BOREMATIC (en)

Safety Precautions

To ensure operator safety, use this product in conformance with the directions and specifications given in this User's Manual.
Use under other conditions may compromise safety.

⚠ WARNING
- Always keep batteries out of reach of children, and if swallowed, consult a physician immediately.
- Batteries should never be short-circuited, disassembled, deformed or come in contact with extreme heat or flames.
- If battery alkaline liquid comes in contact with the eyes, flush eyes immediately with clean water and consult a physician. If battery alkaline liquid comes in contact with the skin, flush the exposed area thoroughly with clean water.

⚠ CAUTION
- Never attempt to charge the primary battery or reverse the positive-negative terminals when mounting. Improper battery handling or mounting may cause the battery to explode, cause battery leakage and/ or serious bodily injury or malfunctioning.
- Always handle the sharp measuring faces of this product with care to avoid injury.

Note
- Do not disassemble or modify this product. It can cause failure.
- Avoid using or storing this product where there is significant temperature change. Prior to use, thermally stabilize the product at room temperature.
- Do not store this product in a high-humidity or dusty environment. Do not use this product where it could be splashed with coolant, etc.
- Do not apply sudden shocks (such as dropping) or excessive force to this product.
- Be sure to perform reference point adjustment before measurement.
- Oil or cutting chips adhering to or rust on the sliding part of the contact point results in incorrect operations. Wipe off oil and cutting chips after use.
- To clean this product, use a soft cloth soaked in a diluted neutral detergent. Do not use any organic solvent (thinner, etc.). It may deform or damage this product.
- Do not use an electric engraver to put numbers or marks on the product. It can cause failure.
- The supplied battery is used to check functions and performance. It might not provide the specified life.
- If the product will not be used for more than three months, remove the battery from and store it properly. Otherwise, liquid may leak from the battery and damage the product.
- The warranty shall not apply if the product falls or is damaged as a result of fair wear and tear, including battery drain.
- Do not twist this product or let it hang while it is fitted in a workpiece.
- Only use the supplied contact points. Do not remove the contact point.
- The measured value differs depending on whether the entire surface of the contact point is used for measurement or only at the tip because of the mechanism of this product. Make the reference point adjustment under the same conditions as for the measurement.
- Be sure to make the reference point adjustment before measurement or after detach/attach of the gage head and extension rod (option).
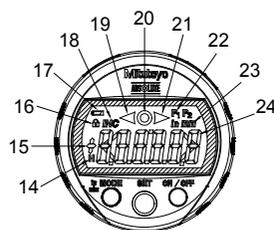
Icons of Switch Operations

🖐 = ✋ < 1 sec   🖐 = ✋ > 2 sec

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1. Part Names
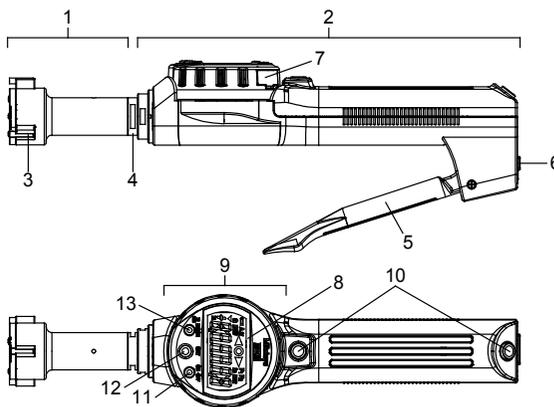
1 Gage head	8 Display unit (LCD)
2 Main body unit	9 Control panel part
3 Contact point	10 DATA/HOLD switch
4 Attachment	11 Battery ON/OFF switch
5 Lever	12 SET switch
6 Output connector	13 MODE in/mm switch
7 Battery holder (with protection cap)	(in/mm switch is for in/mm product only)

|	
14 Hold display	20 Tolerance judgment display (OK)
15 Sign display	21 Tolerance judgment display (+NG)
16 Function lock display	22 P.SET display
17 Power supply voltage warning display	23 Unit display (in is for in/mm product only)
18 INC display	24 Measured value display (tolerance judgment
19 Tolerance judgment display (-NG)	enlarged display)

2. Setting the Battery

Note
- Be sure to use SR44 (silver oxide battery).
- Be careful not to damage battery terminals when installing the battery.
- If the battery holder is not correctly mounted, it may cause abnormal display or failure.
- Do not use a sharp-pointed tool to remove the battery holder and do not pry out the battery holder, to prevent damage to it.
- Replacing the battery clears all settings. Reset them.
- When disposing the battery, comply with ordinances and regulations.

At purchase, the battery is not set in this product. Follow the procedure below to set the battery.

1 Use a driver or other tool to remove the battery holder.
2 When replacing a battery, remove the old battery from the battery holder.
3 Set a new battery (SR44) in the battery holder as shown in the figure below.
4 Mount the battery holder.
     >> "- - - - - -" lights.
5 Press the SET switch twice.
     >> Absolute measurement (ABS) mode starts.
       If it does not enter the absolute measurement (ABS) mode, remove the battery once, and then set it again.
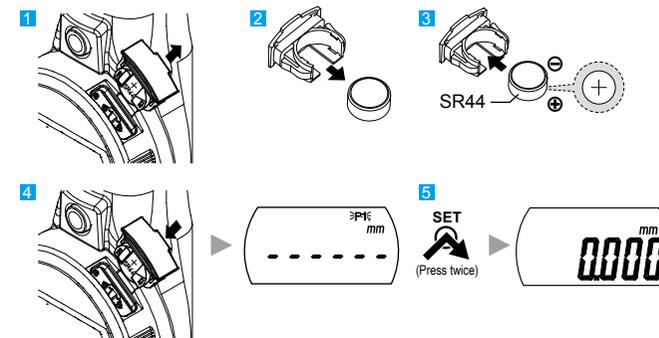
3. Powering On/Off

To turn on the power, press the battery ON/OFF switch.
To turn off the power, hold the battery ON/OFF switch (for two seconds or longer).
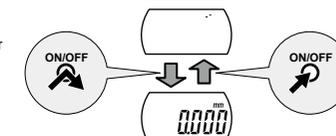
Note
- This product starts up in the last used measurement mode upon power-on. (For measurement modes, see "4. Switching Measurement Modes".)
- If this product is not turned on even when the battery ON/OFF switch is pressed, the battery may be exhausted. Replace it.
- Power-off during any setting cancels the setting and restores the previous status.
- When the power is turned on, a value other than the actual one or "Err 30" may be displayed. This is not a failure. It will return to the actual value by operating the lever.

4. Switching Measurement Modes

This product has the following two measurement modes:
- Absolute measurement (ABS) mode: Sets the reference point with a ring gage (reference gage) and measures a diameter of the workpiece.
- Incremental measurement (INC) mode: Zero-sets the display value with a reference master and measures the difference in diameter between the reference master and the workpiece.

To switch the measurement modes, hold the SET switch (for two seconds or longer).

Absolute measurement (ABS) mode

Incremental measurement (INC) mode
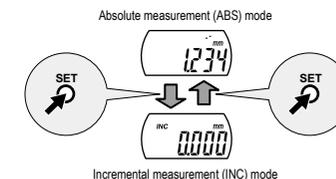
Note
When the SET switch is pressed in the incremental measurement (INC) mode, the display value is zero-set.

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5. Reference Point Adjustment

Note
- Prior to measurement, be sure to follow the procedure below to check and set the reference point.
- Use a calibrated dedicated ring gage for the reference point adjustment of this product.
- Remove any dirt or oil from the ring gage and the measuring surfaces of this product before the reference point adjustment.
- Use the same position and conditions for both the reference point adjustment and the measurement.
  For measurement using the tip of the contact point, use it for the reference point adjustment as well (Figure 1).
- Keep the base of the gage head away from the bottom during reference point adjustment or measurement (Figure 2).

Figure 1

Figure 2

Workpiece

Reference point adjustmen
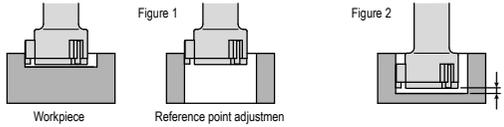
1) For absolute measurement (ABS) mode
Registers (Presets) the diameter of a reference gage such as a ring gage with this product as reference point.
Two preset values (P1, P2) can be registered with this product for setting the reference point. This is useful when using the same preset value many times, or when switching the value according to the gage head replaced.
Follow the procedure below to register the preset values.

1 Start setting the reference point.
1 Press the SET switch.
>> "P1" or "P2" blinks, and the preset value set at the last time is shown.
>> Proceed to step **4**-1 if you do not change the preset value.
2 Press the MODE switch to select "P1" or "P2".
3 Hold the SET switch (for two seconds or longer).
>> The sign blinks, and the preset value becomes settable.
2 Set the preset value (sign).
1 Press the MODE switch to change the sign.
>> Pressing the MODE switch toggles "+ ⇄ -".
2 Press the SET switch.
>> The sign is confirmed, and the next digit blinks.
3 Set the preset value (number).
1 Press the MODE switch to change the number.
>> Pressing the MODE switch cycles "0 → 1 → 2... → 9 → 0" in this order.
2 Press the SET switch.
>> The value is confirmed, and the next digit blinks.
>> To skip a digit, press the SET switch.
>> Repeat these steps (1 and 2) to confirm all the digit numbers.
>> When the lowest digit number is confirmed, "P1" or "P2" blinks.
**4** Register the preset value.
1 Confirm the sign and number you set, and press the SET switch.
>> The preset value is registered, and the display returns to the absolute measurement (ABS) mode.
5 Set the ring gage (reference gage).
1 Wipe the ring gage and the measuring surfaces of this product clean.
2 Grasp the lever and slowly insert this product into the ring gage.
3 Slowly release the lever to have the contact points touch the inner surface of the ring gage.
4 Lightly shake the entire product to ensure that the entire contact point touches the inner surface (to the largest display value).

Note
Do not move the inserted product until completion of setting the reference point.
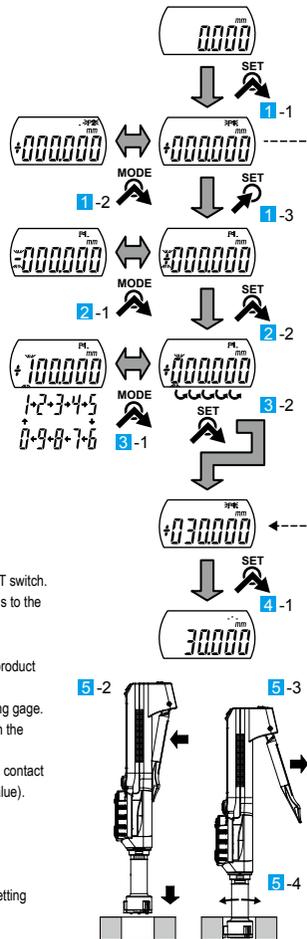
6 Call the preset value you set.
1 Press the SET switch twice.
>> The position of the contact points are set as the reference point with the preset value.

Note
- If you set a wrong sign or number in the step **4**, hold the SET switch (for two seconds or longer), and retry from step **2**.
- The reference point (sign and number) you set is kept even when the power is turned off. However, replacing the battery clears the settings. Reset them.
- To stop or cancel the setting along the way, hold the MODE switch (for two seconds or longer).

2) For incremental measurement (INC) mode
The incremental measurement (INC) mode is useful when comparing the diameter of the workpiece with that of the master.

1 Set the ring gage (reference gage).
1 Wipe the ring gage and the measuring surfaces of this product clean.
2 Grasp the lever and slowly insert this product into the ring gage.
3 Slowly release the lever to have the contact points touch the inner surface of the ring gage.
4 Lightly shake the entire product to ensure that the entire contact point touches the inner surface (to the largest display value).

Note
Do not move the inserted product until completion of setting the reference point.

2 Press the SET switch for two seconds or longer.
>> The display value is cleared (zero-set), and "INC" lights.
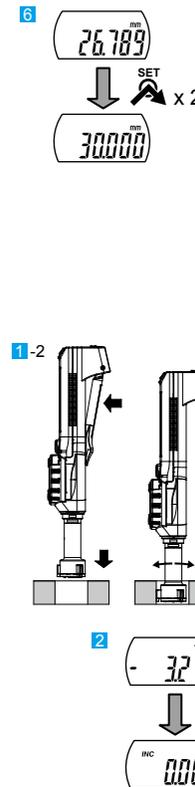
6. How to Measure

Insert this product into the workpiece with the same position and procedure as for the reference point adjustment and read the display value.
When the tolerance judgment function is not set to OFF, the result is shown.

7. Holding of Display Value (No Connection to External Device)
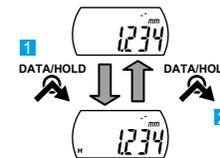
Display value can be held (fixed).

1 Press the DATA/HOLD switch in the measurement mode.
>> "H" lights, and the display value is held.

2 To release the hold, press the DATA/HOLD switch again.

Note
The hold function does not work when the DATA/HOLD switch is pressed during the tolerance judgment enlarged display.

8. Tolerance Judgment (Upper and Lower Limits Setting)

Set the allowed upper and lower limits against the reference value in order to judge whether a measured value is within the range (tolerance) and thus acceptable.
For the tolerance judgment function, "OFF", "Normal display of judgment result", or "Enlarged display of judgment result" can be selected.
The tolerance value can be set for each absolute measurement (ABS) mode and incremental measurement (INC) mode.

Note
The upper and lower limits can be set for each measurement mode (ABS and INC). Confirm that the desired measurement mode is selected before starting the setting of the tolerance judgment.

Follow the procedure below to set the tolerance judgment function.

1 Enter the parameter setting mode.
1 Hold the MODE switch (for two seconds or longer) in the measurement mode for which the tolerance judgment function is set.
>> The display enters the parameter setting mode.
2 Select the tolerance judgment function.
1 Confirm that the tolerance judgment function (tol) is shown.
2 Press the SET switch.
>> The tolerance judgment function can be set.
3 Set the method of displaying the judgment result.
1 Press the MODE switch to select the method of displaying the judgment result.
>> Pressing the MODE switch cycles "OFF" (Disable the tolerance judgment) → "◄O►" (Enable the tolerance judgment (normal display)) → "◄□►" (Enable the tolerance judgment (enlarged display)) in this order.
2 Press the SET switch.
>> The setting is confirmed.
>> When "normal display" or "enlarged display" is set, " ▶ " blinks, and the upper limit can be set.
>> Setting "OFF" proceeds to the next parameter "Fn-Loc" (function lock).
4 Set the upper limit.
1 Hold the SET switch (for two seconds or longer).
>> The sign blinks, and the value can be set.
2 Press the MODE switch to set the value.
>> Pressing the MODE switch cycles "+ → → -", "0 → 1 → 2... → 9 → 0" in this order.
3 Press the SET switch.
>> The value is confirmed.
>> The next digit blinks, and the value can be set.
>> Repeat these steps to confirm all the digit values.
>> When the lowest digit value is confirmed, " ▶ " blinks.
4 Press the SET switch.
>> " ◀ " blinks, and the lower limit can be set.
5 Set the lower limit.
1 Set it as with the upper limit.
2 Press the SET switch to finish the setting of the lower limit.
>> The display shows the next parameter "Fn-Loc".

Note
- When a lower limit larger than the upper limit is set, "Err 90" is displayed, and the values set are cleared. Press the SET switch to cancel the error display, and start the setting again from the upper limit. (See "10. Errors and Countermeasures".)
- Different tolerance limit values cannot be set between "normal display" and "enlarged display".
- To stop the setting along the way, hold the MODE switch (for two seconds or longer). Note that any unconfirmed settings are discarded.
- All settings are kept even when the power is turned off. However, replacing the battery clears the settings. Reset them.

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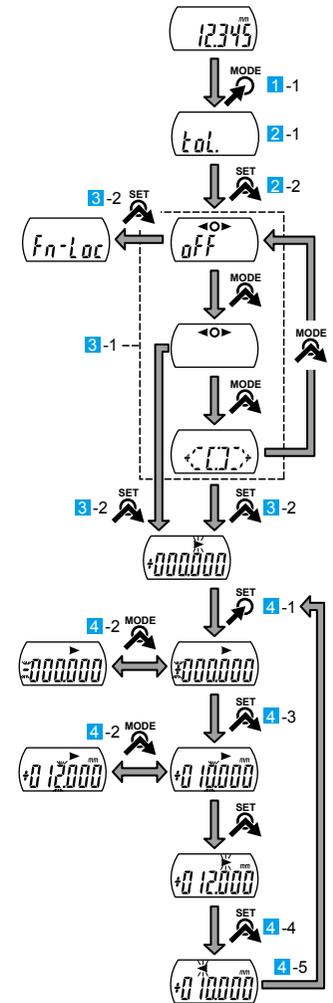
9. Function Lock Function (Prevention of Incorrect Operations)

This product provides the function lock function which disables the reference point setup operations to prevent the reference point from being changed carelessly.

When the function lock is effective, "🔒" blinks on the display unit, and the operations are disabled except the power on/off, hold/release of the display value, output of the display value, and release of the function lock.

1 Enter the parameter setting mode.
  1 Hold the MODE switch in the measurement mode (for two seconds or longer).
    >> The display enters the parameter setting mode.
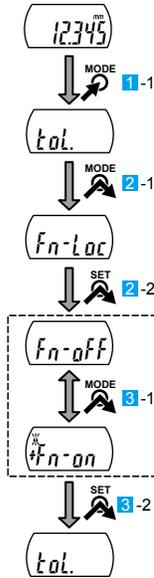
2 Select the function lock function.
  1 Press the MODE switch to select the function lock function (*Fn-Loc*).
  2 Press the SET switch.
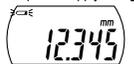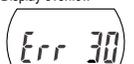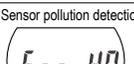   >> The function lock function can be set.
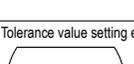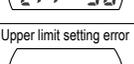
3 Set ON/OFF.
  1 Press the MODE switch to select ON/OFF.
    >> Pressing the MODE switch toggles ON/OFF.
  2 Press the SET switch.
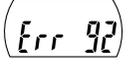   >> The setting is confirmed.

Note
- The function lock function becomes effective after quitting the parameter setting mode and returning to the measurement mode.
- When the function lock function is effective, no other operations than releasing the function lock can be executed. To set another item, release the function lock.
- To stop the setting along the way, hold the MODE switch (for two seconds or longer). Note that any unconfirmed settings are discarded.
- All settings are kept even when the power is turned off. However, replacing the battery clears the settings. Reset them.

10. Errors and Countermeasures

| Error display	Cause and countermeasure
ABS composition error	This may appear during movement of the contact point and disappear soon due to the internal processing, and this can be ignored. If it occurs in the static condition, the internal sensor fails. Contact your dealer or the nearest Mitutoyo sales office for repair.
Low power supply voltage mark	The battery is low. Replace the old battery with a new one.
Display overflow (Err 30)	The measured value exceeds the number of digits which can be displayed. • At absolute measurement (ABS) mode: Set the reference point again. (See "5. 1) For absolute measurement (ABS) mode".) • At incremental measurement (INC) mode: Perform the zero-set. (See "5. 2) For incremental measurement (INC) mode".)
Sensor pollution detection error (Err 40)	Condensation due to rapid temperature change or pollution due to other causes occurs on the detection unit. • Turn the power off, and perform thermal stabilization for about two hours. • If this is not solved after thermal stabilization, contact your dealer or the nearest Mitutoyo sales office for repair.
Tolerance value setting error (Err 90)	The lower limit is larger than the upper limit. • Reset to make sure that the upper limit is larger than the lower limit. (See "8. Tolerance Judgment (Upper and Lower Limits Setting)".)
Upper limit setting error (Err 91)	The upper limit exceeds the number of digits which can be displayed. • Set a proper upper limit. (See "8. Tolerance Judgment (Upper and Lower Limits Setting)".)
Lower limit setting error (Err 92)	The lower limit exceeds the number of digits which can be displayed. • Set a proper lower limit. (See "8. Tolerance Judgment (Upper and Lower Limits Setting)".)

11. How to Mount/Dismount Gage Head and Extension Rod (Option)

Note
- When loosening or tightening the attachment with a spanner, do not hold the main body unit by hand. It can cause damage.
- Be sure to make the reference point adjustment after detach/attach of the gage head and extension rod (option).

1 Set the supplied spanner into the grooves on the attachment to hold the main body unit, and rotate the gage head by hand to release it.

2 Keep holding the main body unit by the spanner, rotate and tighten the extension rod and the gage head in this order by hand.

Dismount it in the same way.
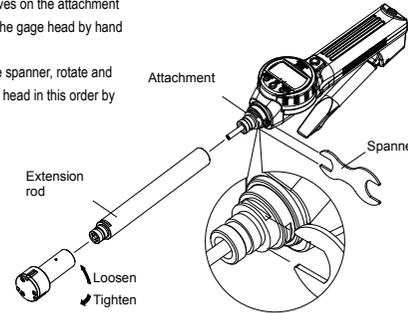
12. Output Function

1) External output of the display value

By connecting this product with an external device by the connection cable (option), the display value can be output to external.

Note
- Parts No.905338 (1 m) and No.905409 (2 m) are available as the connection cable (option) for this product.
- Be sure to check the direction of the connector when attaching the connection cable.

1 Hold the battery ON/OFF switch (for two seconds or longer) to turn it off.

2 Connect this product with an external device.
  1 Remove the protection cap of the output connector on this product.
  2 Connect this product with an external device using the connection cable.

3 After turning on the product, press the DATA/HOLD switch in the measurement mode.
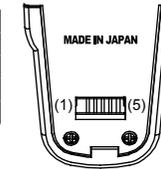 >> Display value is output to the connected external device.
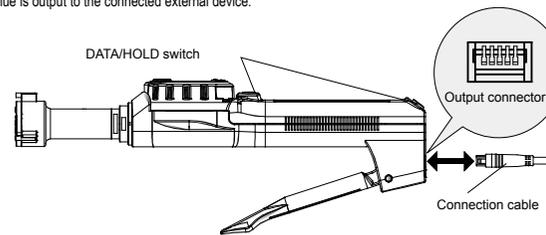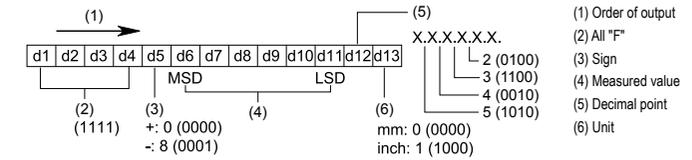
Note
- The external output using the DATA/HOLD switch is not available during the tolerance judgment with enlarged display. However, the external output is possible by inputting an output request (REQ) from the external device.
- Before using the external output function, carefully read the operation manual of the connected data processor.
- When output requests (REQ) are received in a short interval, data output may fail. (If continuous data output is requested from the external counter, set the output request interval on the counter to 0.4 second or longer.)
- The held display value is released when it is output externally.
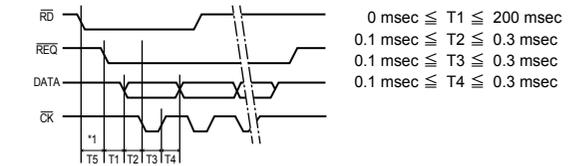
2) Output connector

1	GND
2	DATA
3	$\overline{CK}$
4	$\overline{RD}$
5	$\overline{REQ}$

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3) Output format

(1) →

d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13

MSD ... LSD

(2) (1111)
(3) +: 0 (0000) -: 8 (0001)
(4)
(5) X.X.X.X.X.X. — 2 (0100) — 3 (1100) — 4 (0010) — 5 (1010)
(6) mm: 0 (0000) inch: 1 (1000)

(1) Order of output
(2) All "F"
(3) Sign
(4) Measured value
(5) Decimal point
(6) Unit

4) Timing chart

$\overline{RD}$, $\overline{REQ}$, DATA, $\overline{CK}$

*1 T5 T1 T2 T3 T4

0 msec $\leq$ T1 $\leq$ 200 msec
0.1 msec $\leq$ T2 $\leq$ 0.3 msec
0.1 msec $\leq$ T3 $\leq$ 0.3 msec
0.1 msec $\leq$ T4 $\leq$ 0.3 msec

*1: T5, the time from the Low level of $\overline{RD}$ to the input of $\overline{REQ}$, depends on the performance of the data processor.

13. Specifications

Maximum measuring length	Maximum permissible error J_{MPE}[1]	Resolution
8 - 20 mm	±5 µm (maximum difference 5 µm)	0.001 mm
25 - 125 mm	±6 µm (maximum difference 6 µm)	
0.35 - 0.8 in	±0.00025 in (maximum difference 0.00025 in)	0.00005 in
1 - 5 in	±0.0003 in (maximum difference 0.0003 in)	

*1: Maximum permissible error for indicated value via contact with full measuring face J_{MPE} (20 °C)

- Display unit : LCD display (six digits and minus sign)
- Power supply : silver oxide battery (SR44 No.938882) 1 pc
- Battery life : 5,000 hours
- Use temperature range : 5 °C to 40 °C
- Storage temperature range : -10 °C to 60 °C
- Standard accessories : Spanner

14. Options

- Connection cable (1 m) : No.905338
- Connection cable (2 m) : No.905409
- Extension rod (length 100 mm, measuring range 6 mm - 12 mm) : No.952322
- Extension rod (length 150 mm, measuring range 12 mm - 20 mm) : No.952621
- Extension rod (length 150 mm, measuring range 20 mm - 50 mm) : No.952622
- Extension rod (length 150 mm, measuring range 50 mm - 125 mm) : No.952623

15. Offsite Repair (Charged)

If any of the following problems occurs, the product needs to be done offsite repair (charged). Please contact the nearest distributor or Mitutoyo sales office.
- Malfunction of contact point
  Oil or rust on the sliding part of the contact point results in malfunction.