Dial Indicators/Dial Test Indicators

Nomenclature

Dial faces

0.01mm


Continuous dial (Dual reading)


Balanced dial (Multi-revolution)


Continuous dial (Reverse reading)


Balanced dial (One revolution)

0.001mm


Continuous dial (Dual reading)

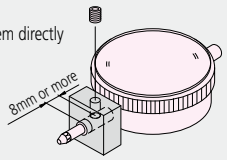
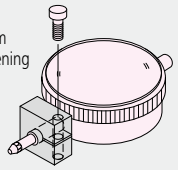
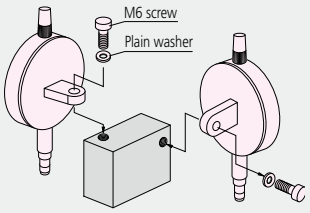

Balanced dial (Multi-revolution)


Continuous dial (Double scale spacing)


Balanced dial (One revolution)

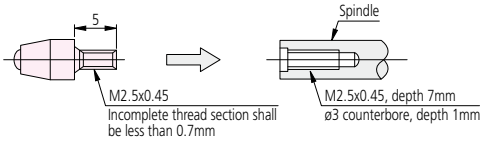
Continuous dial: For direct reading
Balanced dial: For reading the difference from a reference surface
Reverse reading dial: For depth or bore gage measurement
One revolution dial: For error free reading of small differences

Mounting a Dial Indicator

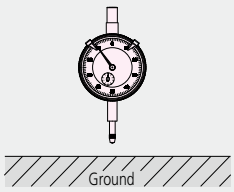
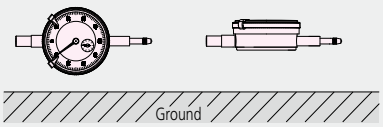
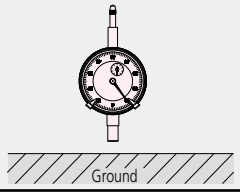
Stem mounting	Method	Clamping the stem directly with a screw 	Clamping the stem by split-body fastening 
	Note	● Mounting hole tolerance: ø8G7(+0.005 to 0.02) ● Clamping screw: M4 to M6 ● Clamping position: 8mm or more from the lower edge of the stem ● Maximum clamping torque: 150N·cm when clamping with a single M5 screw ● Note that excessive clamping torque may adversely affect spindle movement.	● Mounting hole tolerance: ø8G7(+0.005 to 0.02)
Lug mounting	Method		
	Note	● Lugs can be changed 90 degrees in orientation according to the application. (The lug is set horizontally when shipped.) ● Lugs of some Series 1 models (Nos. 1911, 1913-10, & 1003), however, cannot be altered to horizontal. ● To avoid cosine-effect error, ensure that a dial indicator is mounted with its spindle in line with the intended measurement direction.	

Dial Indicator Contact Point

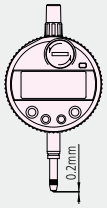
- Screw thread section is standardized on M2.5x0.45 (Length: 5mm).
- Incomplete thread section at the root of the screw shall be less than 0.7mm when fabricating a contact point.



Dial gage and Digimatic indicator positions

Position	Remarks
Contact point down (normal position) 	—
Spindle horizontal (lateral position) 	If measurement is performed with the spindle horizontal or contact point up, the measuring force is less than when the contact point is down. In this case be sure to check the operation and repeatability of the indicator or digital display. For guaranteed-operation specifications according to positions of Digimatic indicators and dial gages, refer to the product descriptions in a general catalog.
Contact point up (upside-down position) 	

Setting the origin of a Digimatic indicator



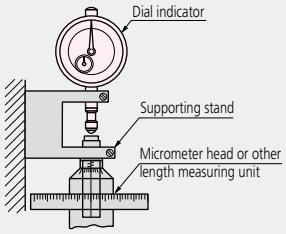
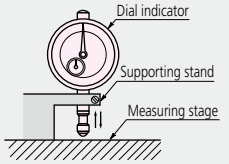
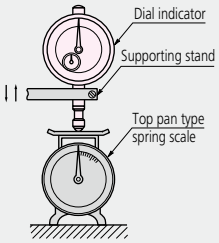
Repeatability in the range of 0.2 mm from the end of the stroke is not guaranteed for Digimatic indicators. When setting the zero point or presetting a specific value, be sure to lift the spindle at least 0.2 mm from the end of the stroke.

Notes on using dial gages and Digimatic indicators

- 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 this cleaning, contact Mitutoyo for repair.

Dial Indicators/Dial Test Indicators

Dial Indicator B7503-1997 (Extract from JIS/Japanese Industrial Standards)

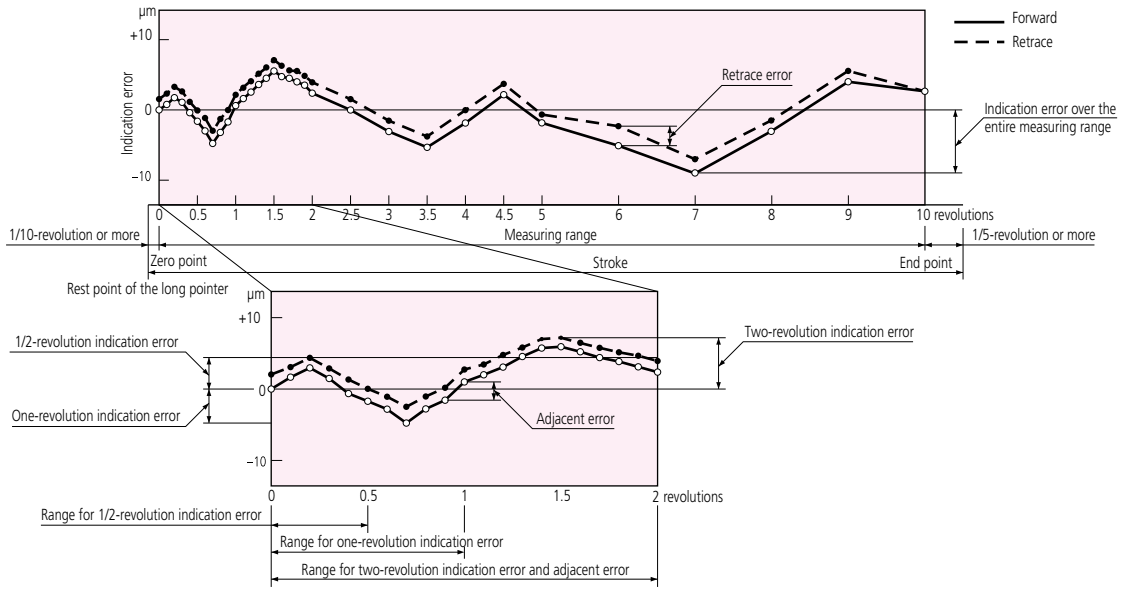
No.	Item	Calibration method	Diagram of calibration setup	Tools for calibration
1	Indication error	Holding the dial indicator with its spindle set vertically downward, follow the procedure prescribed below and determine the error of indication with reference to the dial graduations. First, displace the spindle upward over the entire measuring range while plotting errors at every 1/10 revolution of the pointer for the first two revolutions from the zero point, at every half revolution for the five revolutions, and at every revolution after the fifth revolution, then reverse the spindle displacement at the end of the measuring range of the dial indicator and plot errors at the same points measured during upward spindle displacement. Determine errors from a bidirectional error curve thus obtained. (Fig. 1)		For 0.001mm or 0.002mm graduation dial indicators with a 2mm measuring range or less: A micrometer head or other measuring unit with 0.5µm graduation or less and instrumental error of ±1µm and a supporting stand. For dial indicators other than the above: A micrometer head or other measuring unit with 1µm graduation or less and ±1µm instrumental error and a supporting stand.
2	Adjacent error			
3	Retrace error			
4	Repeatability	Apply the contact point of the dial indicator perpendicularly to the upper face of a measuring stage, displace the spindle quickly and slowly five times at a desired position within the measuring range and determine the maximum difference between the five indications obtained.		Measuring stage Supporting stand
5	Measuring force	Holding a dial indicator with its spindle set vertically downward, displace the spindle upward and then downward continuously and gradually and take measurements of the measuring force at the zero, middle, and end points in the measuring range in both the upward and downward directions.		Supporting stand Top pan type spring scale (graduation: 2gf or less) or force gage (sensitivity: 0.02N or less)

Maximum permissible error of indication

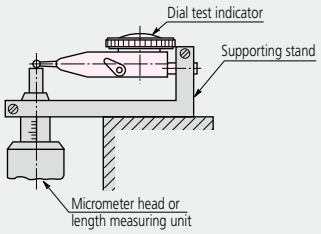
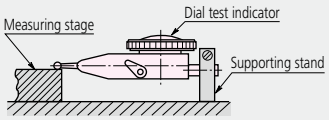
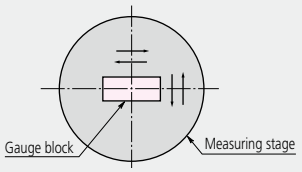
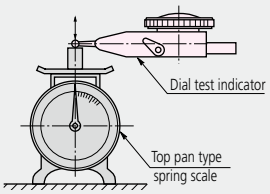
Unit: µm

		Graduation and measuring range					
		0.01mm	0.002mm		0.001mm		
Measuring range		10mm or less	2mm or less	Over 2mm and up to 10mm	1mm or less	Over 1mm and up to 2mm	Over 2mm and up to 5mm
Retrace error		5	3	4	3	3	4
Repeatability		5	0.5	1	0.5	0.5	1
Indication error	1/10 revolution *1	8	4	5	2.5	4	5
	1/2 revolution	±9	±5	±6	±3	±5	±6
	One revolution	±10	±6	±7	±4	±6	±7
	Two revolutions	±15	±6	±8	±4	±6	±8
	Entire measuring range	±15	±7	±12	±5	±7	±10

*1: Adjacent accuracy
Remarks: Values in the table above apply at at 20°C.
Performance: Maximum permissible errors of a dial indicator shall comply with the table above.
Permissible errors of indication shall be evaluated inclusive of the uncertainty of calibration.



Dial Test Indicator B7533-1990 (Extract from JIS/Japanese Industrial Standards)

No.	Item	Calibration method	Diagram of calibration setup	Tools for calibration
1	Wide-range accuracy	(1) For an indicator of 0.01 mm graduation: Displace the contact point so as to move the pointer clockwise in increments of 0.1 mm with reference to the graduations from the zero point to the end point of the measuring range while taking readings of the calibration tool at each point and determine this accuracy from the error curve drawn by plotting the differences of each "indicator reading - calibration tool reading". (2) For an indicator of 0.002 mm graduation: Displace the contact point so as to move the pointer clockwise in increment of 0.02 mm with reference to the graduations from the zero point to the end point of the measuring range while taking readings of the calibration tool at each point and determine this accuracy from the error curve drawn by plotting the differences of each "indicator reading - calibration tool reading". The instrumental error of the calibration tool shall be compensated prior to this measurement.		Micrometer head or measuring unit (graduation: 1µm or less, instrumental error: within ±1µm), supporting stand
2	Adjacent error			
3	Retrace error	After the completion of the wide-range accuracy measurement, reverse the contact point from the last point of measurement while taking readings at the same scale graduations as for the wide-range accuracy measurement and determine the retrace error from the error curve plotted.		
4	Repeatability a	Holding the dial test indicator with its stylus parallel with the top face of the measuring stage, displace the contact point quickly and slowly five times at a desired position within the measuring range and determine the maximum difference in indication.		Measuring stage, Supporting stand, and Gauge block of grade 1 as stipulated by JIS B7506 (Gauge block)
	Repeatability b	Holding the stylus parallel to a gauge block placed on the measuring stage, move the gauge block to and fro and left to right under the contact point within the measuring range and determine the maximum difference in indication.		
5	Measuring force	Holding an indicator by the case or stem, displace the contact point gradually and continuously in the forward and backward directions respectively and take a reading of measuring force at the zero, middle and end points of the measuring range in each direction. ●Performance The maximum measuring force in the forward direction shall not exceed 0.5N. The difference between the maximum and minimum measuring forces in one direction shall not exceed 0.2N (20gf). Note that the smallest possible measuring force is desirable for indicators.		Top pan type spring scale (graduation: 2gf or less) or force gage (sensitivity: 0.02N or less)

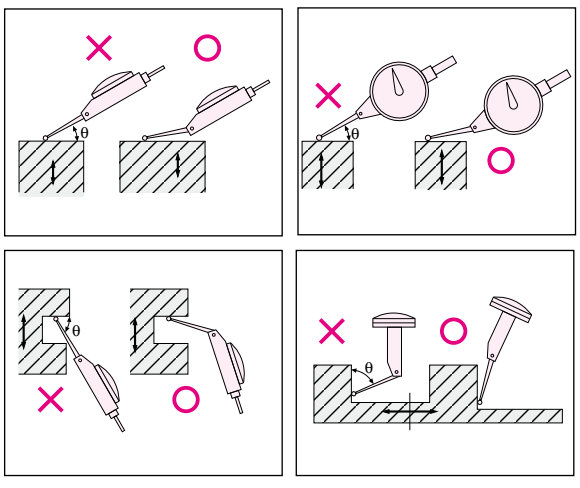
● Accuracy of indication

Permissible indication errors of dial test indicators are as per the table below. (Unit: µm)

Graduation (mm)	Measuring range (mm)	Wide range accuracy	Adjacent error	Repeatability	Retrace error
0.01	0.5	5	5	3	3
	0.8	8			
	1.0	10			4*1
0.002	0.2	3	2	1	2
	0.28				

*1: Applies to indicators with a contact point over 35 mm long.
Remarks: Values in the table above apply at 20°C.

Dial Test Indicators and the Cosine Effect



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 true measurement.
True measurement = dial reading 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 true 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.)