minimize the angle between movement directions during use.

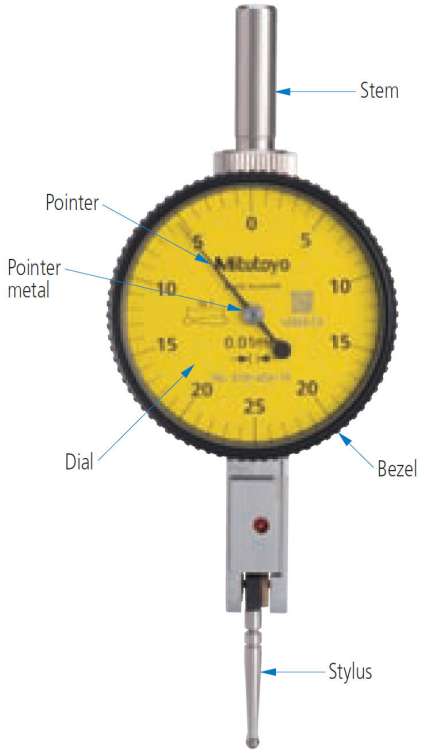












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The reading of any indicator will not represent an accurate measurement if its measuring direction is misaligned with the intended direction of measurement (cosine effect). Because the measuring direction of a dial test indicator is at right angles to a line drawn through the contact point and the stylus pivot, this effect can be minimized by setting the stylus to minimize angle θ (as shown in the figures). If necessary, the dial reading can be compensated for the actual θ value by using the table below to give the resulut of measurement.
Result of measurement = indicated value x compensation value

Compensating for a non-zero angle

Angle	Compensation value
10°	0.98
20°	0.94
30°	0.86
40°	0.76
50°	0.64
60°	0.50

Examples

If a 0.200mm measurement is indicated on the dial at various values of θ, the result of measurements are:
For θ = 10°, 0.200mm×.98 = 0.196mm
For θ = 20°, 0.200mm×.94 = 0.188mm
For θ = 30°, 0.200mm×.86 = 0.172mm

Note: A special contact point of involute form can be used to apply compensation automatically and allow measurement to be performed without manual compensation for any angle θ from 0 to 30°. (This type of contact point is custom-made.)

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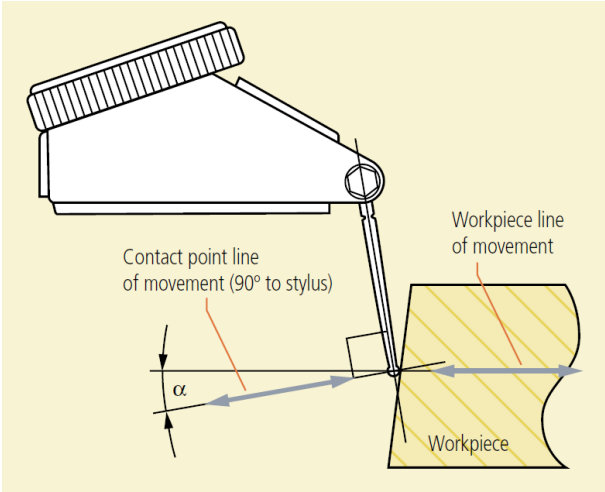
COSINE EFFECT

The principle of test indicators is based on the stylus movement in a circular arc. The scale graduation is only correct for a certain stylus length (i.e. that of the standard stylus).
Plus, it is only correct when the angle α between the line of movement of the contact point line and that of the workpiece is minimal.
Due to the cosine effect the indication becomes progressively non-linear as this angle increases.

If minimising the cosine effect in the gauge indication is important for the particular application, the angle α must be kept as low as possible.

If kept within 15º the effect will be less than 4%.



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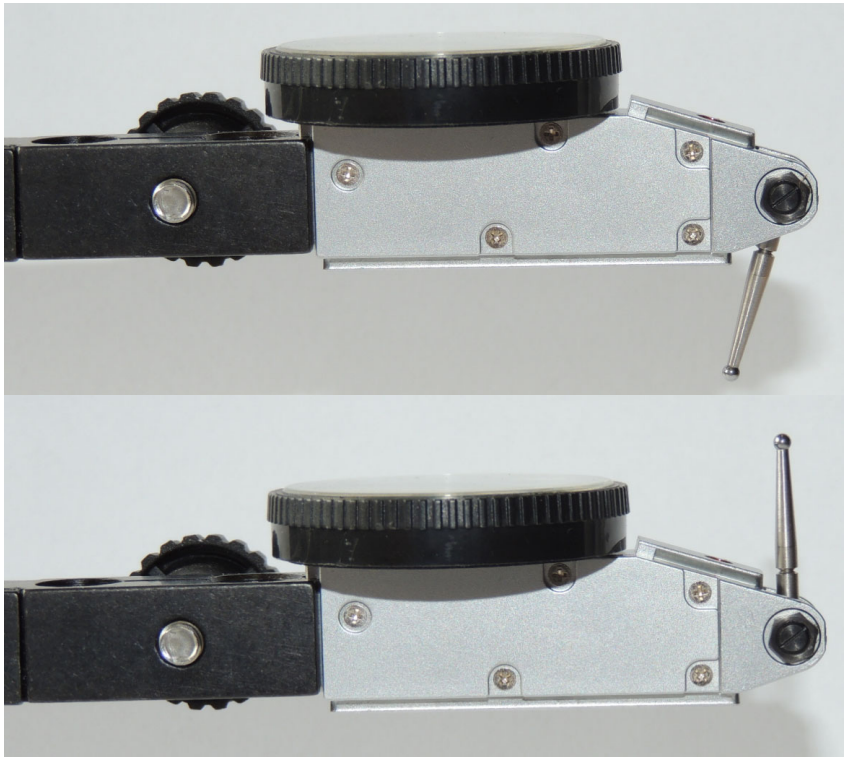
COSINE EFFECT

The rest position of the stylus can be adjusted over a range of about 240° as shown so the stylus becomes as parallel as possible to the workpiece surface.



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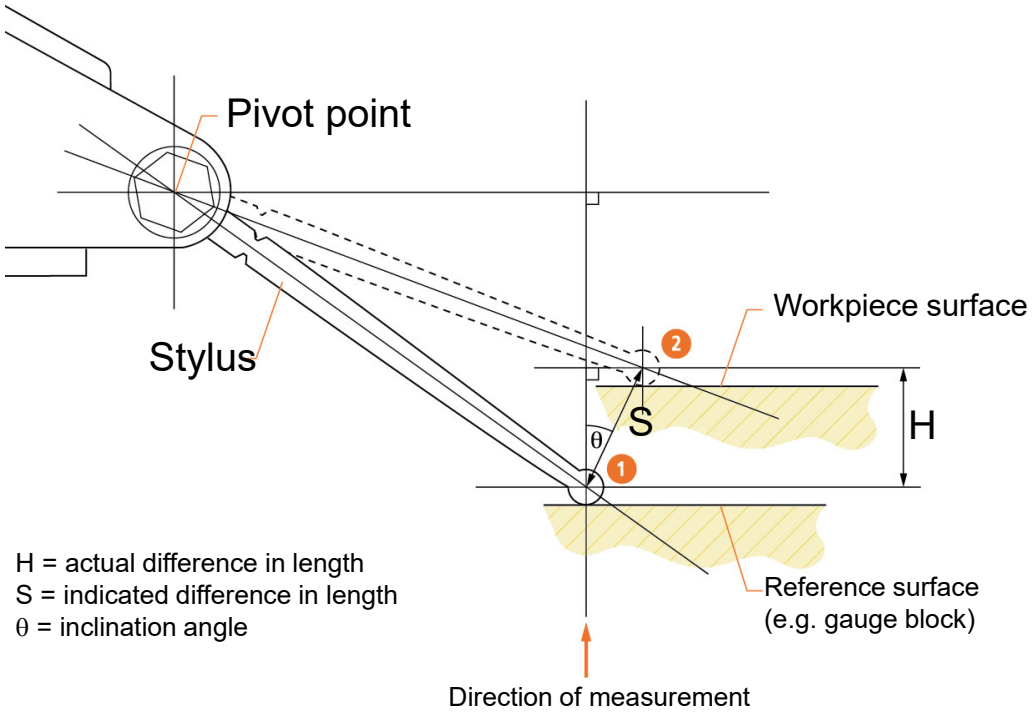
COSINE EFFECT

Due to the rotational movement, the values obtained by dial test indicators are non-linear. The contact point travels a longer distance compared to the actual difference in length. The ratio between the two depends on the orientation of the stylus.



H = actual difference in length
S = indicated difference in length
θ = inclination angle

Inclination Angle	Compensation Factor
10°	0,98
20°	0,94
30°	0,86
40°	0,76
50°	0,64
60°	0,50

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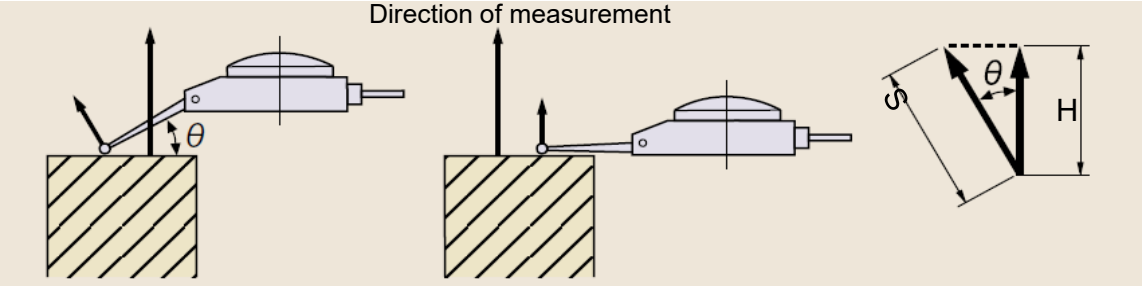
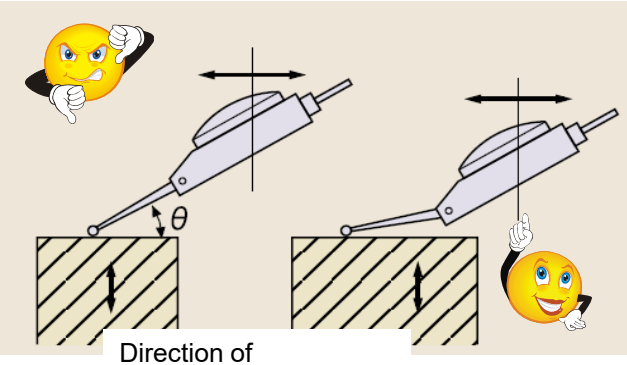
COSINE EFFECT

Measuring deviations due to the position of the stylus axis can be avoided by aligning the stylus parallel to the measuring surface. Otherwise a measuring error occurs, caused by the cosine effect (cosine error).





$$H = S \cdot \cos\theta$$

H = actual difference in length
S = indicated difference in length
θ = inclination angle

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Before Use

1. Clean the contact point with a dry cloth.

2. Check the bentness of pointer and inclination of pointer metal (**Fig. 1**).
Then, move the stylus throughout its range to check that the movement is smooth without stickiness or jamming.

3. Be sure to use the stylus with standard length according to models, otherwise a large measuring error may be caused. (**Fig. 2**)

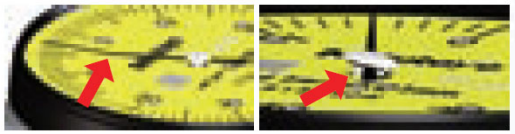

Fig. 1

Fig. 2

During Use

1. Use a holding fixture that will not deflect significantly during normal use. (**Fig. 3**)

2. Do not disassemble or modify the indicator. Failure to observe this may cause inaccuracy or malfunction.

3. A Dial Test Indicator's scale factor depends on the angle between the directions of movement of contact point and workpiece, and is only unity when these are aligned. In practice, to avoid significant error, if the angle θ (**Fig. 4**) is kept less than 10° during measurement then the effect of a change in scale factor can be ignored. If this angle cannot be kept small then a factor can be applied to the dial reading to compensation for this 'cosine effect' as per the table below.

4. Be sure not to apply force to the bezel and the stylus in lateral direction (**Fig. 5**). It affects the operation and accuracy.

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APPLICATIONS OF DIAL TEST INDICATORS

Dial Test Indicators are primarily intended to provide assistance with setting up workpieces on machine tools and surface plates.
Typical tasks are aligning a flat surface with an X or Y machine axis or a hole axis with a spindle axis.

Centering a workpiece in a machine tool

Application in a bench center

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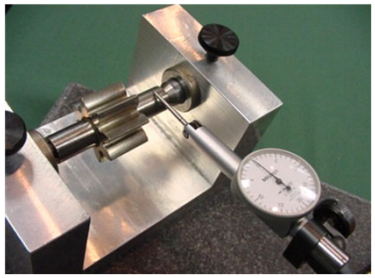
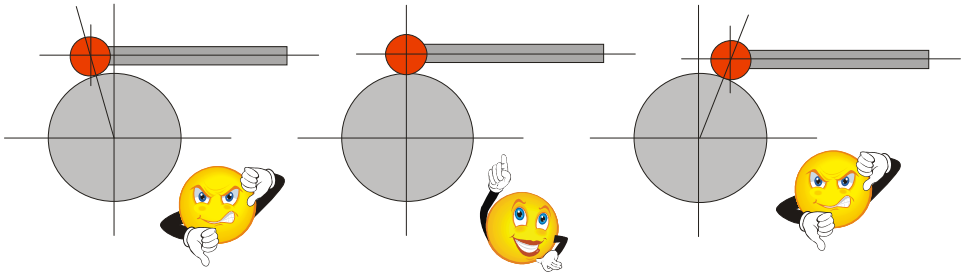
RUN-OUT MEASUREMENT WITH DIAL TEST INDICATOR

The setup for a run-out check requires the use of a bench centre in which the workpiece can be rotated along its axis while the indicator is applied to the required position on the toleranced feature for each run-out test.



It is important to position the contact point correctly. Too far one way raises the spectre of cosine effect. Too far the other way risks that the shank of the stylus touches the workpiece instead of the stylus tip.



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