

# MANUAL TR-110

Surface roughness tester



*Changes in products and/or product specifications can emerge due to new technologies and continuous development.*

*We reserve the right to change or modify specifications of products without prior notice.*

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# 1. GENERAL INTRODUCTION

Pocket-Sized Surface Roughness Tester TR-110 is a new generation of Surface Roughness Tester Series, introduced to market by in 2003. It features high accuracy, wide application, simple operation, portability and stable performance. The tester is widely used in measuring the surface roughness of various metals and non-metals. Its integrated structure of sensor and main body and hand-held design make it suitable to be used in production sites.

Updated functions of TR-110:

- TR-110's appearance, which tallies with current new design trend, makes it more amiable than previous product generation. More logical operation offers a comfortable use procedure to users. With a long-life Li-ion rechargeable battery, the tester can be worked for a long time with a short rechargeable time, and is workable during battery recharge. Circuit function is improved. Working voltage is debased. Accordingly, its work wastage and circuit noise are debased. Its sensor's driver setup, material and working process have been ameliorated. With a more precise assembly, the tester has gotten a more stable performance. Some necessary instruction information such as testing indication, low battery indication etc has been added to the new designed LCD interface.
- A protective sheath for the sensor stylus offers an effective protect for the sensor stylus, so as to guarantee its precision. Backlight is adopted to assure the tester to be used in dark place. Smaller size and lighter weight.

## **2. WORK PRINCIPLE**

When the sensor driven by a driver is making a linear uniform motion along the testing surface, the stylus which touches with the work surface moves up and down along the work surface perpendicularly. Its motion is converted into electric signals, which are amplified, filtered and transformed into digital signals through A/D. The signals are then processed by CPU into Ra and Rz values before being displayed on the screen.

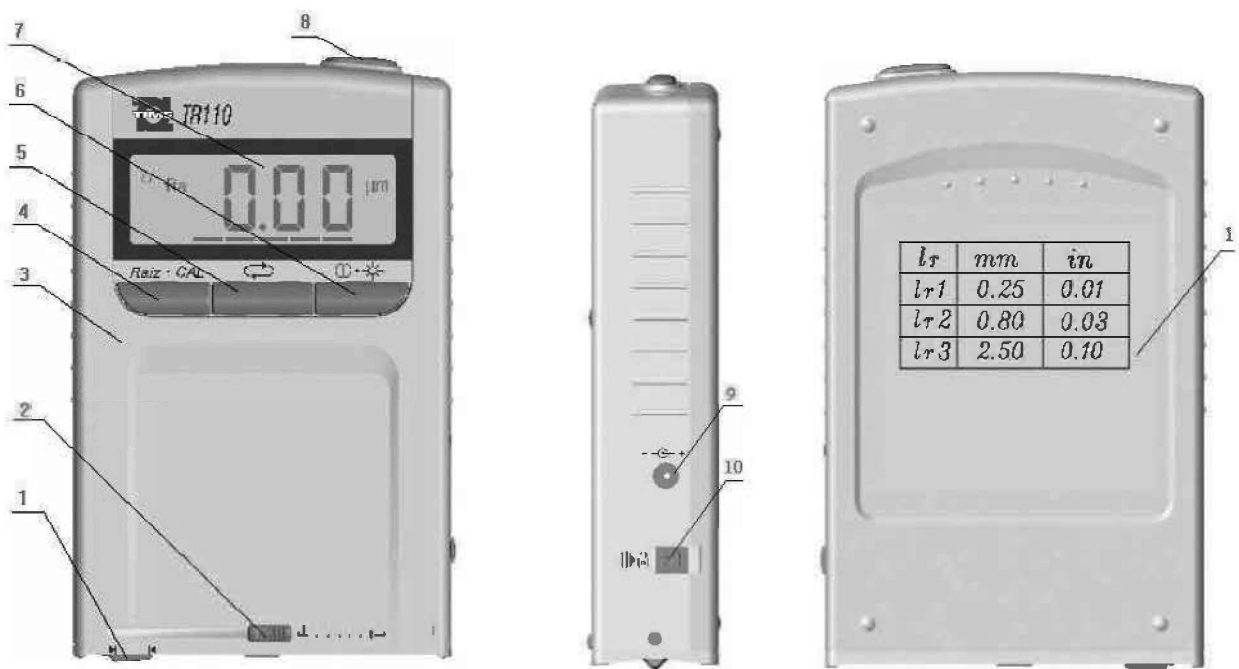
### 3. STANDARD DELIVERY

Main body	1
Li-ion rechargeable Battery	1
Standard sample plate	1



## 4. NAME OF EACH PART

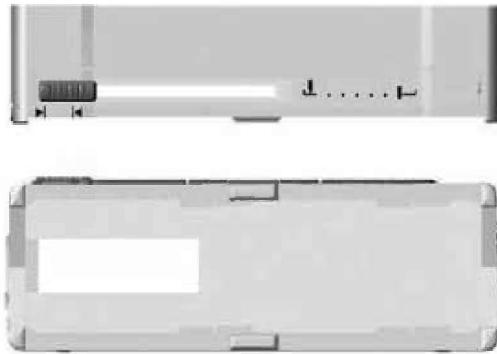
1. Stylus mark
2. Switch of sensor stylus protective sheath
3. Main body crust
4. Left Key
5. Middle Key
6. Right Key
7. LCD
8. Start Key
9. Charging socket
10. Back cover lock
11. Label



## 5. OPERATION

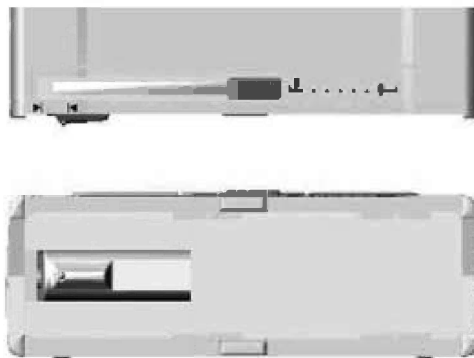
### 5.1 PREPARATION BEFORE OPERATION

Take the tester from the carrying case.  
The sensor stylus protective sheath should be closed. (Refer to Picture 1)



*Picture 1 closed sensor stylus protective sheath*

Pull the switch of sensor stylus protective sheath to the right, and open the sensor stylus protective sheath. The sensor stylus will show for measuring (Refer to Picture 2)



*Picture 2 Open sensor stylus protective sheath*



Hints the location of sensor stylus protective sheath (on or off) and the sensor stylus status of being used or being protected.

Please pay attention to close the sensor stylus protective sheath when the testing is finished. Because the sensor is the most important precise part of this tester, and it will affect on directly the precision of the tester, it should be protected very well.



## 5.2 SWITCH ON, SWITCH OFF AND BACKLIGHT

Press the Right Key to switch on. The screen will display as picture 3. After a "di..." sound, the tester enters the measuring status and is ready to work with the display of measuring parameters and sampling length set at previous time. (Refer to Picture 3)



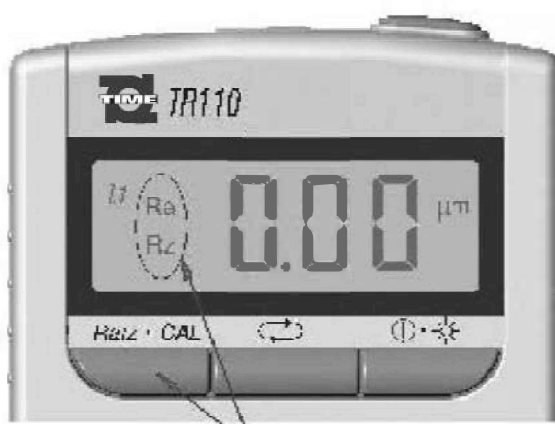
Picture 3

When the tester is in the switch on status, keep pressing the Right Key for 1.5 seconds, the Backlight will be turned on; if keep pressing the Right Key for 3.5 seconds, the tester will be turned off, and the tester will enter the status of low work wastage.

## 5.3 SET UP PARAMETERS

The user should set up these parameters such as Ra, Rz and suitable sampling length (2.5mm, 0.8mm or 0.25mm) (sampling length refer to 7).

After switch on, press the Left Key gently and quickly to set up the value of Ra, Rz (Refer to Picture 4)

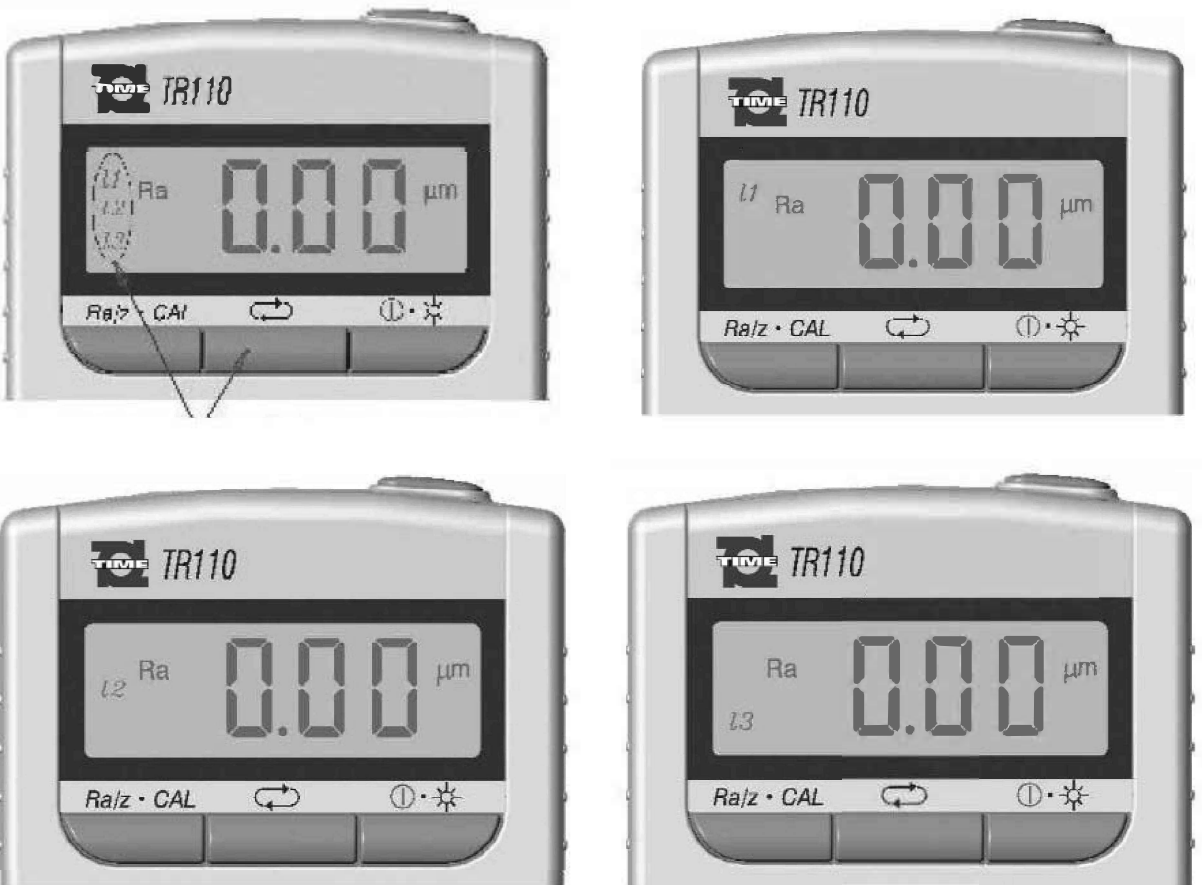


Picture 4 Ra/Rz conversion by press the left key gently and quickly

Then the LCD will display as follows:





Press the Middle Key gently and quickly to select the sampling length (0.25mm, 0.8mm, 2.5mm) by turns. (Refer to Picture 5)



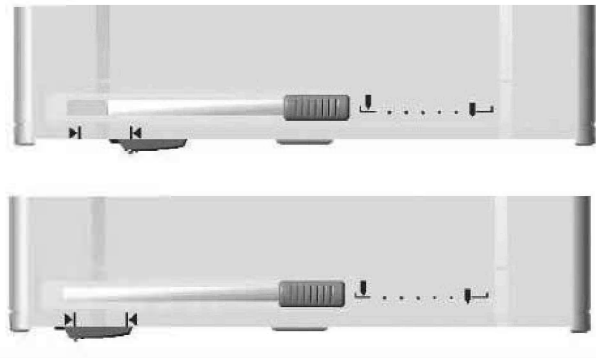
Picture 5 Select the cut-off sample length by pressing the middle key

## 5.4 MEASURING

When the parameters are set up and the cut-off samples length is decided, it will come to measurement. Point the Stylus mark  to the measured area stably and then press the Start Key on the top to start measurement. The sensor will move along the measured surface, and the screen will display as Picture 6.  will show the stylus' travel dynamically. The total length of its travel is 6mm.



Picture 6 Sensor Stylus travels as Picture 7.



Picture 7

After two "di, di...." sounds, the measurement finishes, and the screen will show as the picture in the right.



### Note:

- During the sensor' travel, do your utmost to make sure the tester is on the measured surface stably so as to avoid its influence to the precision.
- Before the sensor return to its previous position, the tester will not make any response to further operation. The screen will show the measuring result as the picture in the right. New measurement is prohibited until the entire measurement is finished.

## 5.5 CALIBRATION

Before use, a Calibration should be done with the standard sample plate as follows:

Firstly, locate the tester onto the reticle area of the standard sample plates, and make the sensor's travel direction is vertical to the veins direction of the reticle (refer to picture 8). After that, press the start key to make measurement. The measuring value will be shown on the screen (Refer to Picture 9, the measuring value here is 3.21). And then it comes to the next step of calibration.



Picture 8

When the tester is under non-measuring status, keep pressing the Left Key more than 2 seconds, the tester will enter the status of Calibration. (Refer to picture 9)



Picture 9

Press the left key for a long time, the test will enter the status of mean value calibration and a symbol CAL will display on screen

Press the Left Key and Middle Key to adjust the displaying value to the value indicated on the standard sample plate (Refer to picture 10).



Picture 10

Under CAL status, press the left key to increase the value by turns and press the middle key to decrease the value

Press the Start Key to exit the status of Calibration. After calibration, the calibrated measuring value Ra will show on the screen. (At the meantime, the new standard sample plate value Ra will be stored to the memory instead of the old one). After the sensor returns to its original place, the tester can be used to make normal measurement.

If the user has multi- reticle sample plate, he can choose suitable sample plate to calibrate the tester against his measuring range in common use. By this way, the tester's precision can be improved greatly.

## 5.6 M/IN SWITCH

Switch the m/in by keep pressing the Middle Key. (Refer to Picture 11)

Picture 11





## 5.7 SWITCH OFF AUTOMATICALLY

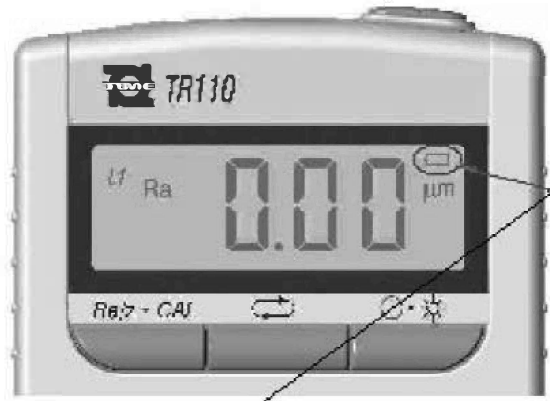
The tester will switch off automatically if there is no operation in 90 seconds.



## 5.8 INDICATION OF LOW BATTERY


When the battery symbol on the upper right of the screen display , low battery is indicated. Recharge is needed.

When both " " and "-" are shown on the screen together with "di,di.." sound, utmost low battery is indicated and an prompt recharge should be done. (Refer to Picture 12)




Picture 12


## 5.9 BATTERY RECHARGE

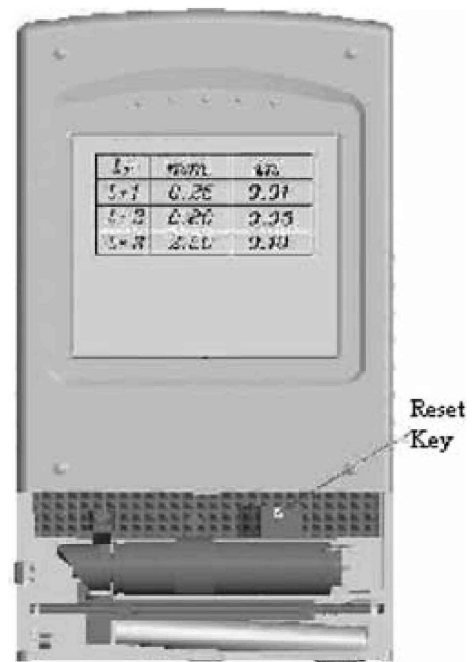
Plug the charger into the the tester's recharge socket (on the left side of the tester)  and have the tester recharged. 3 hours recharging-time is enough. The tester is workable during recharging.

## 5.10 RESET

When the tester is down, it can be restart-on with reset switch. Pull the lock  on the in the right side of the tester, and the reset switch will show on the upper right of the circuits board (Refer to picture 13). After pull the switch down and then up, the tester will be restarted on.

If the tester won't be used for a long time, pull down the reset switch to power off.

After reset or power off, the back cover should be covered and locked  .



## **6. MAINTENANCE AND REPAIR**

### **6.1 MAINTENANCE**

- Protect the tester from collision, violent shock, heavy dust, dampness, oil stain and strong magnetic field etc.
- Please switch off in time after each measurement to save the energy, and have the battery recharged promptly when necessary.
- The usual suitable recharging-time for the tester is 3 hours. Please pay attention to prevent the battery from being damaged by over-time recharge.
- The sensor is the precision part of the tester and particular care should be taken of it. After each use, put on the protective sheath gently so as to avoid violent shock to the sensor.
- Standard sample plate provided with the tester should be given special protection to avoid scratch which may make the calibration inaccurate.

### **6.2 REPAIR**

If any trouble occurs, repair should be done by the manufacturer. Any user should not dismantle and repair it. Any tester that is sent back to manufacturer for checking and repair should attach a statement about the trouble together with the warranty card and the sample plate provided with the tester. Please keep in touch with the sales department or agents.

## 7. TECHNICAL PARAMETERS AND FUNCTIONS

### 7.1 MAIN TECHNICAL PARAMETERS

- Measurement parameters ( $\mu\text{m}$ ): Ra, Rz
- Traveling Length (mm): 6
- Sampling Length (mm): 0.25, 0.80 and 2.5
- Evaluation Length (mm): 1.25, 4.0 and 5.0
- Measuring Range ( $\mu\text{m}$ ): Ra: 0.05–10.0; Rz: 0.1–50
- Display Error:  $\pm 15\%$
- Repeatability of Displayed Value:  $< 12\%$
- Radius and angle of the stylus point: Radius:  $10.0 \pm 2.5 \mu\text{m}$   
Angle:  $90^\circ$
- Stationary measuring force and its variations of the sensor stylus:  
Stationary measuring force:  $= 0.016\text{N}$   
Variation of the measuring force:  $= 800\text{N/m}$
- Pressure of the skid-dependent of the sensor:  $= 0.5\text{N}$
- Battery: 3.6V Li-ion battery
- Charger: DC 6V,  
with 3-hour recharging time.
- Dimension: 110 mm x 70 mm x 24 mm
- Weight: 200g

### 7.2 MAIN FUNCTIONS

- Optional measuring parameters: Ra, Rz
- Optional sampling length
- Calibration function
- Automatic testing of battery voltage and sound of alarm
- Battery recharging function, workable while recharging

### 7.3 OPERATING ENVIRONMENT

- Operating conditions Temperature:  $0 \sim 40^\circ\text{C}$   
Relative humidity:  $< 80\%$   
No vibration; no corrosive media
- Conditions for storing Temperature:  $- 20^\circ\text{C} \sim 60^\circ\text{C}$   
Relative humidity:  $< 90\%$   
Ventilation: Grade 3



## 8. TERMINOLOGY AND PARAMETERS FOR SURFACE ROUGHNESS

**Surface Roughness** is the microcosmic geometric form on the work-piece surface composed by peak and valley with small interspaces.

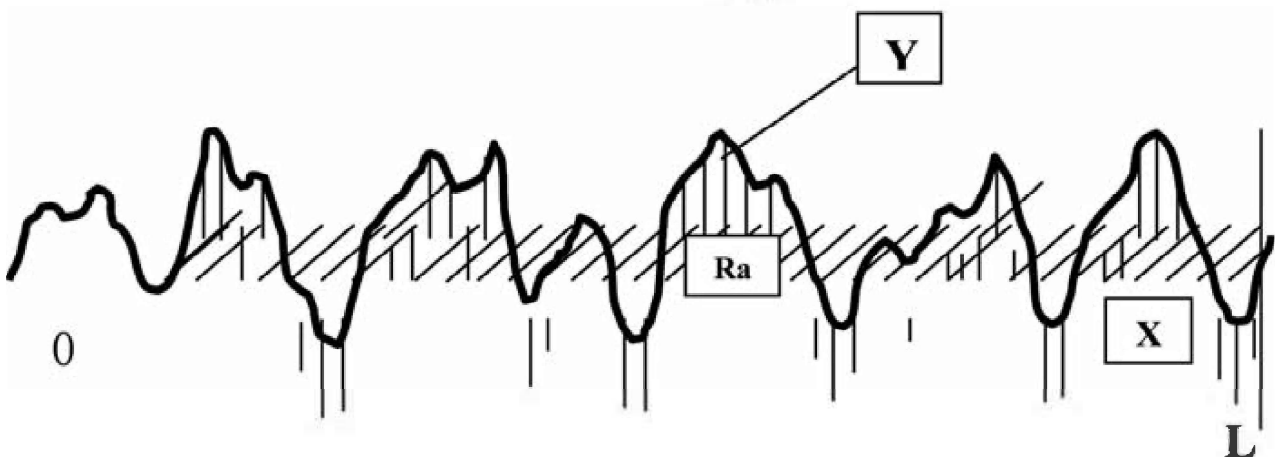
**Sampling Length** is the benchmark's length used to be distinguish its surface roughness.

**Evaluation Length** is the necessary length for evaluating the roughness profile. It may include one or more sampling lengths.

**Ra: Arithmetical Mean Deviation of Profile**

is arithmetic mean value of the deviation of the profile within sampling length.

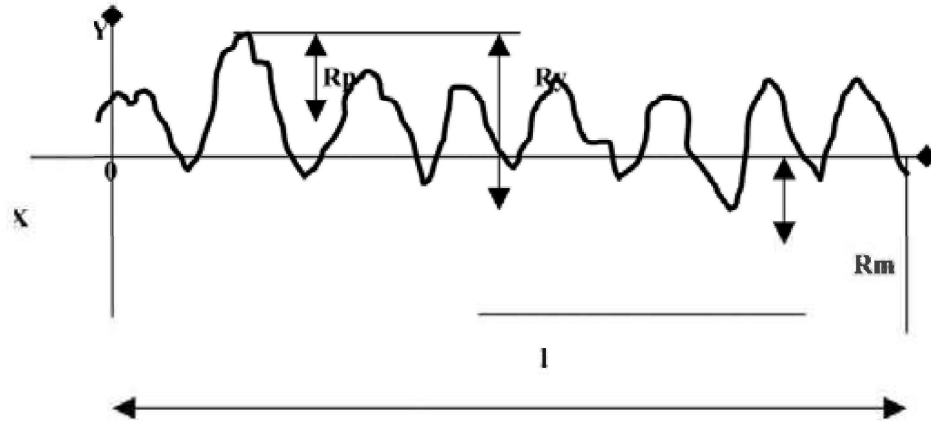
$$Ra = \frac{1}{n} \sum_{i=1}^n |y_i|$$



**Rq:**

Root-mean-square Deviation of Profile is the root-mean-square of the deviation of profile within sampling length.

$$Rq = \left( \frac{1}{n} \sum_{i=1}^n y_i^2 \right)^{\frac{1}{2}}$$



**Rz:** Ten Point Height of Irregularities  
The sum of two averages five maximum profile peaks average and five maximum profile valley averages within the sampling length.

**Ry (ISO) Maximum Height of Profile**

The distance between profile peak line to valley line within sampling length.

**Ry (DIN) Maximum Height of Profile**

To get Ry (DIN) value: first calculate the distance between profile peak line and valley line in each sampling length, the maximum of which is the Ry (DIN) for the evaluation length.

$$Rz = \frac{\sum_{i=1}^5 y_{pi} + \sum_{i=1}^5 y_{vi}}{5}$$

## 9 RECOMMENDED SAMPLING LENGTH TABLE

<b>Ra (μm)</b>	<b>Rz (μm)</b>	<b><u>Sampling Length (mm)</u></b>
>40~80	>160~320	8
>20~40	>80~160	8
>10~20	>40~80	8
>5~10	>20~40	2.5
>2.5~5	>10~20	2.5
>1.25~2.5	>6.3~10	0.8
>0.63~1.25	>3.2~6.3	0.8
>0.32~0.63	>1.6~3.2	0.8
>0.25~0.32	>1.25~1.6	0.25
>0.20~0.25	>1.0~1.25	0.25
>0.16~0.20	>0.8~1.0	0.25
>0.125~0.16	>0.63~0.8	0.25
>0.1~0.125	>0.5~0.63	0.25
>0.08~0.1	>0.4~0.5	0.25
>0.063~0.08	>0.32~0.4	0.25
>0.05~0.063	>0.25~0.32	0.25
>0.04~0.05	>0.2~0.25	0.25
>0.032~0.04	>0.16~0.2	0.25
>0.025~0.032	>0.125~0.16	0.25
>0.02~0.025	>0.1~0.125	0.25
>0.016~0.02	>0.08~0.1	0.08
>0.0125~0.016	>0.063~0.08	0.08
>0.01~0.0125	>0.05~0.062	0.08
>0.008~0.01	>0.04~0.05	0.08
>0.0063~0.008	>0.032~0.004	0.08
<0.063	<0.032	0.08

