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# MT4100-MT3100

## Coating Thickness Gauge

### Instruction manual

<b>1 OVERVIEW.....</b>	<b>3</b>
1.1 MEASURING PRINCIPLE .....	3
1.2 STANDARD CONFIGURATION.....	3
1.3 OPERATION ENVIRONMEN.....	4
1.4 DESIGNATION OF THE INSTRUMENT'S COMPONENTS.....	4
1.4.1 LCD Display.....	5
1.5 TECHNICAL PARAMETERS.....	5
<b>2 PREPARATIONS FOR MEASUREMENT .....</b>	<b>6</b>
2.1 CHECK VOLTAGE.....	6
2.2 REPLACING THE BATTERY .....	6
2.3 BASIC MEASURING STEPS .....	7
2.4 FUNCTIONS AND OPERATION WAY .....	8
2.4.1 Working Way.....	8
2.4.2 Measuring way.....	8
2.4.3 Converting Units (Metric <=> Inch).....	<i>Error! Bookmark not defined.</i>
2.4.4 Online print (MT4100) .....	10
2.4.5 Online statistical values .....	<i>Error! Bookmark not defined.</i>
2.4.6 Limit value seMTing .....	<i>Error! Bookmark not defined.</i>
2.4.7 Backlight seMTing.....	11
<b>3 CALIBRATING THE INSTRUMENT.....</b>	<b>11</b>
3.1 CALIBRATING WAY .....	11
3.1.1 One-point calibration(Zero-seMTing).....	11
3.1.2 Two-point calibration .....	12
3.1.2.1 One calibration foil .....	12
3.1.2.2 Two-calibration foil .....	12
3.2 CORRECTING THE BASIC CALIBRATION .....	13
<b>4 MEASUREMENT AND STATISTICS .....</b>	<b>14</b>

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4.1 MEMORY FUNCTION.....	14
4.2 STATISTICS.....	14
4.3 DISPLAY OF VALUES.....	14
<b>5 DELETION FUNCTION.....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
5.1 DELETION SINGLE VALUE.....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
5.2 DELETION MEASURING VALUES.....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
5.3 DELETION ALL VALUES.....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
<b>6 PRINTER (MT4100) .....</b>	<b>16</b>
6.1 PREPARATIONS FOR PRINT .....	16
6.2 PRINT FUNCTION.....	16
<b>7 DATA TRANSFER TO PC USING (MT4100) .....</b>	<b>16</b>
<b>8 FACTORS INFLUENCING THE MEASURING ACCURACY.....</b>	<b>17</b>
8.1 DESCRIPTION ABOUT THE INFLUENCING FACTORS .....	17
8.2 MATTERS SHALL FOLLOW WHEN USING THE INSTRUMENT .....	19
<b>9 MAINTENANCE AND REPAIRING.....</b>	<b>20</b>
9.1 REQUIREMENT ON ENVIRONMENT.....	20
9.2 ERROR DISPLAY .....	20
9.3 TOTAL RESET.....	20
<b>10 MATTERS NEED FOR ATTENTION .....</b>	<b>21</b>

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# 1 Overview

The instrument adopts the magnetic and eddy current principle to measure in a non-destructive way .The instrument is a portable thickness-measuring meter, it can measure the thickness of coating and plating rapidly, non-destructively and precisely.It can be used both in lab and the **work site**.This instrument can be widely used in the inspection fields, e.g. manufacturing, metal processing, chemical industry and commodity inspection, etc.It is a gauge essential for the **material protection**.

The meter meets the following standards:

GB/T 4956—2003 Measuring Thickness of the Nonmagnetic Coating on a Magnetic Metallic Substrate, Magnetic

GB/T 4957—2003 Measuring Thickness of all electrically insulating coating on nonferrous metals, Eddy current Way

## 1.1 Measuring Principle

The instrument adopts the magnetic and eddy current principle to measure in a non-destructive way

Magnetic way (type F probe)

measure the thickness of non-magnetic coatings on magnetic metallic base (e.g. zinc, aluminum, Cr. Copper, rubber, paint, coating on the base of steel, iron, alloy and hard magnetic steel etc.)

eddy current way (type N probe)

measure all electrically insulating coating layers,such as lacquer,Varnish, paint,anodizing coating on nonferrous metals,also on austenitic VA steel materials.

## 1.2 Standard Configuration

main frame	1
Substrate	1

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Calibration foil	5
9V BaMTery	1
Probe F1/N1	1
Manual Instruction	1

### 1.3 Operation environmen

Temperature: 0°C~40°C

Humidity: 20%RH~90%RH

Without strong magnetic field

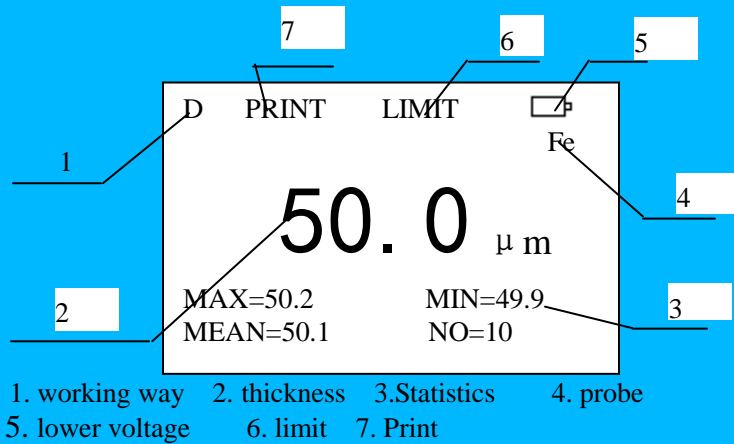
### 1.4 Designation of the Instrument's Components



1、PC(RS232 interface)    2、Probe    3、Display    4、Keyboard

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### 1.4.1 LCD Display



## 1.5 Technical Parameters

List 1 of technical parameters

Type F probe :

Probe		F400	F1	F1/90°	F10
Measuring Principle		Magnetic method			
Measuring range(μm)		0~400	0~1250	0~10000	
Min resolution(μm)		0.1	0.1	10	
Tolerance	One-point calibration (μm)	±(2%H+0.7)	±(2%H+1)		±(2%H+10)
	Two-point calibration (μm)	±(1%H+0.7)	±((1%H+1)		±(1%H+10)
Minimum radius of curvature (convex) (mm)		1	1.5	flat	10
Minimum measuring area(mm)		Φ3	Φ7	Φ7	Φ40
Minimum thickness of base material(mm)		0.2	0.5	0.5	2

Type N probe :

Probe		N400	N1	CN02
Measuring Principle		Eddy current method		
Measuring range (μm)		0~400	0~1250	10~200
Min resolution(μm)		0.1	0.1	1
Tolerance	One-point calibration (μm)	$\pm(2\%H+0.7)$	$\pm(2\%H+1.5)$	$\pm(2\%H+1)$
	Two-point calibration (μm)	$\pm(1\%H+0.7)$	$\pm(1\%H+1.5)$	-----
Minimum radius of curvature (convex) (mm)		1.5	3	flat
Minimum measuring area(mm)		Φ4	Φ5	Φ7
Minimum thickness of base material(mm)		0.3	0.3	0

Note: H——Measured Value

## 2 Preparations for measurement

### 2.1 Check voltage

The instrument can be operated using 9V baMTery .

Press“ON/OFF”, Please pay aMTention to baMTery.

If the instrument is not switched on, it has no baMTery or lower Voltage。 Please replace the baMTery.

No indicated by the flashing baMTery symbol, the instrument has plenty of voltage.

indicated by the flashing baMTery symbol, the instrument has a lower voltage, Please replace the baMTery.

### 2.2 Replacing the BaMTery

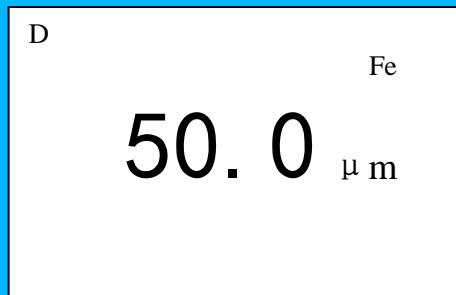
a)Press ON/OFF to turn off the instrument;

- 
- b) Open the baMTery box;
  - c) Take out the baMTeries and place in new ones, notice the polarity;
  - d) Cover the baMTery box.

If the instrument will not be used for long time, you shall take out the baMTeries, **so as to prevent the instrument from corroding by the baMTeries.**

## 2.3 Basic Measuring Steps

Get ready the test piece, Place the probe in an open space, press ON/OFF, turn on the instrument; **When it is normal, after start up, it will display the measurement kept when shut down last time, e.g.:**



Whether it is necessary to calibrate the instrument, and if necessary calibrate it in a proper way;

### Measure

Get rapidly in a vertical way the probe into contact with the test surface in a vertical way and press lightly the positioning jacket of the probe, after a buzz, it will display the measurement on the screen, raise the probe for the next measurement; If the measurement exceed the range it will display ----.

### Turn off the instrument

The gauge can be turned off automatically or by hand.

Auto turning off: The instrument will turn off automatically 2~3min later if it has no operation.

Manual turning off: By pressing “ON/OFF” it will turn off immediately.

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## 2.4 Functions and Operation Way

### 2.4.1 Working Way

The instrument has two working way.: direct and APPL

- In the direct way: Max 100 latest measured values can be stored. If 100 readings are stored in the direct way ,The latest value instead of the first One.
- In APPL way : Max 100 measured values can be stored in any APPL.There are five APPL ,a total of max 500 readings of the five APPLS can be stored.

If 100 readings are stored in this APPL,the instrument display “full of memory. the values can be measured,but it is not stored.

#### Converting two working way:

When the instrument is switched on,Direct will be automatically displayed.

- Press “MENU” , “system setup ” appears; Press “MENU”
- Press “↑” or “↓” , select “working” ;
- Press “MENU” , “working” seMTing.

System Setup	Meas: Single	Meas: Single
Limits	Working: Direct	Woring: *F2
Function	Unit: $\mu$ m	Unit: $\mu$ m
View	Print: off	Print: off

**Note:** “\*” there is calibration values in this APPL;

Press two “ESC”.

### 2.4.2 Measuring way

There are two measuring way: single measuring and continual measuring

Single measuring – once the probe contacts the test piece, a buzz will give out, and it will display a measurement;

Continual measuring-the probe is measuring continually,display values continually.

Converting two measuring way:

single measuring or continual measuring;

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- 
- a) Press “MENU” , “System Setup” options appears;
  - b) Press “MENU” , select “Meas”
  - c) Press “MENU” , selecte “Single” or “Cont” ;
  - d) Press two “ESC”.

System Setup	Meas: Single
Limits	Working: Direct
Function	Unit: $\mu$ m
View	Print: off

### 2.4.3 Converting Units (Metric <=> Inch)

- a) Press “MENU” , “System Setup” options appears;
- b) Press “MENU” , Press “ $\uparrow$ ” or “ $\downarrow$ ” select “unit seMting” ;
- c) Press “MENU” , select “unit: um” or “ unit: mils” ;
- d) Press “ESC” .

System Setup	Meas: Single
Limits	Working: Direct
Function	Unit: $\mu$ m
View	Print: off

### 2.4.4 Online statistical values

- a) Press “MENU”, Select “System setup”;
  - b) Press “MENU” , Press “ $\uparrow$ ” or “ $\downarrow$ ” select “stats” seMting;
  - c) Press “MENU” select “stats:on” or “stats:off”;
  - d) Press two “ESC” , ESC.
-

System Setup
Limits
Function
View

Working way:	direct
Unit:	μ m
Print:	off
Stats:	on

## 2.4.5 Limit value setting

To monitor your measured values, you can set an upper and a lower limit value. This setting is useful. If the limit value is exceeded or if it is not reached, an audio signal will sound, and a warning note will appear on the display.

- a) Press "MENU", press "↑" or "↓", select "Limits";
- b) Press "MENU", enter "Limits";
- c) Press "MENU" select "Upper" or "Lower", press "↑" or "↓" until the numerical value for the upper limit value or lower limit value is set.
- e) Press two "ESC", OK.

System Setup
Limits
Function
View

Upper	1250
Lower	0.0

Press two "ESC".

## 2.4.6 Online print (MT4100)

Online print : Connect the infrared adapter with the printer using the RS232 interface .

If the "online printout: on", the single values can be transferred to a printer.

System Setup
Limits
Function
View

- 
- a) Press "MENU", Select "System Setup";
  - b) Press "MENU", Press "↑" or "↓" select "Print"; Press "MENU" select "print : on" or "print: off";
  - c) Press "ESC", ESC.

Working way:	direct
Unit:	$\mu$ m
Print:	off
Stats:	<input checked="" type="checkbox"/> on

### 2.4.7 Backlight seMTing



Press " ", shut on or shut off backlight.

## 3 Calibrating the Instrument

In order that the measurement is accurate, one shall calibrate the instrument at the measuring site

### 3.1 Calibrating Way

Three calibrating ways are available during the measuring for the instrument: Zeroing, Two-point calibration and a basic calibration in respect to the probe. The calibrating of the instrument is very simple.

#### 3.1.1 One-point calibration (Zero-seMTing)

To do this, you have to use an uncoated test object having similar dimensions and material properties to those of the coated object.

Make a measuring on the substrate, it will display on screen  $<x \times \mu\text{m}>$ .

Press ZERO key, the screen displays  $<0.0>$ . The calibration completes, you can now begin the measurement.

You can repeat continuously several times, so as to get the mean value for several calibrations, in this way you can improve the accuracy for calibration;

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## 3.1.2 Two-point calibration

### 3.1.2.1 One calibration foil

As with, “Zero seMTing”, you have to use an uncoated test object having similar dimensions as the coated object. To do this, choose a calibration foil which is closest to the expected coating layer thickness.

When measuring after this calibration, the guaranteed measurement tolerance are complied with.

Carry out one-point calibration as described 3.3.1.

Put the calibration foil on the uncoated test object and place the probe repeatedly on the foil.

Make a measuring, it will display on screen  $<x \times \mu\text{m}>$ .

Press “↑” or “↓”, until the thickness value of the calibration foil agrees with the displayed value. The calibration completes, you can now begin the measurement.

**Note:** If the thickness value of the calibration foil agrees with the displayed value, Press “↑” and “↓” must be set,

2. You can repeat continuously (b,c) several times, so as to get the mean value for several calibrations, in this way you can improve the accuracy for calibration;

### 3.1.2.2 Two-calibration foil

Choose two calibration foil which is closer to the expected coating layer thickness, the expected coating layer thickness is between the two calibration foil value. upper value shall be at least  $3\times$  of the lower one. in this way you can improve the accuracy for calibration.

Carry out one-point calibration as described 3.3.1.

Put the lower calibration foil on the uncoated test object and place the probe on the foil.

Make a measuring, it will display on screen  $<x \times \mu\text{m}>$ . Press “↑” or “↓”, until the thickness value of the calibration foil agrees with the displayed value.

Put the upper calibration foil on the uncoated test object and place the probe on the foil.

Make a measuring, it will display on screen  $<x \times \mu\text{m}>$ . Press “↑” or “↓”, until the thickness value of the calibration foil agrees

The calibration completes, you can now begin the measurement.

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## 3.2 Correcting the Basic Calibration

It is necessary to change the basic calibration under the following case:

- The probe tip is worn.
- Special application.

If the error exceeds obviously the given range during measuring, you shall re-calibrate the probe, this is called basic calibration. You can re-calibrate the probe by inputting 6 calibrating values (one zero and five thickness values).

With the instrument is OFF, hold down  $\uparrow$ , then press ON/OFF, now you enter into the basic calibrating status for type F probe;

Zero first as described 3.3.1. . You can repeat continuously several times, so as to get the mean value for several calibrations, in this way you can improve the accuracy for calibration; Use standard pieces in thickness-incremental order, and you can calibrate several times for each thickness value. Each value shall be at least  $1.6\times$  of the previous one, and it's best to be  $2\times$ . For example F1:  $50\mu\text{m}$ ,  $100\mu\text{m}$ ,  $200\mu\text{m}$ ,  $400\mu\text{m}$  and  $800\mu\text{m}$ . The max. value shall be close but lower than the max. measuring range of the probe.

After inputting 6 calibrating values, measure the zero point, the instrument turns off automatically, and the new calibrating value has already saved in the instrument. At a new startup, the instrument will work with the new calibrating value.

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***Note: 1、 Each thickness shall be at least  $1.6\times$  of the previous thickness, otherwise it will be regarded that the basic calibration failed.***

***2、 If the thickness value of the calibration foil agrees with the displayed value, Press " $\uparrow$ " and " $\downarrow$ " must be set,***

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## 4 Measurement and statistics

### 4.1 Memory function

In direct way, Max 100 latest measured values can be stored.

In APPL way, Max 100 measured values can be stored in any APPL. There are five APPL, a total of max 500 readings of the five APPLS can be stored.

If 100 readings are stored in this APPL, the instrument display “full of memory. the values can be measured, but it is not stored.

### 4.2 Statistics

The instrument is provided with online statistics. This means that the statistics values are re-calculated and displayed in the two boMTom lines after every measurement. The statistics values calculated by instrument are:

No: Number of measured values

Mean: Average of measured values

S.DEV: Standard deviation

Max: Maximum single value of the measurement series

Min: Minimum single value of the measurement series

⊙ In direct way, a total of max.100 readings can be stored. The new reading instead of the first reading.

⊙ In APPL way, the statistics values calculated during this APPL.

### 4.3 View

Display of measuring values and Statistical values

a) Press “MENU”, press “↑” or “↓”, select “View”;

b) Press “MENU”, press “↑” or “↓”, select display measurements or Statistics;

c) Press “MENU”, select “Statistics”, it can be displayed:

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System Setup  
Limits  
Function  
View

Statistics  
Measurements

NO= 009  
MEAN= 50.2  
S. DEV= 0.1  
MAX= 50.4  
MIN= 50.1

## 5 Deletion function

### 5.1 Deletion single value

In any working way, press "Clear", deletion the end measuring value.

### 5.2 Deletion measuring values or all Values

In any working way, all measuring values are deleted.

- a) Press "MENU", press "↑" or "↓", select "Function";
- b) Press "MENU", enter "Function"; Press "↑" or "↓", select "delete File" or "delete All";
- c) Press "MENU", display "Press[MENU] to confirm" or "Press[ESC] to cancel" Press "MENU" t, all measuring values are deleted.

d) Press two "ESC", OK.

System Setup  
Limits  
Function  
View

Delete File  
Delete All  
Print File  
Print stats

Press[ MENU ] to confirm  
Press[ ESC ] to cancel

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## 6 Printer (MT4100)

### 6.1 Preparations for Print

The infrared data transmission from instrument to a printer;

The infrared adapter must be connected to the printer.

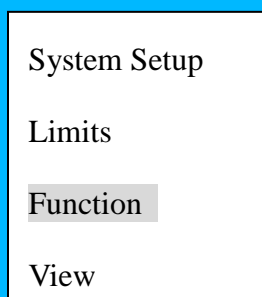
Press“ON/OFF”;

The printer must be set as follows:

-Baud rate: 9600、

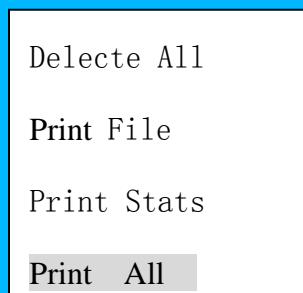
\_Data bits: 8

-stop bit: 1



### 6.2 Print function

- Press“MENU”, Press“↑”or“↓”, select“Function”;
- Press“MENU”, Press“↑”or“↓”, select “Print File ” 、 “Print Stats” 、 “Print all”, Press“MENU”。
- Press two“ESC”, OK。



## 7 Data transfer to PC using (MT4100)

The serial interface parameter of the PC must be set as follows:

-Baud rate: 9600、

\_Data bits: 8

-stop bit: 1

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- a) Press“MENU”, Press“↑” or“↓”, select“Function”;
- b) Press“MENU”, enter“Function” press“↑”or“↓”, select “Send Date”
- c) Press“MENU”, in direct way, sentStatistical values and single values; In APPL way, sent statistical values and single values in this APPL;
- d) Press two“ESC”, OK.

System Setup	Print File
Limits	Print Stats
Function	Print All
View	Send Date

## 8Factors Influencing the Measuring Accuracy

### 8.1 Description about the Influencing Factors

#### a) Magnetism of substrate metal

The thickness-measuring in magnetic way will be influenced by the magnetism change in metal (in practice, the magnetism change in mild steel can be taken as slight), in order to avoid the influence from heat treatment and cold machining, you shall calibrate the instrument by using standard pieces with the same characteristic with the test substrate metal; or you can calibrate the instrument with the test piece that is to be

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coated.

**b) Thickness of substrate metal**

Each instrument has a critical thickness of substrate metal. When being higher than this thickness, the measuring will not be influenced by the thickness of substrate metal. As for the critical thickness of this instrument, please refer to aMTachment table 1.

**c) Edge effect**

This instrument is sensitive to the sudden change in surface shape of test piece. Therefore the measurement near the test piece's edge or inner corner is not reliable.

**d) Curvature**

The curvature of a test piece will influence the measuring. This influence will always increase as the curvature radius reduces. Therefore, it is not reliable to measure on the surface of a curved test piece.

**e) Deformation in the test piece**

The probe will make the soft coating deform, therefore it is impossible to get reliable data on such kind of test piece.

**f) Surface roughness**

The surface roughness of the substrate metal and coating will influence the measuring. The higher the roughness is, the higher its influence will be. A rough surface will result in systematic error and accidental error. During each measurement, you should increase the measuring times at different positions so as to avoid such kind of accidental error. If the substrate metal is rough, you have to zero the instrument by several positions on the test substrate metal that is not coated and with similar roughness; or you can zero the instrument by removing the coating by solving it with a solution that will not corrode the substrate metal.

**g) Magnetic field**

The strong magnetic field generated by different electric devices surrounding will seriously disturb the thickness measuring in magnetic way.

**h) Substance aMTached**

This instrument is sensitive to the substance aMTached that will hinder the close contacting between the probe and coating, therefore you must remove the substance aMTached so that the probe can contact the test surface directly.

**i) Pressure of probe**

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The pressure applied by the probe on the test piece will influence the readout of the measurement, therefore you must keep constant pressure.

**j) Direction of probe**

The placing way of probe will influence the measuring. During the measuring, you shall maintain the probe to be vertical to the test piece surface.

## **8.2 MaMTers shall follow when using the Instrument**

**a) Characteristics of substrate metal**

For magnetic way, the magnetism and surface roughness of the substrate metal of the standard piece shall be similar with that of the test piece.

**b) Thickness of substrate metal**

Whether the thickness of substrate metal exceeds the critical thickness, if not, you can calibrate it by one of ways in 3.

**c) Edge effect**

You shall not measure thickness by placing the probe close to the suddenly changing point, e.g. edge, hole and internal corner, etc.

**d) Curvature**

Never measure on the curved surface of the test piece.

**e) Times for reading readout**

Normally, as the readouts of the instrument are not completely the same, therefore it is necessary to take several readouts in each measuring area. For the local difference in coating's thickness, it is also required to make several measurements in a given area, especially the surface is rough.

**f) Surface cleanness**

Before measuring, you shall remove any substance aMTached to the surface, e.g. dust, oil and corrosion product, etc., but don't remove any coating.

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## 9 Maintenance and Repairing

### 9.1 Requirement on Environment

Avoid **impact**, heavy dust, damp, strong magnetic field and greasy dirt, etc.

### 9.2 Error display

- 1) Probe is too close to metal:

The probe was too close to the metal during switch-on. Hold the probe free in the air and then switch the instrument on.

- 2) Magnetic interference fields

Close to the probe are too strong magnetic interference fields

- 3) Instrument defective

If this error message appears, please send the instrument to your supplier or to the manufacturer for repair.

- 4) Other errors

If the following errors appear on your instrument :

Instrument does not allow any further measurements;

not logical display values;

Keys have no more function;

Please remove the battery within 20 seconds. Insert the battery again and reset the instrument.

### 9.3 Total Reset

This setting causes:

a) the deletion of all single values and of the statistical values

b) the deletion of the set calibration values and resetting to all calibration

Procedure:

a. Switch off the instrument , Press “ZERO” and “ON/OFF”, until appears “reset? ”;

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b.Press“MENU”, Display“reset”set reset;

## **10MaMTers Need For AMTention**

I. After purchasing product from our company, please fill carefully the *Warranty Registration Card* and stamp your office on it. Please send copy (I) and the copy of invoice to the User Service Dep. of our company, or you can ask the seller to send that on your behalf.(II) The copy (I) will be sent to (left at) the maintenance station of local branch for **registration**.For any area without maintenance station, please send copy (I) and (II) back to the User Service Dep. of our company.When the procedure are not complete, we can only maintain but offer no warranty service.

II. For any product from our company, since the day user purchases it, if it has any fault in term of quality (except for non-warranty parts), please contact the maintenance stations of local branches at different areas of our company for repairing, replacing or returning by using the “Warranty Card” (the copy kept by the user himself) or the copy of the invoice issued when purchasing the product.During the warranty period, if one has no way to show the warranty card or the copy of the invoice, we will count the warranty period based on the shipping date, and the period is one year.

III. If any product of our company has fault after the warranty period, the maintenance will be

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