CM30

Coating Thickness Gauge

Operating Manual

YUSHI INSTRUMENTS

CONTENTS

1 Overview

CM30 series color display coating thickness gauge developed and produced by our company adopts the principle of magnetic / eddy current measurement to measure non-magnetic coating on magnetic metal or non-conductive coating on non-magnetic metal. It has the newest metal case, which is processed by CNC precision machining and anodizing, and is equipped with stainless steel covers.The whole body and connectors are waterproof and sealed, which fully meets the IP68 waterproof and dust-proof standard. It's not only convenient to operate, but also has the function of storing large amounts of data.

CM30 can be widely used in manufacturing, metal processing industry,aerospace, railway transportation, chemical industry, commodity inspection and other testing fields, it's an essential instrument in nondestructive testing industry.

This gauge complies with the following standards:

GB/T 4956-2003 Non-magnetic coatings on magnetic substrates, Measurement of coating thickness, magnetic method.

GB/T 4957-2003 Non-conductive coatings on Non-magnetic substrates, Measurement of coating thickness, Eddy Current method.

JB/T8393-1996 Magnetic and Eddy Current Measuring instrument for coating thickness.

JJG818-2005 Magnetic and Eddy Current Measuring instrument for coating thickness.

GB/T 4208-2017 Shell Protection Class (IP code)
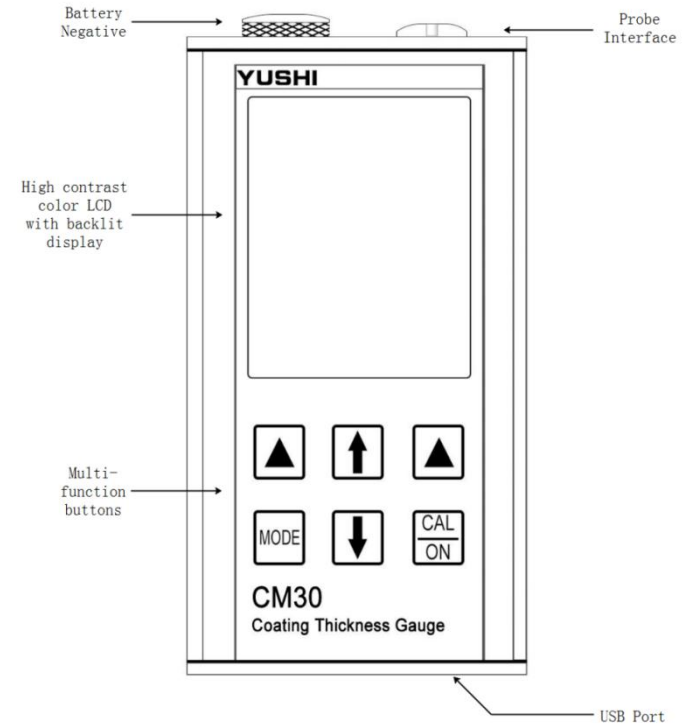
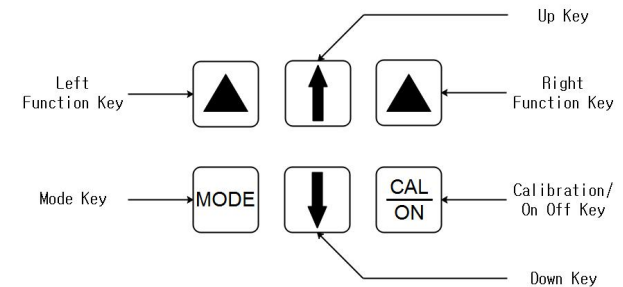## 1.1 Gauge Overview

Figure 1.1 Main Instrument

Figure 1.2 Key Area

1.2 Technical Parameters

Display	2.4" (320×240) IPS
Working Principle	Magnetic / Eddy Current
Unit	Metric(μm/mm) / Imperial(mils)
Resolution	High / Low (metric mode only)
Language	Chinese / English
Statistic Data	Number of Measured Values, Average Value, Maximum Value, Minimum Value, Standard Deviation, Variable Coefficient
Calibration Method	Zero Calibration, One-Point Calibration, Two-Point Calibration
Number of Files	200
Storage Capacity	200,000
Backlight	Adjustable 6 levels
Communication	Communication Software (USB data transfer)
Power Off	Auto power off after 3 min. no operation or manual off
Display Mode	Large Font Mode, Statistics Mode and Trend Graph Mode
Protection level	IP68
Power Supply	2pcs 1.5V AA Batteries
Operating Time	20 Hours
Working Environment	-10 to +50℃ no strong magnetic field
Size	121.5mm*63.5mm*31.5mm
Weight	317g (No probe and no battery)
Guarantee	1 Year

Table 1.1 Technical Parameters

1.3 Measuring Parameters

Instrument Model		CM30F	CM30N	CM30FH	CM30FN
Probe Type		F3	N2	F10	FN1.5
Measuring Principle		Magnetic	Eddy Current	Magnetic	Magnetic / Eddy Current
Measuring range (μm)		0～3000	0～2000	0～10000	0～1500
Low Range Resolution(μm)		0.1	0.1	0.1	0.1
Tolerance(μm)		±(2%H+2)	±(2%H+2)	±(2%H+10)	±(2%H+2)
Testing Condition (mm)	Min. Curvature Radius(convex)	5	5	10	5
	Min.Measuring Diameter	Φ20	Φ20	Φ40	Φ20
	Min. Substrate Thickness	0.5	0.5	2	0.5

Table 1.2 Measuring Parameters

1.4 Standard Configuration

Instrument Model	CM30F	CM30N	CM30FH	CM30FN
Main Unit	1pc			
Probe	1pc			
Cal Zero Plate(pc)	Fe×1	Al×1	Fe×1+ Al×1	Fe×1
Calibration Foils	5pcs			
Alkaline battery(AA)	2pcs			
USB Communication Cable	1pc			
Communication CD	1pc			
Operating Manual	1pc			
Seal Box	1pc			

Table 1.3 Standard Configuration

1.5 Optional Configuration

Probe (Include Calibration Foils)	F3	N2	FN1.5	F10
Cal Zero Plate(PC)	Fe Zero Plate,Al Zero Plate			
Cal Thickness Foils (PC)	Optional Many Kinds Thickness			

Table 1.4 Optional Configuration

2 Instrument Operation

2.1 Turn the Gauge on

● If the probe is connected before turning on the instrument, keep the probe away from the object under test.
● Press the button "on" until the screen displays "coating thickness gauge" and current version number, then the gauge is turned on.
● If the probe is connected before turning on the instrument, the measurement interface is displayed.
● If the probe is not connected before turning on the instrument, the screen will indicate that the probe is not connected, then press "return " the corresponding ▲ key to operate without probe.

2.2 Probe Connection

Just align the red dot mark of the probe plug with the red dot mark of the slot on the top of the instrument and insert it. If the instrument is turned on before the probe is inserted, there will be a notice when the instrument detected the probe, then press the key of ▲ and go back to measurement interface. If the surface of the instrument is in parameter configuration or file management, the user needs to exit these two interfaces before the instrument begin to recognize the probe.

There are Multiple types of probe can be matched with the instrument, please make sure that the probe used is consistent with the probe selected in the instrument. If necessary, you can enter the "power on setting" menu to select the probe type. Refer to 2.9.1 for specific operation method.

2.3 Measurement Method and Attention

- Hold the probe housing on the slope near the head end.
- The probe falls vertically on the surface of the object to be measured until the value appears on the screen.
- It is recommended that the probe should be lifted more than 5cm from the surface of the object to be measured each time.
- If the probe is placed on the surface of the object to be measured for a long time without reading, you can lift the probe to measure again or restart the instrument.
- There is a probe measurement status indicator icon at the lower part of the instrument measurement interface, indicating that the probe is in the measured surface (highlighted white) or the probe is lifted (gray) state, as shown in the figure below.
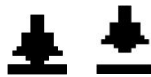
Figure 2.1 Probe Condition

2.4 Measurement Interface

CM30 has three Display Mode, Large Font Mode, Statistics Mode and Trend Graph Mode, which can be switched cyclically by pressing the ▲ key corresponding to "View". The interface diagram and description are shown in the figure below.
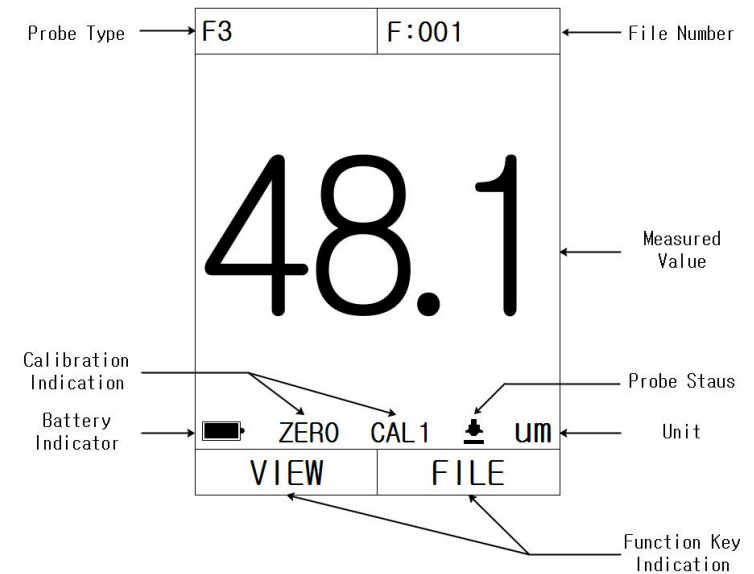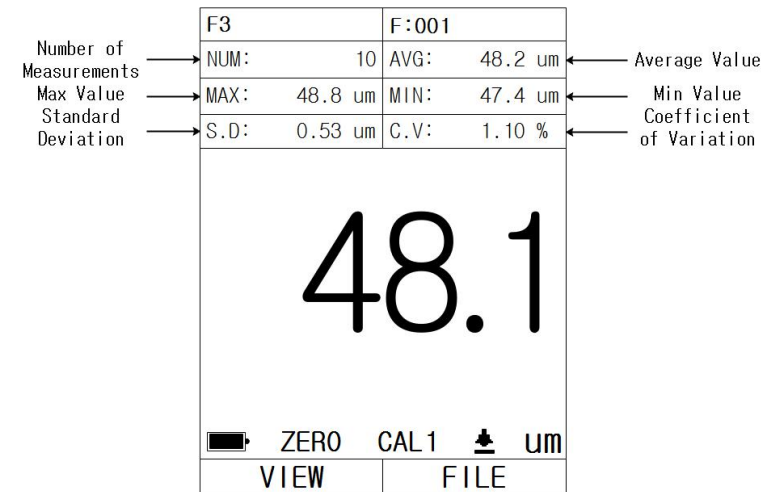
Figure 2.2 Large Font Mode
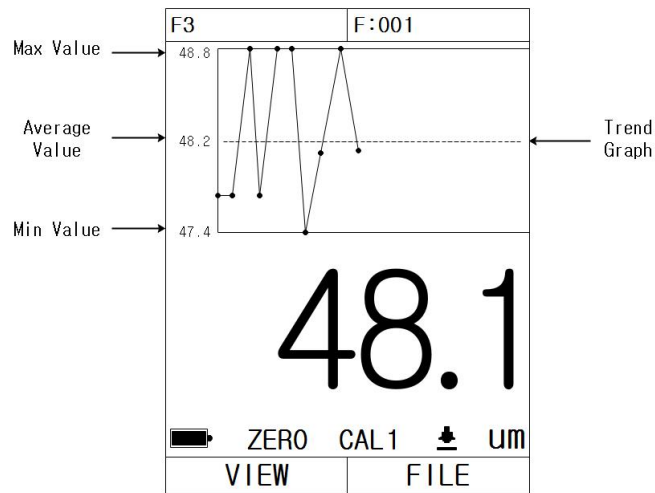
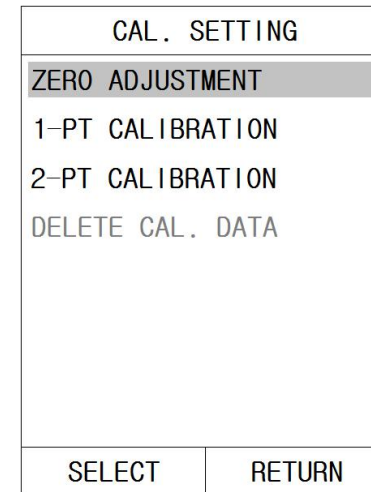Figure 2.3 Statistics Mode

Figure 2.4 Trend Graph Mode

Figure 2.5 Calibration Menu

2.5 The Measurement Interface Deletes the Measurement Value

When the instrument is turned on and used, press the ↑ key to delete the value on the screen if there is an incorrect measurement value due to factors such as measurement position error or environmental interference. When the storage function of the instrument is turned off, press and hold the ↑ key for about 3 seconds to delete all unsaved measurement values and statistical values according to the prompts.

2.6 Calibration

It is necessary to calibrate the coating thickness gauge before using it, you can enter the calibration menu by pressing the "CAL" key. The purpose of calibration is to match the probe with the workpiece to be measured, so as to make the measurement more accurate near or within a certain range.

2.6.1 Zero Adjustment

Take uncoated workpieces or workpieces with the similar shape and structure to make the probe to zero.

Enter zero adjustment mode, the upper left corner of the screen shows "ZERO: --" and the measurement area shows "---", indicating that ZERO adjustment can be carried out. At this point, the "zero adjustment" is not displayed in the lower left corner of the screen.

Each time the probe measures the workpiece and a value appears on the screen, one zero adjust operation is completed. The upper left of the screen will simultaneously display the current zero adjustment times (see the figure below), the maximum number is 10 times. Press the ▲ key corresponding to "Zero adjustment" to complete the zero adjustment. The ZERO icon will be displayed on the measurement interface.

Zero
Adjustment
times

Zero Mark →

ZERO:01

1.0

um

Peroform
Zero
Adjustment

| ZEROING | RETURN |

Figure 2.6 Zero Adjustment Interface

2.6.2 One-Point Calibration

Take uncoated workpieces or workpieces with the similar shape and structure to test the standard test piece, and adjust the gauge value same or close to the standard test piece.

Enter One-Point Calibration mode, the gauge will request to execute the Zero adjustment program first, user can choose whether to do the Zero adjustment or not. If the Zero adjustment is needed, method is the same as 2.6.1, if not, press

the ▲ key corresponding to "ignore" (see the figure below), to skip the Zero adjustment and enter to One-Point Calibration directly.

ZERO:--

———

Ignore Zero
Adjustment

| IGNORE | RETURN |

One point
calibration
times
One point
calibration
mark

CAL1:01

49.0

um

Perform
Calibration

| CAL. | RETURN |

Figure 2.7 Zero Adjustment and One-Point Calibration Interface

For One-Point Calibration, it is recommended to use a standard test piece with the same coating to the test workpiece. Place the standard test piece on the uncoated workpiece, and the probe should fall on the standard test piece steadily each time.A value appears on the screen one time will be one measurement action. The upper left on the screen will simultaneously display the current measurement times.The maximum testing measurement is 10 times. Then by using ↑ and ↓ keys to adjust the value on the screen to the thickness of the standard test piece, then press ▲ corresponding to the "Calibration" to complete One-Point Calibration. The CAL1 will be displayed on the measurements interface.

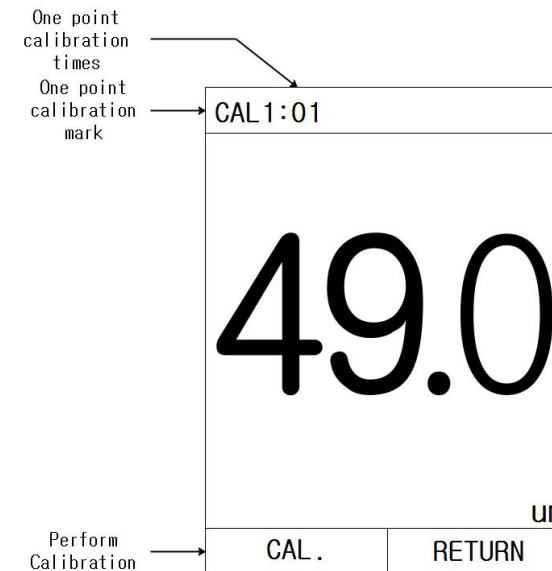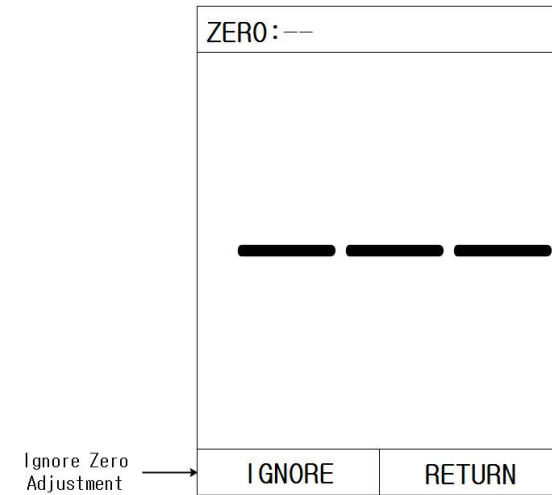### 2.6.3 Two-Points Calibration

On the basis of One-Point Calibration, test another standard piece which is different from the first one, and adjust the gauge value same or close to the standard test piece. First calibrate the thinner test piece, and then the thicker test piece.

Enter the Two-Points Calibration mode, the gauge will request to execute the Zero adjustment program first, the user can choose whether to do it or not. If performing Zero adjustment, the method is the same as 2.6.1, if not, press the ▲ key corresponding to "ignore" in the lower left corner of the screen to skip the Zero adjustment and enter the first point calibration of Two-Points Calibration. The first point calibration method is the same as 2.6.2-point calibration part.

After completing the first point calibration, enter the second point calibration of Two-Points Calibration. At this time, the upper left corner of the screen displays "CAL2: --", and place the larger thickness of standard piece in the uncoated workpiece, and the probe should fall on the standard test piece steadily each time, a value appears on the screen one time will be one measurement action. The upper left on the screen will simultaneously display the current

measurement times. The maximum testing measurement is 10 times. Then by using ↑ and ↓ keys to adjust the value on the screen to the thickness of the standard test piece, then press ▲ corresponding to the "Calibration" to complete Two-Points Calibration. The CAL2 will be displayed on the measurements interface.

2.6.4 Delete Calibration Data

Delete all calibration data of the current probe in the instrument.

2.7 Parameter Configuration

Press the "MODE" key to display the parameter configuration interface. There are multiple parameter adjustment options, including working mode (This option is available when the probe type is FN.), unit, resolution, upper limit, lower limit, language, backlight, automatic power off and reset. Referring to the figures below:

1. Press "mode" key to display the parameter configuration interface
2. Adjust the option cursor position by ↑ and ↓ keys
3. Press "select" to activate the parameters
4. Press ↑ and ↓ to adjust the parameters
5. Press "Return" to complete the parameter configuration
6. Press "mode" key to exit the parameter configuration interface

Figure 2.8 Parameter Configuration Interface

- Work Mode(This option is available when the probe type is FN.)Set the working mode of the current probe（F or N）
- Unit：Set the measurement unit to metric or imperial
- Resolution(Only metric mode)：Set measurement accuracy, See the table below:

Range Resolution	0~999μm			>=1mm
High	0~99.9μm		100~999μm	0.01mm
	0.1μm		1μm	
Low	0~200μm	200~500μm	500~999μm	
	1μm	2μm	5μm	

Table 2.1 Resolution

- Upper Limit ： Set the maximum thickness alarm value, when the measured value is greater than the upper limit value, the measured value is in red.
- Lower Limit ： Set the minimum thickness alarm value, when the measured value is less than the lower limit value, the measured value is in red.
- Language：Set display language
- Backlight: 6 levels, automatic, 100%, 80%, 60%, 40%, 20%. Under auto matic backlight condition, the instrument defaults to 100% backlight brig htness, and the backlight brightness automatically adjusts to 5% without operation for 30 seconds. The backlight brightness can be restored by ope rating any key or probe measure value.
- Auto Power Off：Auto power off after 3 min. no operation or manual off
- Reset：Restore the factory default settings of the gauge

2.8 File Manager

Press▲ corresponding to "file" to display the file management interface (see the figure below). Adjust the option bar by pressing ⬆ and ⬇ keys, and press the ▲ key corresponding to "SELECT" to set the current option or enter.

Figure 2.9 File Manager Menu

- Storage Function：Setting storage on and off. When the storage function is on, the measured value will be automatically stored in the corresponding file.
- File No.：Set the storage location of measured value, the number is from 001 to 200, and the file number can be switched by ⬆ and ⬇ keys after selection. Long press to quickly switch.
- Check File：View the data of the current file, including statistical data and measured values, which can be viewed through ⬆ and ⬇ keys, (see the figure below). The first page is statistical data, including the number of

measured values, maximum, minimum, average, standard deviation and coefficient of variation. The remaining pages are the measured values. The number in the upper right corner is the sequence number of the measured values displayed on the current page. The number column A-T is the sequence of the measured values displayed on the current page.

STATISTICS	
FILE:001	
NUM	10
MAX (um)	48.8
MIN (um)	47.4
AVG (um)	48.2
S.D (um)	0.53
C.V (um)	1.10
	RETURN

FILE:001			0001-0020
NO.	VALUE	NO.	VALUE
A	47.7um	K	
B	47.7um	L	
C	48.8um	M	
D	47.7um	N	
E	48.8um	O	
F	48.8um	P	
G	47.4um	Q	
H	48.1um	R	
I	48.8um	S	
J	48.1um	T	
			RETURN

Figure 2.10 Statistics Page

● Clear the current file : Clear the statistics and measured values of the current file. When the storage function is turned off, the unsaved measurement data and statistical data can be cleared.

● Clear all files : Clear the statistics and measured values of all files. The clearance will be a little longer, please be patient.

2.9 Power On Setting

2.9.1 Enter "Power On Setting"

● When the instrument is power off, hold down the left ▲ key in the key area, press the "ON" key, and release the left ▲ key when the instrument enters the menu of "POWER ON SETTING" (See the figure below)

POWER ON SETTING	
PROBE TYPE	F3
LANGUAGE	ENGLISH
USER DEBUG	
FACTORY DEBUG	
SELECT	EXIT

Figure 2.11 Power Up Setting

"Probe Type", "Language Setting" and "User Debugging" in "Power-on Setting" are open to users. The current interface can be switched by the ↑ and ↓ keys, and the corresponding ▲ key can be "selected". Press the ▲ key corresponding to "Exit", and the instrument will exit the "current setting" and enter the measurement interface.

2.9.2 Probe Type

In the "Power On Setting" interface, select the option article to the "Probe type" option by the ↑ and ↓ keys, press the corresponding ▲ key of "select" to enter the option of "Probe Type" (see the figure below), and then press the ↑ and ↓ keys to switch the probe type, the probe type are F3, N2, FN1.5 and F10 in sequence. After completion, press the ▲ key corresponding to "Return", return to "Power-on Setting"

```
     POWER ON SETTING
PROBE  TYPE              F3
LANGUAGE          ENGLISH
USER  DEBUG
FACTORY  DEBUG



     RETURN
```
Figure 2.12 Probe Type Setting

2.9.3 Language Setting

In the "Power-on Setting" interface, select the option article to the "Language Setting" option by the ↑ and ↓ keys, press the corresponding ▲ key of "Select" to enter the option of "Language Setting" option (see the figure below), then switch the language type by the ↑ and ↓ keys, including

Chinese and English, after completion, press the corresponding▲ key of "return", return to "power-on setting"

```
     POWER ON SETTING
PROBE  TYPE              F3
LANGUAGE          ENGLISH
USER  DEBUG
FACTORY  DEBUG




     RETURN
```
Figure 2.13 Language Setting

2.9.4 User Debugging

It is mainly aimed at the measurement deviation caused by the worn standard probe after the user purchases the instrument due to the long time use of the instrument, or the user purchases other probes separately from the manufacturer. User can complete the matching and debugging of the probe and the instrument by himself through the user debugging software and instructions provided by the manufacturer.

In the "Power-on Setting" interface, select the option article to the "User debugging" by the ↑ and ↓ keys, and press the corresponding ▲ key of "Select" to enter the "User debugging" interface (see the figure below)

```
        USER DEBUG
INPUT STD. VALUE
COLLECT DATA
COMMUNICATION
DELETE COLL. DATA
DELETE ALL DATA
OPERATING MODE          F


   SELECT      RETURN
```
Figure 2.14 User Debugging

There are two ways to input the standard value of the calibration foil of the data to be collected into the instrument, namely "input calibration foil value" and "communication connection" under user debugging. "Input calibration foil value" is a manual input method, and "communication connection" can be used for data transmission through the upper computer software.

Enter the calibration foil value

The option cursor is at "input calibration foil value", press the ▲ key corresponding to "select" to enter the manual input calibration foil standard value interface, as shown in Figure 2.15 (left), through keys to move the cursor up and down,

"MODE" and "CAL/ON" keys to move left and right cursor, press the ▲ key corresponding to "input" to input, modify or delete the current standard value under the cursor.

When the standard value is input, as shown in Figure 2.15 (right), set the current digit value with the ▲ and ▼ keys, and the "MODE" and "CAL/ON" keys move left and right to switch the number of digits, after completion, press the ▲ key corresponding to "Return" to save the input or modified value. If you press the ▲ key corresponding to "Delete", the standard value under the cursor will be deleted.

Note: 1. The standard value unit is metric micron (μm)

   2.The standard value 0μm is the default value, no need to input

[MODE] ←	[CAL/ON] →	um		[MODE] ←	[CAL/ON] →	um
NO.	STD.	NO.	STD.	NO.	STD.	NO.	STD.
1		11		1	00000.0	11	
2		12		2		12	
3		13		3		13	
4		14		4		14	
5		15		5		15	
6		16		6		16	
7		17		7		17	
8		18		8		18	
9		19		9		19	
10		20		10		20	
INPUT		RETURN		DELETE		RETURN	

Figure 2.15 Enter the calibration foil value

Communication Connection

Connect the instrument to the computer via the data cable. At this time, the "communication connection" option changes from gray unavailable to green option. Press the ▲ and ▼ keys to adjust to the "communication

connection" option, and press the corresponding ▲ key of "Select" to enter the "communication connection" "Interface (see the figure below)

USER DEBUG		COMMUNICATION
INPUT STD. VALUE		
COLLECT DATA		
COMMUNICATION		
DELETE COLL. DATA		CONNECTED
DELETE ALL DATA		
OPERATING MODE F		
SELECT	RETURN	RETURN

Figure 2.16 Communication Connection

Open the user debugging software on the computer, select the serial port, enter the number of standard values to be collected, Click OK, then enter the standard values to be collected from small to large (see the figure below), and finally click to send standard values. In the process of data transmission, the button continues to be pressed, and the transmission ends when the button is lifted.
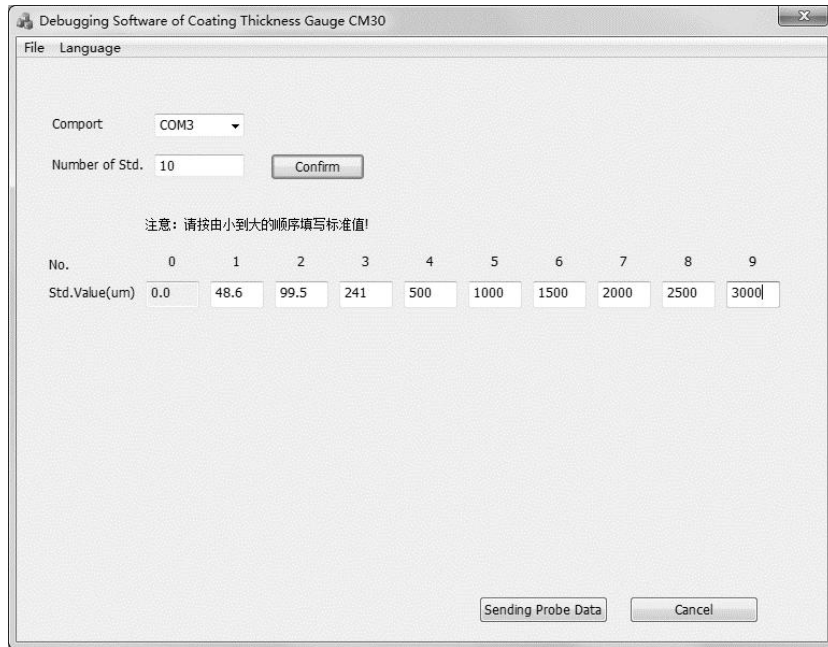
Figure 2.17 Communication Software

Explanation and selection method of standard value:

- The manufacture built-in standard values (Unit: μm) are 0, 10, 20, 50, 100, 250,500,600,700,800,900,1000,1100,1200,1300,1400,1500,1600,1700,1800,1900,2000,2200,2500,2800,2900,3000,3500,4000,4500,5000,5500,6000,6500,7000,7500,8000,8500,9000,9500,10000, 10 to 250 are example values, and the rest are actual collected values

- The standard value of F3 probe is 0 to 3000, the standard value of N2 probe is 0 to 2000, the standard value of FN1.5 is 0 to 1500, and the standard value of F10 probe is 0 to 10000 (excluding 10)

- When the user selects the standard value, it is not allowed to use two adjacent values. For example, the standard foil of 18μm and 22μm is not allowed. The system determines that the value between 15μm ((10+20) /2) and 35μm ((20+50) /2) is around 20μm

- Selection method: the more values selected by the user (the most is the number of built-in standard values of the manufacturer), the probe measurement values are more accurate after debugging; When the user has very few calibration foils, it is recommended to use them all.

- If the user wants to debug the F3 probe, use 500, 1000, 2000 for debugging,it can only ensure that the measurement value of 0-2000 is more accurate, and the error of 2000-3000 is larger.

  If the instrument has standard value data, the option of "Collection data" will change from gray unavailable to green optional (see the figure below)

```
        USER DEBUG
INPUT STD. VALUE
COLLECT DATA
COMMUNICATION
DELETE COLL. DATA
DELETE ALL DATA
OPERATING MODE          F


   SELECT        RETURN
```

Figure 2.18

Through the ⬆ and ⬇ keys to adjust to the "collection data" option, press the corresponding ▲ key of "select" to enter the "collection data" interface (see the figure below)

F3		⬇	
NO.	STD.	PERIOD	CHANGE
1	3000		–
2	2500		
3	2000		
4	1500		
5	1000		
6	500		
7	241		
8	99.5		
9	48.6		
10	0.0		
CANCEL		SAVE	

Figure 2.19 Collect the Initial Data

On the Screen, top right corner icon shows the probe testing status of lift and fall, which doesn't display when no probe connected. User should follow the order of serial numbers to do data collection. The collection method is to place the standard thickness foil corresponding to the current cursor option in the standard column on the zero plate and do the test, and till the probe testing icon displays fall situation, uplift the probe, then the period column and change column display the collected data, meanwhile the probe status shows uplift. Press the ⬆ and ⬇ keys to switch the standard values, and continue to collect data.

Notice: After data collection, the data value of the period column is from small to large -from top to bottom, while the change column is from large to small (for the change column allows two adjacent change values to be the same, and the change column corresponding to the standard value below 50μm allows two adjacent change values to be up smaller than down). See the figure below

F3		⬇	
NO.	STD.	PERIOD	CHANGE
1	3000	69	–
2	2500	105	13.9
3	2000	161	8.93
4	1500	264	4.85
5	1000	464	2.50
6	500	915	1.11
7	241	1426	0.51
8	99.5	1916	0.29
9	48.6	2175	0.20
10	0.0	2500	0.15
CANCEL		SAVE	

Figure 2.20 Collect the Completed Data

After value collection, press the corresponding ▲key of "save" and exit the "data collection"

interface, if press "cancel", it will not be saved and exit the "data collection" interface. The "Deleted data" option in the "User Debugging" interface can delete the standard values and collected data which has been stored in the instrument.

The "Delete collected data" option in the "User debugging" interface can delete all collected data, and the "Delete all data" option can delete the standard values stored in the instrument and the collected data.

2.10 Communication Function

The communication function is to transmit the measured values stored in the instrument to the computer.

Align the red dot mark of the USB cable plug with the red dot mark of the slot at the bottom of the gauge and insert it. Open the computer communication software, click Setting-ComPort, and select the corresponding port. Click   to enter the file number to be downloaded and confirm.

Note: the communication connection must be operated under the measuring interface of the instrument!

3 Factors Affecting Measurement Accuracy

Measuring Method / Influencing Factor	Magnetic	Eddy Current
Magnetic Properties of Base Metal	√	—
Electrical Properties of Base Metal	—	√
Base Metal Thickness	√	√
Edge Effect	√	√
Curvature	√	√
Deformation of Sample	√	√
Surface roughness	√	√
Magnetic Field	√	—
Adherent Material	√	√
Probe Pressure	√	√
Probe Orientation	√	√

Table 3.1 Influencing Factors   √：indicates influential

4 Maintenance and Repair

4.1 Environmental Requirements

Strictly avoid collision, heavy dust, humidity, strong magnetic field and oil pollution.

4.2 Battery Replacement

Please replace the batteries promptly when the battery power is low, the steps are as follows:

1. Press "ON" key to turn off the gauge.

2. Remove the battery cover.

3. Take out the batteries and replaces with new ones. Pay attention to the polarity.

4. Re-tighten the cover again.

Note: Unless under special circumstances, it is not recommended to take out the battery directly when the instrument is on.

4.3 Maintenance

Contact our maintaining department in case of the following problems:

1. Component is damaged and cannot be measured.

2. The display is abnormal.

3. The measuring error is abnormally big in normal usage.

4. Keyboard failure or confusion.

Since the coating thickness gauge is a high-tech product, the maintenance work should be completed by the professional trained maintenance personnel. Please do not disassemble and repair by yourself.