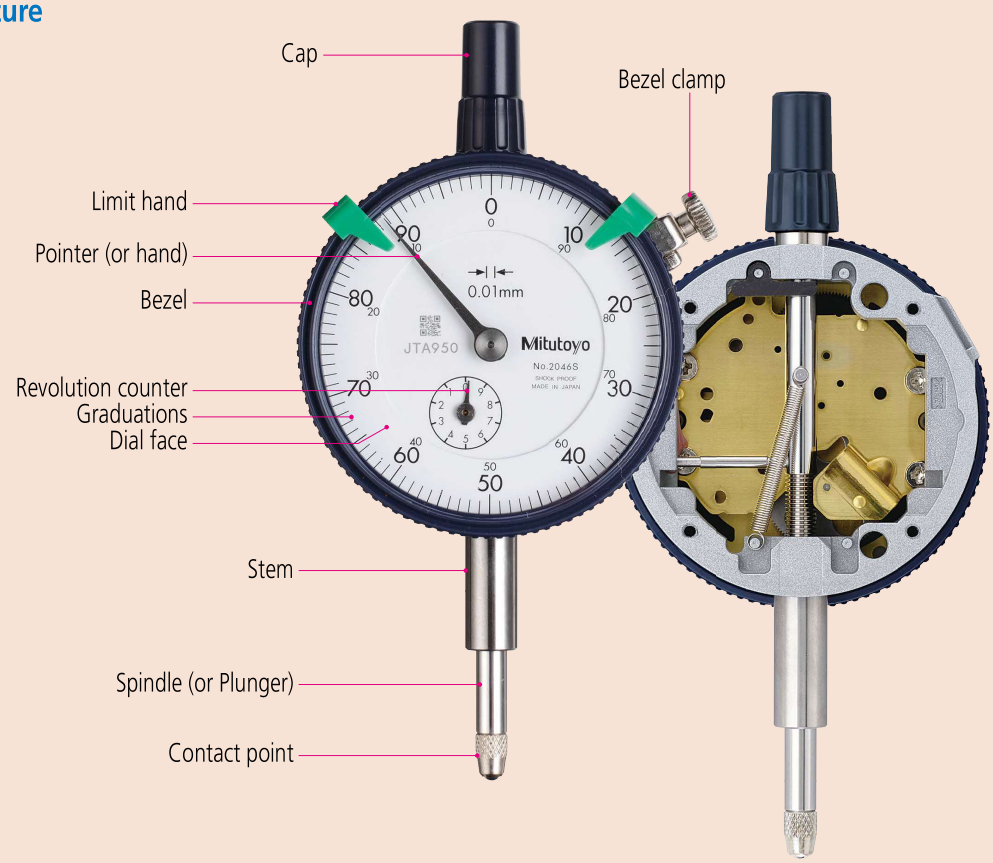
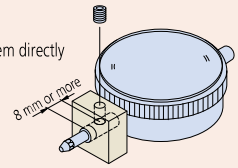
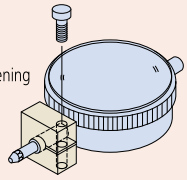
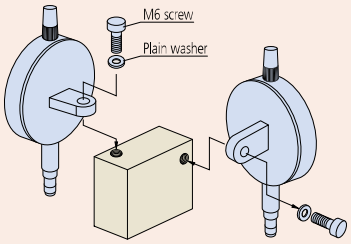
Nomenclature

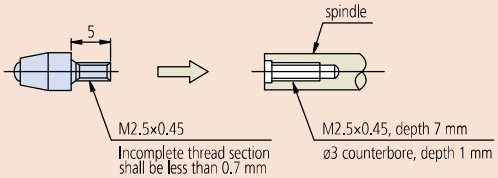


Mounting a Dial gage

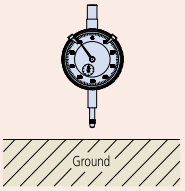
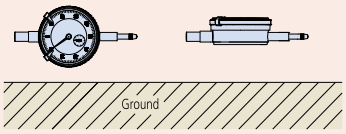
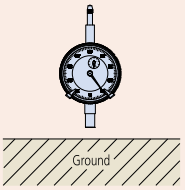
Stem mounting	Method	Clamping the stem directly with a screw  	Clamping the stem by split-clamp fastening 
	Note	• Mounting hole tolerance: ø8 G7 (+0.005 to 0.02) • Clamping screw: M4 to M6 • Clamping position: 8 mm or more from the lower edge of the stem • Maximum clamping torque: 150 N·cm when clamping with a single M5 screw • Note that excessive clamping torque may adversely affect spindle movement.	• Mounting hole tolerance: ø8 G7 (+0.005 to 0.02)
Lug mounting	Method	 	
	Note	• Lugs can be changed 90° in orientation according to the application. (The lug is set horizontally when shipped.) • Lugs of some SERIES **1** models (**1911T-10**, **1913T-10** and **1003T**), however, cannot be altered to horizontal. • To avoid cosine-effect error, ensure that any type of gage or indicator is mounted with its spindle in line with the intended measurement direction.	

Contact point

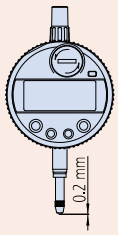
- Screw thread is standardized on M2.5×0.45 (Length: 5 mm).
- Incomplete thread section at the root of the screw shall be less than 0.7 mm when fabricating a contact point.



Measuring orientation

Orientation		Remarks
Vertical (contact point downward)		–
Lateral (spindle horizontal)		If measurement is performed in the lateral orientation, or upside-down orientation, the measuring force is less than in the vertical orientation. In this case be sure to check the operation and repeatability of the indicator. For guaranteed-operation specifications according to the operating orientation refer to the specific product descriptions in the catalog.
Upside-down (contact point upward)		

Setting the origin of a Digimatic indicator

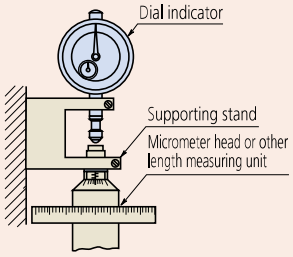
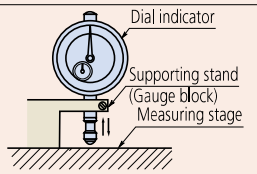
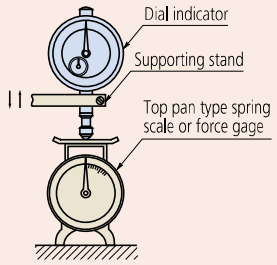


The accuracy specification in the range of 0.2 mm from the end of the stroke is not guaranteed for Digimatic indicators. When setting the zero point or presetting a specific value, be sure to lift the spindle at least 0.2 mm from the end of the stroke.

Notes on using a dial indicator or Digimatic indicator

- Do not lubricate the spindle. Doing so might cause dust to accumulate, resulting in a malfunction.
- If the spindle movement is poor, wipe the upper and lower spindle surfaces with a dry or alcohol-soaked cloth. If the movement is not improved by cleaning, contact Mitutoyo for repair.
- Before making a measurement or calibration, confirm if the spindle moves upward and downward smoothly, and stability of the zero point.

Dial Indicator Standard B7503: 2017 (Extract from JIS / Japanese Industrial Standards)

Item		Model	Measuring method (zero-point fixed)	Evaluation method (performance evaluation by moving the zero point)	Measurement examples
Indication error	Indication error over the entire measuring range	One-revolution dial indicator and multi-revolution dial indicator	Set the dial indicator on the supporting stand, and read the indication error*1 of the next point while gradually retracting the spindle. - Every 1/10 revolution for the first two revolutions*2 - Every half revolution from two to five revolutions - Every revolution from five to ten revolutions - Every five revolutions from 10 to 50 revolutions - Every ten revolutions after 50 revolutions Next, after retracting the spindle for more than three graduations of the long hand, extend the spindle gradually and read the indication error at the same measurement point in the retract direction.	Obtain the difference between the maximum and the minimum values of indication error of all measurement points in both retract and extend directions.	
	1/10 revolution indication error			During the first two revolutions in both retract and extend directions, obtain the maximum difference of the indication error among the adjacent measurement points per 1/10 revolutions*3.	
	1/2 revolution indication error	Multi-revolution dial indicator		During the first five revolutions in both retract and extend directions, obtain the maximum difference of the maximum and the minimum indication errors over the measuring range per 1/2 revolutions.	
	1 revolution indication error			During the first ten revolutions in both retract and extend directions, obtain the maximum difference of the maximum and the minimum indication errors over the measuring range per one revolution.	
Retrace error		One-revolution dial indicator and multi-revolution dial indicator		Obtain the maximum difference of all the measuring points in reference to the indication error at the same measuring point in both forward and backward directions.	
Repeatability		One-revolution dial indicator and multi-revolution dial indicator	Set the dial indicator on the supporting stand, retract the spindle at a desired position within the measuring range. Then, extend the spindle quickly and slowly three times and read each value.	Obtain the maximum difference among five indication values.	
Measuring force			Set the dial indicator on the supporting stand, retract and extend the spindle continuously and gradually, and read the measuring force at the zero and end points.	Obtain the maximum measuring force, the minimum measuring force, and the difference of the measuring force in both retract and extend directions at the same measurement point.	

*1 For how to read the indication error, either read the input quantity of the measuring instrument aligning the long hand to the graduation, or read the indication value of the dial indicator according to the moving amount of the measuring instrument.
*2 With the one-revolution dial indicator, read the indication error per 10 graduations.
*3 With the one-revolution dial indicator, obtain the maximum difference of the indication error in the interval of adjacent 10 graduations.

Maximum permissible error

(unit: µm)

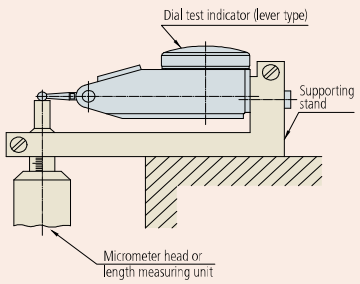
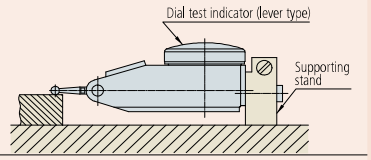
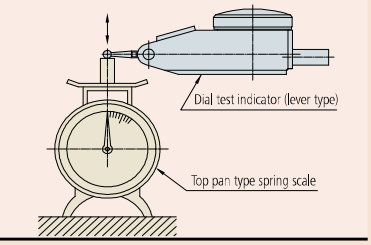
		Maximum permissible error (MPE) by measurement characteristics -- dial indicators with bezel dia. 50 mm or larger												Maximum permissible error (MPE) by measurement characteristics - dial indicators with bezel dia. 50 mm or smaller and Back Plunger type dial indicators						
Graduation (mm)		0.01								0.005	0.001			0.01				0.005	0.002	0.001
Measuring range (mm)		1 or less	Over 1 and up to 3	Over 3 and up to 5	Over 5 and up to 10	Over 10 and up to 20	Over 20 and up to 30	Over 30 and up to 50	Over 50 and up to 100	5 or less	1 or less	Over 1 and up to 2	Over 2 and up to 5	1 or less	Over 1 and up to 3	Over 3 and up to 5	Over 5 and up to 10	5 or less	1 or less	1 or less
Retrace error		3	3	3	3	5	7	8	9	3	2	2	3	4	4	4	5	3.5	2.5	2
Repeatability		3	3	3	3	4	5	5	5	3	0.5	0.5	1	3	3	3	3	3	1	1
Indication error	Arbitrary 1/10 revolution	5	5	5	5	8	10	10	12	5	2	2	3.5	8	8	8	9	6	2.5	2.5
	Arbitrary 1/2 revolution	8	8	9	9	10	12	12	17	9	3.5	4	5	11	11	12	12	9	4.5	4
	Arbitrary One revolution	8	9	10	10	15	15	15	20	10	4	5	6	12	12	14	14	10	5	4.5
	Entire measuring range	8	10	12	15	25	30	40	50	12	5	7	10	15	16	18	20	12	6	5

Note 1: The maximum permissible error (MPE) for one-revolution dial indicators does not specify the indication error of an arbitrary 1/2 and 1 revolution.
Note 2: The MPE represents the value at 20 °C, which JIS B 0680 defines as the standard temperature.
Note 3: The measurement characteristics of a dial indicator have to meet both maximum permissible error (MPE) and measurement force permissible limits (MPL) at any position within the measuring range in any posture when the measurement characteristics are not specified by the manufacturer.

Mitutoyo's Response to Dial Indicator Standard B 7503: 2017

- We guarantee the accuracy of completed products by inspecting them in the vertical posture. Standard-attached inspection certificate includes inspection data.
- We issue paid-for inspection certificates for horizontal or opposite posture if required.
- It is said that, for evaluation of the compatibility to the specifications, JIS B 0641-1 or the criteria where the internationally-recognized specification range and the OK range are equal shall be applied. Also, it is said that the uncertainty is preferred to be evaluated based on ISO 14253-2 and ISO/IEC Guide 98-3. Therefore, we perform shipping inspection of dial indicators inclusive of the uncertainty of calibration as in the past.

Dial test indicator (lever type) Standard B7533: 2015 (Extract from JIS / Japanese Industrial Standards)

No.	Item.	Measuring method	Measuring point	Evaluation method	Diagram
1	Error of indication over a range of Measuring range	Holding the dial test indicator (lever type), define the reference point at near the contact point resting point where the indication and error of indication is set zero. Then, move the contact point in the forward direction and read the error of indication at each measuring point. Next, after moving the contact point for more than three graduations from the end of the measuring range, move the contact point in the backward direction and read the error of indication at the same measurement point in the forward direction. (The forward direction is the direction against the measuring force to the contact point of the lever-operated dial indicator; the backward direction is the measuring force applied direction.)	Per 10 graduations in the forward and backward direction from the reference point to the end point.	Obtain the difference between the maximum and the minimum values of indication error of all measurement points in the forward direction.	
2	Error of indication over a range of 10 scale divisions			In the forward direction from the reference point to the end point, obtain the maximum difference of the indication error among the adjacent measurement points per 10 graduations.	
3	Error of indication over a range of One revolution			In the forward direction from the reference point to the end point, obtain the maximum difference of the maximum and the minimum indication errors to be read by the zero-point fixed method over the measuring range per 1 revolution.	
4	Hysteresis			Obtain the maximum difference in reference to the indication error at the same measuring point in both forward and backward directions among all the measurement points.	
5	Repeatability	Holding the dial test indicator (lever type) with its contact point parallel with the top face of the measuring stage, move the contact point quickly and slowly five times at a desired position within the measuring range and read the indication at each point.	At arbitrary points within the measuring range	Obtain the maximum difference of the five measured values.	
6	Measuring force	Holding the dial test indicator (lever type), move the contact point in the forward and backward directions continuously and gradually, and read the measuring force in the measuring range.	Reference point and end point within the measuring range	Obtain the maximum and the minimum values in reference to the measuring force.	

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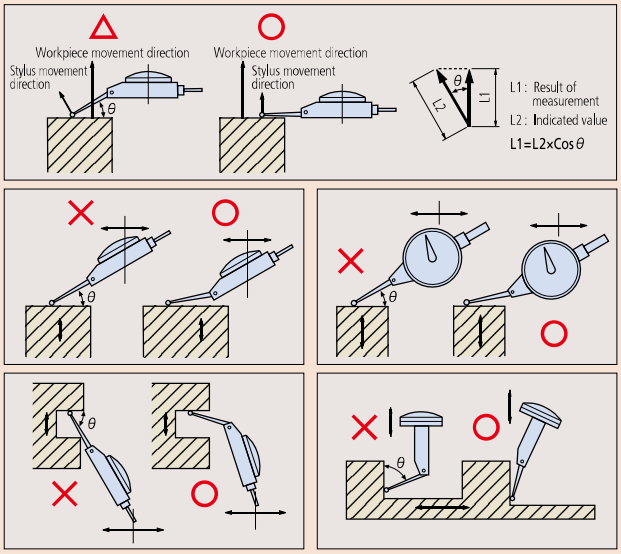
• Maximum permissible error and permissible limits

Graduation (mm)		0.001/0.002			0.01			
Revolution		1 revolution	Multi-revolution		1 revolution			Multi-revolution
Measuring range (mm)		0.3 or less	Over 0.3, up to 0.5	Over 0.5, up to 0.6	0.5 or less	Over 0.5, up to 0.6		Over 1.0, up to 1.6
						L1 ≥ 35	35 < L1	
Error of indication over a range of	Measuring range (μm)	4	6	7	6	9	10	16
	One revolution (μm)	—	5	5	—	—	—	10
	10 scale divisions (μm)	2	2	2	5	5	5	5
Hysteresis (μm)		3	4	4	4	4	5	5
Repeatability (μm)		1	1	1	3	3	3	3
Measuring force (N)	Max.	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Min.	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Dial Test Indicators and the Cosine Effect

Always minimize the angle between movement directions during use.



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 result of measurement.
Result of measurement = indicated value × compensation value

Compensating for a non-zero angle

Angle	Compensation value
10°	0.98
20°	0.94
30°	0.87
40°	0.77
50°	0.64
60°	0.50

Examples

If a 0.002 mm measurement is indicated on the dial at various values of θ, the result of measurements are:
For θ=10°, 0.002 mm×0.98=0.00196 mm
For θ=20°, 0.002 mm×0.94=0.00188 mm
For θ=30°, 0.002 mm×0.87=0.00174 mm

Mitutoyo's Response to Lever-operated Dial Indicator B 7533: 2015

- In the finished product inspection, the accuracy is guaranteed using the horizontal, tilted, vertical type dial indicator with its dial face facing upward; the parallel type with its dial face set in the vertical orientation.
  Standard-attached inspection certificate includes inspection data.
- The inspection certificate for other than the above postures is available for a fee.
- It is said that, for evaluation of the compatibility to the specifications, the criteria based on JIS B 0641-1 or ISO/TR14253-6 shall be applied.
  Also, it is said that the uncertainty is preferred to be evaluated based on ISO 14253-2 and ISO/IEC Guide 98-3. Therefore, we perform shipping inspection of dial indicators inclusive of the uncertainty of calibration as in the past.
- For pocket types, we perform the finished product inspection based on JIS B 7533-1990.