Coating Thickness Gauge TT260

Instruction Manual

TIME Group Inc.
Beijing TIME High Technology Ltd.

Content

1 Introduction

The instrument is a type of portable measuring gauge, capable of measuring rapidly, nondestructively, and precisely the thickness of coating and cladding material. It is suitable for on site as well as for laboratory uses. Via the using of different probes, many sorts of measuring can be satisfied by the gauge. It can be applied comprehensively to manufacturing, metal processing and chemical profession as well as to commercial inspection. It is indispensable for the major of materials protection.

Features:

- Two thickness measuring methods adopted, the gauge can be applied to thickness measuring of non-magnetic coating on magnetic metal substrate as well as non-conductive coating on non-magnetic metal substrate;
- 5 types of probes can be used (F400, F1, F10, N1, CN02,)；
- 2 measuring modes are available: continuing measuring mode（CONTINUE）and single measuring mode（SINGLE）；
- 2 operation modes are available: direct mode (DIRECT) and batch mode (A-B)；
- 5 statistic values：mean value（MEAN）, max. value（MAX）, min. value（MIN）, numbers of measuring（NO.）, standard deviation（S. DEV）；
- 2 methods can be used to calibrate the gauge, and the system error of the probe can be corrected by use of basic calibrating method:
- Storage function: 495 measuring values can be stored;
- Deletion function: delete the single questionable data occurring in measuring, as well as all of the data in memory area to perform the new measuring;
- Limit can be set: capable of alarming automatically for measuring values out of limit; and a batch of measuring values can be analyzed via histogram;
- Printing function: measuring value, statistic value, limit and histogram can be printed;
- Capable of communication with PC: measuring values and statistic values can be sent to PC to perform the further process for data;
- Indication of low voltage;
- Buzzing indication in the course of operation;
- With the function of error warning, error warning can be carried out through display or buzzing;
- Two shut down modes are available: manual shut down mode and automatic shut down mode;

1.1 Measuring principles

The gauge adopts two measuring thickness methods of magnetic method and eddy current method, is capable of measuring the thickness of non-magnetic coating (aluminum, chromium, copper, enamel, rubber, paint and etc.) on magnetic metal substrate (steel, iron, alloy, magnetic hardness steel and etc.), and the thickness of non-conductive coating (enamel, rubber, paint, plastic and etc.) on non-magnetic metal substrate (copper, aluminum, zinc, tin, and so on).

a) Magnetism method (F-probe)

The probe and the magnetic metal substrate will form a closed magnetic circuit when probe contacting with the coating; the magnetic resistance of closed magnetic circuit varies due to the existing of non-magnetic coating. The thickness of the coating can be measured through the variation of magnetic resistance.

b) Eddy current method (N-probe)

The high frequency alternating current generates an electromagnetic field in probe coil; eddy current will be formed on metal substrate when the probe contacting with coating, and the eddy current has an effect of feedback on the coil in probe. The thickness of the coating can be calculated through measuring the effect of feedback.

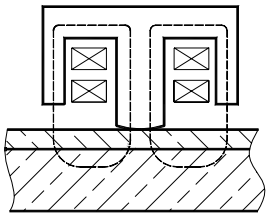


Fig. 1-1 principle of magnetism method

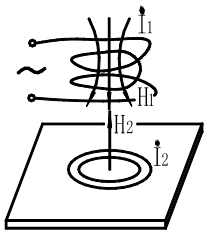


Fig. 1-2 principle of eddy current method

1.2 Standard configuration and optional parts

Table 1-1 Standard configuration

Designation	Quantity
TT260	1
Probe	1
Printing head	1
Standard test plate	5
Substrate	1
Charger	1

Table 1-2 Optional parts

Designation	Quantity
Probes for other applications	

Designation	Quantity
Communication cable	
Communication software	

1.3 Name of every part of the gauge

1.3.1 Name of every part of the gauge

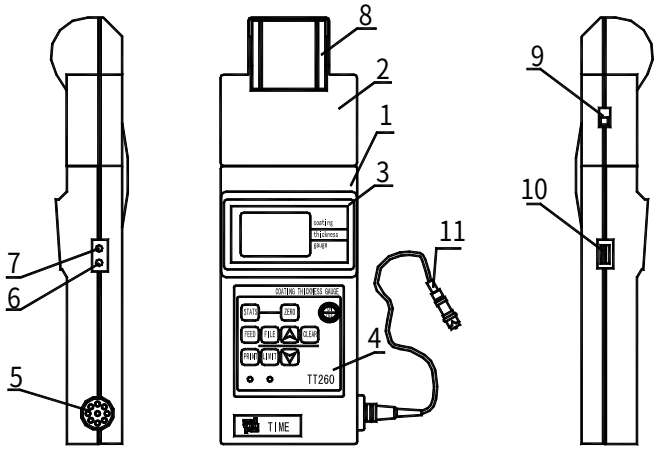


Fig.1-3 name of every part of gauge

1. TT260 2. Mini printing head 3. Display 4. Key pads 5. Probe socket
6. Charger socket 7. Communication interface 8. Printer paper case
9. Printer activating switch 10. Power switch 11.Probe

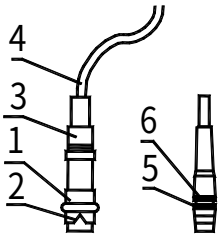


Fig. 1-4 name of every part of probe

1. Positioning sleeve 2. V-groove in probe 3. Loading sleeve
4. Connecting cable 5. Plug 6. Locking nut

1.3.2 Screen display

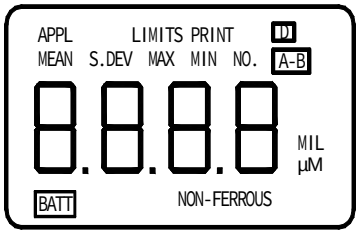


Fig.1-5a Full screen LCD display

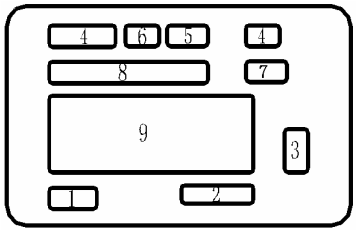


Fig.1-5b schematic diagram of display functions

1. Low voltage indication 2. Probe type indication 3. Unit of measurement
4. Operation mode indication 5. Print indication 6. Set limit indication
7.Communication connecting indication 8. Statistics Indication 9. Data area

1.4 Specifications

1.4.1 Measuring scope and measuring error（See Appendix 1）

1.4.2 Other specifications

Environment of application: Temperature: 0~40℃
Humidity: 20%～90%RH
No strong magnetic field
Power source: ½AA nickel-hydride, 5×1.2V, 600mAh
Dimensions: 270mm×86 mm×47 mm
Weight: approximate 530g

2 Operation

You must read carefully the Chapter 3 (Calibration) and the Chapter 4 (Factors affecting the measuring accuracy) prior to the use of the gauge.

2.1 Basic steps

a) Get the object to be tested ready（See the Chapter 4）;
b) Insert probe plug into the probe socket of TT260, and tightening the locking nut;
c) Put the probe on an open space, press the “ON/OFF” key to switch on the machine;

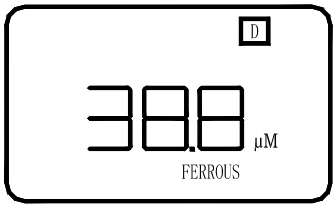
d) Check the voltage of battery

Note 1：If printer is connected with TT260, the switch of printer should be set on "OFF" position before press "ON/OFF" key to switch on the machine;

Note 2： If the indicator "BATT" is not display, it indicates that the voltage of the battery is normal; if the indicator "BATT" is displayed, it indicates that the voltage of the battery is low and recharge is needed; "BATT" will be displayed for about 1 second if the voltage of battery is insufficient when switching on the machine, then the machine will shut down automatically.

Note 3：Power switch should be cut off during the long terms of idling. Remember to press the power switch first when using, then press "ON/OFF" key to switch on the machine.

In normal circumstances, the instrument displays the previous measurement value after being switched on. For example:



Of which："NON-FERROUS" ------ N-Probe

"FERROUS" ------ F-Probe

"D" ------ Direct mode

"38.8" -------- the last measuring value before the last shutting down of machine

e) If calibration is need, choose the appropriate method to do so. (See the Chapter 4);

f) Start measuring

Swiftly bring the probe into contact vertically with the tested surface and press it lightly. With a buzzer sound, the measured value would be displayed on the screen. Lift the probe and conduct the next measurement;

g) Switch off the machine

The machine will shut off automatically if operation stops for about 2-3 minutes; and it can be shut off immediately when press "ON/OFF" key.

Note: 1. An obvious questionable value will be appeared if the probe is unstable during the measuring; it can be delete by pressing "CLEAR" key;

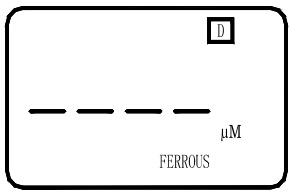
2. Five statistics values will be displayed by pressing "STATS" key after having measured for three times or more. I.e.: mean value (MEAN), Standard deviation (S.DEV), number of measuring (NO.), the max. value (MAX) and the min. value (MIN).

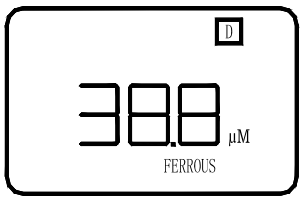
2.2 Functions and operations

2.2.1 Measuring methods: (single ⇔Continuous)

The section states all of the functions of the machine and its operating methods in detail.

- Single measurement method—— Each time the probe contacted with the tested object, the measured value is displayed with a buzzing indication;
- Continuous measurement method——Not to lift the probe during dynamic measuring. And there is no buzzing sound during the operation. The screen displays the flashing measured values.
- Method of changing between the two methods: in the shut-off state, press down and hold the "STAT" key for 3 seconds; release the key after "- - - -" is displayed, then the changing is completed.





2.2.2 Operating methods (Direct ⇔ Batch)

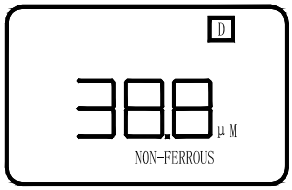
- Direct mode —— it is used for random measurement. The values are stored temporarily in the memory unit (there are 99 memory units). When all the 99 units are occupied, the new values will take place of the old ones. The last 99 values participate in the statistical calculation.

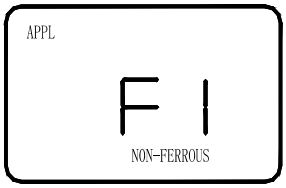
- Batch mode (APPL) —— the mode facilitates users to record data in batches, with each batch containing 99 values. 495 values can be stored by the total 5 batches. "FFFF" will be displayed when each batch is occupied by 99 values. At this time, the gauge still can be used to measure, however, the measuring value can only be displayed other than stored and participated in the statistical calculation. If necessary, the data of batch can be deleted to perform the new measurement.
  A calibration value has been set in each batch, and every measuring value of the batch is made out on the substrate of the calibration value. Limit can be set in each batch, thus beyond limit identifying and warning can be carried out on measuring results in the batch. In batch mode, each measuring value can be automatically sent into the statistical program to take part in statistical calculation. Several sets of measuring values based on different calibration values can be stored in this mode, thus the mode is especially suitable for on the spot measuring.

Note: All of the measuring values can be sent into statistical program

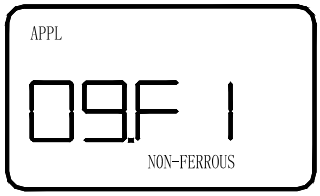
Changing method between the two modes:

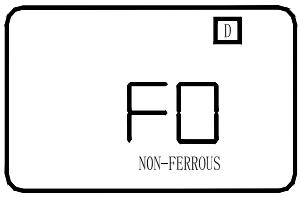
a) The instrument will be in direct operating mode automatically after switching on, and “D” is displayed in operating mode area. Press “FILE” key, then press “↑” key, it will be in batch mode, and “APPL” is displayed in operating mode area;





b) Batch No. can be selected by using “↑”and “↓” key.





Note: 1. The first two number present the number of stored measuring value in the batch, and 99 numbers can be stored in one batch at most;
2. The “.” between them expresses that a calibration value has being exist in the batch;
3. FX expresses batch No., and there is five batches at most.

c) Pressing “↓”key in batch mode, It is changed into direct mode when “F0” is displayed.

2.2.3 Statistical calculation

At least 3 measuring values are needed to produce the following 5 statistical values: Mean value (MEAN), Standard deviation (S. DEV), Number of measurement (No), the Max. value (MAX) and the Min. value (MIN).

a) Measured values participating in statistical calculation

⊙ In direct mode, all of the measured values (including the measured value prior to switching off) will take participate in statistical calculation.

Note: The old measured values will be replaced by new values when all of the 99 memory cells are occupied. The latest 99 measured values will be stored in memory.

⊙ In batch mode, only the measured values in one batch take participate in one statistical calculation .

Note: The statistical value can not be modified after 99 values are stored in a batch, though measurement can continue. If necessary, the memory cells can

be cleaned up to perform the next measuring.

b) Display statistical values

⊙ In direct mode, the five statistical values will be displayed in turn by pressing “STATS” key.

⊙ In batch mode, the five statistical values will be displayed in turn by selecting batch No. and pressing “STATS” key.

2.2.4 Storage

In batch mode, measuring values can be stored in memory cells automatically; with 99 values in each batch at most, thus 495 values can be stored in the total 5 batches.

2.2.5 Deletion

⊙ Delete the current value

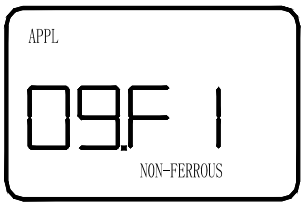
In despite of direct mode or batch mode, press “CLEAR” key in the status of displaying measuring value, the current value will be deleted with a buzzing sound.

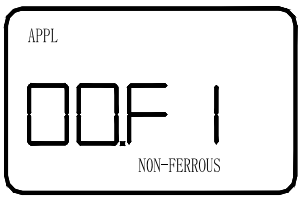
⊙Delete all of the measured values, statistical values and two-point calibration value in direct mode

Press “CLEAR” key twice in the status of displaying measured value under direct mode, all of the measuring values, statistical values and two-point calibration value in direct mode will be deleted with a long buzzing sound.

⊙ Delete all measured values and statistical values in a certain batch

Select batch No. and press “CLEAR” key twice, “00.Fx” is displayed on screen with a long buzzing sound; All of the measured values and statistical values will be deleted in this batch.



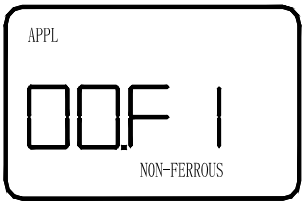


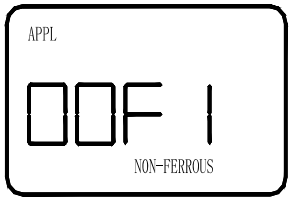
⊙ Delete the limits of a certain batch

Limit values will be displayed by selecting batch No. and pressing “LIMITS” key. The limit values disappear with the pressing of “CLEAR” key again.

⊙ Delete the calibration value in a certain batch

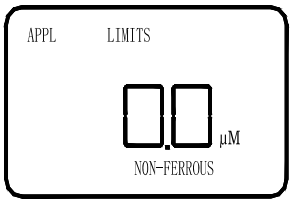
When no measured value is in the batch, press “CLEAR” key. The calibration value will be deleted. And the “.” in “00.Fx”will disappear

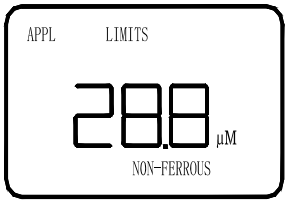




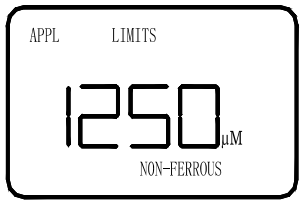
2.2.6 Setting limits

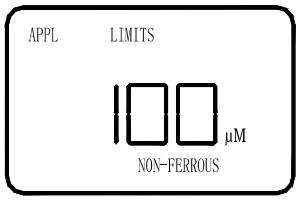
a) Press the “LIMITS”key, the LCD will show the lower limit previously set. Set the new lower limit by pressing “↓” and “↑” key.





b) Press the “LIMITS” key again. LCD will show the upper limit previously set. The new upper limit can be set by pressing “↓” and “↑” key.





Note: 1. The limits are only valid in batch mode;

2. Buzzing sound warning will be sound when measured result is out of the limits;

3. Both the measuring results out of limits and others will be stored to perform statistical calculation;

4. The closing extent between upper limit and lower limit is limited. The min. closing extent between upper limit and lower limit is 3% of upper limit if the upper limit is above 200μm. And the min. closing extent is 5μm if the upper limit is below 200μm.

2.2.7 Printing

The procedures for printing:

a) Insert the printing head into theTT260;
b) Switch on the TT260 by pressing “ON/OFF” key;
c) Set the switch of printing head on the position of “ON”;
d) Press “PRINT” key and the “PRINT” indicator appears；
e) Print statistical values — press “STATS” key, the statistical values will be displayed on screen and printed. One statistical value will be printed with each pressing of “PRINT”.
f) Single printing — each measured value will be printed after measuring in single measuring status.
g) Continuous printing — press “PRINT” key under the status of “F0”, all of the measured values and statistical values in direct mode can be printed out. Press “PRINT” key under the status of “Fx” （x is 1~ 5）, then press all of the measured values, statistical values, limits and histograms in the batch.
h) Canceling print — press “PRINT” key for about 3 seconds, the printing status will be cancelled. And “PRINT” indicator will disappear.

Note: 1. Histogram can only be printed out after limits has been set;
2.Printing will be stopped if switching off the printing head;
3. Feeding paper: press “FEED” key to feed paper in printing head

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2.2.8 Communication with PC

Prior to the communication with PC, the gauge should be connected with the series interface of PC according to the figure 2-2 via the communication cable, and operate the special application software (Data View) of the gauge on PC.

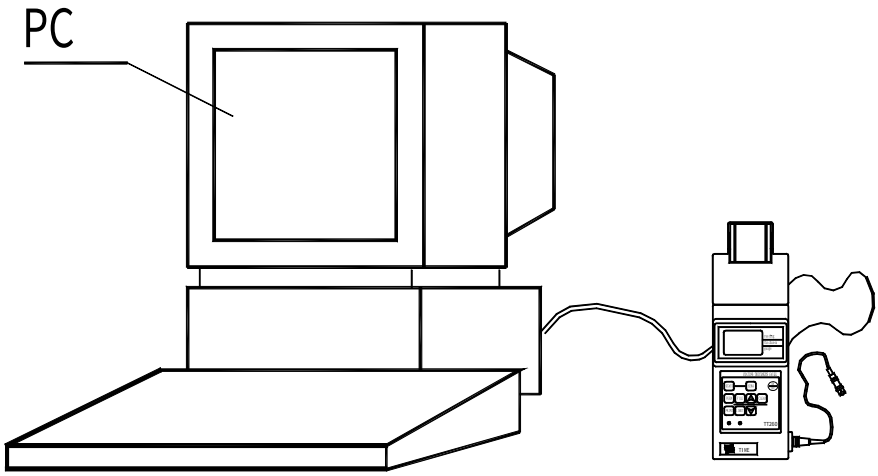


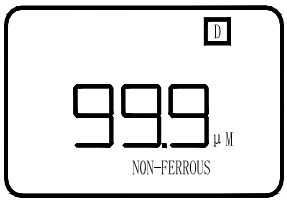
Fig. 2-1 connecting with PC

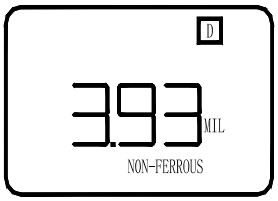
Note 1：Special operating software (Data View) of TIME should be adopted to carry out the communication between the gauge and PC. Please refer to the operation instruction of the software for the operation methods.

2 ： **A-B** indicator will appear on the screen after the connection between TT260 and PC has finished.

2.2.9 Switch of unit system（Metric system <=> imperial system）

Under the condition of switching off, press “ZERO” key and “ON” key then; It will be shifted in a new system with a long buzzing sound.





2.2.10 Keys and operations

Table 2-1 General view list of operation

Key name	Function	Remark
ZERO	Zero calibration	3.3.1
STATS	Display or print the five statistical values Continuous measuring <=> Single measuring	2.2.1, 2.2.3, 2.2.7
FILE	Entering batch mode	2.2.2
LIMIT	Setting limits	2.2.6
CLEAR	Delete test value, statistical value, limit and calibration value	2.2.5
↑、↓	Digital adjust	2.2.2, 2.2.6, 3.3.2.1, 3.3.2.2
PRINT	Print	2.2.7
FEED	Feed paper for printing head	2.2.7
ON/OFF	Switch on/ off	2.1
ZERO+ON/OFF	Metric system <=>Imperial	2.2.9

	system	
↑+↓+ON/OFF	Enter basic calibration status	3.4

*The marking number in the column of remark refers to the chapter which explaining the function in the operation instruction.

2.2.11 Measurement and error

⊙ If appropriate calibration has been performed, all of the measuring values should be in a specified limit of accuracy. (See Appendix 1);

⊙ Only one reading is not reliable according to the viewpoint of statistics. Thus any measuring value displayed on TT260 is the mean value of five "invisible" measuring values. The five measurements are finished by TT260 automatically in less than one second.

⊙ To make a more accurate measurement, a multiple measuring on a point can be performed by using statistical program; The great error can be cancelled by using "CLEAR". The final thickness of coating is:

$$CH = M+S+\delta$$

Of which: CH：Coating thickness

M：The mean value of multiple measurements

S：Standard deviation

δ：The allowable error of gauge

3 Calibration

In order to measure the thickness accurately, it is necessary to calibrate the instrument on the measuring site.

3.1 Calibration standards

Foil with known thickness or sample with known thickness of coating can be used as calibration standards. They are called standards for short.

a) Calibration foil.

As for magnetism method, "foil" refers to non-magnetic metal or non-metal foil or sheet. As for eddy current method, plastic foil is usually adopted. Foil is favorable for calibrating curved surface. It is more suitable than standard sample with coating.

b) Standard sample with coating.

Coating of known thickness, evenly and solidly attached to the substrate is selected as standard sample. As for magnetism method, the coating is non-magnetic; and as for eddy current, coating is non-conductive.

3.2 Substrate

a) For magnetism method, the magnetism and roughness of the surface of the standard substrate metal should be similar to those of the substrate metal of the object to be tested. As for eddy current method, the electric properties of standard substrate metal should be similar to those of the substrate of the object to be tested. In order to prove the applicability of the standard substrate, it is necessary to compare the readings of the standard substrate and the substrate of the object to be tested.

b) If the thickness of the substrate metal of the object to be tested is less than the critical thickness prescribed in the list 1, the following two methods may be used for calibration.
   1) To calibrate on the standard metal substrate of the same thickness as the substrate metal of the object to be tested.
   2) To calibrate by placing a metal pad, which is thick enough and has similar electrical or magnetic property, under the standard metal substrate. Make sure that there is no seam between the substrate and the metal pad. This method is not applicable to objects with coatings on both sides.

c) If the curvature of the coating to be tested is too big to be calibrated on a flat surface, the curvature of the coated standard sample or the curvature of the substrate metal placed below the standard foil should be the same as the curvature of the object to be tested.

3.3 Methods of calibration

Following are the calibration methods can be adopted in measuring:
zero calibration, two-point calibration and calibration on the surface of sand blasting. Two-point calibration includes one-foil method and two-foil method. There is another basic calibration method for the probe. The calibration of the gauge is very simple.

3.3.1 Zero calibration

This method is applicable to all probes, except CN02.

a) To conduct measuring once on the substrate, the screen displays ＜×.×μm ＞.
b) Press the “ZERO” key, the screen displays <0.0>. The calibration is finished and the measurement can be performed.
c) The procedure of a) and b) can be repeated to obtain a more accurate zero point and high accurate measuring. Measuring can start after the zero point calibration is completed.

3.3.2 Two-point calibration

3.3.2.1 One-foil method

This method applies to all probes except CN02. It is suitable for high

precision measurement, small work piece, quenched steel and alloy steel.

a) First carry out zero point calibration according to the procedure mentioned above.
b) Conduct measuring once on standard foil which thickness is approximate equivalent to the estimated coating thickness of coating to be measured. Screen will display ＜××.×μm＞.
c) Correct the readings with "↑" and "↓" key to make them accord with standard value. The calibration is finished and the measurement can be performed.

Note: 1. Even if the resulting value is identical to that of the standard sheet, it is still necessary to press the↑ and ↓key (for example, press ↑once and ↓ once). This note applies to all calibration methods.

2. In order to carry out two-point calibration accurately, repeat b) and c) procedure is possible to improve the accurate of calibration and reduce the accidental error.

3. When probe F10 are used to measure the thickness of metallic coating, two-point calibration method should be adopted.

3.3.2.2 Two-foil method

This method applies to all probes except CN02. The two standard foils should be different in thickness beyond 3 times. The estimated thickness of the coating to be measured should be between the two calibration values. This method is especially suitable for making measurement on rough sand blasting surface and for high precision measurement.

a) First carry out zero point calibration.
b) Make one measurement on the thinner standard foil. Correct the readings with "↑" and "↓" key to make them accord with standard value.
c) Thereon conduct one measurement on the thicker standard foil and correct the readings with "↑" and "↓" key to make them accord with standard value. The calibration is finished and the measurement can be performed.

3.3.2.3 Calibration on sand blasting surface

The special features of sand blasting surface leads to great deviations between measuring values and true values. The thickness of the coating can be determined by the following method:

Method 1:

a) The gauge should be calibrated first on the smooth surface with the same curvature radius and substrate materials according to the methods described in Chapter 3.3.1 or Chapter 3.3.2.1.
b) Calibrate on the surface (without coating) processed with the same sand blasting method about ten times to obtain the mean value Mo.
c) Then, conduct measuring on the sand blasting surface (with coating) for ten times to obtain the mean value Mm.
d) （$Mm—Mo$）$\pm S$ indicates the thickness of the coating.
Of which, S（standard deviation）is the bigger one between S_{Mm} and S_{Mo}.

Method 2:

a) Measuring with the single measuring method in direct mode.
b) Calibrate the gauge with two-foil method first.
c) Perform the measurements for about 5～10 times on the object to be tested. Press "STATS" key, and the mean value in statistical values indicates the coating thickness.

3.3.2.4 The calibration method for chroming coating on copper

The method is suitable for N400, N1 and N1/90° probes, and special calibration standard sheet should be adopted.

⊙ Only one-foil method can be used.

⊙ the special standard sample marking with "CHROME ON COPPER" are used.

3.3.2.5 The calibration method for CN02 probe

A patulous probe, CN02 is only suitable for measuring the thickness of copper plate or copper foil on smooth surface.

a) Place the CN02 probe stably on a copper block of 5.0mm after the starting up of the machine. Press "ZERO" key and the screen will display "OO";
b) Perform once measurement on standard foil;
c) Correct the readings with "↑" and "↓" key to make them accord with standard value. The calibration is finished and the measurement can be performed.
d) To measure the two sides coating copper plate, the two sides coating copper standard sheet is necessary for calibration.

Note: In case of extreme variation of temperature, such as operating outdoor in winter or hot summer, calibration should be carried out on a standard foil whose thickness is close to the thickness of foil to be measured. The ambient temperature when calibrating should be identical to the ambient temperature when using.

Caution: 1. Re-calibration is necessary in case of the following cases:

____An error value had been input when calibrating;
____Operation mistake;
____Probe had been changed.

2. In direct mode, if an error calibration value had been input, please conduct another calibration, thus a new value can be obtained to cancel the error value.
3. Only one calibration value can exist in each batch
4. Zero point calibration and two-point calibration can be repeated by many times to obtain more accurate values and improve the precision of measuring. However, the calibrating phase will stop as long as a measurement is performed in this course.

3.3.3 Correcting calibration value in batch F_X

Re-calibrating can only be carried out after all of the data and calibration

value in batch unit had been deleted, or error code E20 will occur and buzz warning will sound. This method must be adopted after the probe had been changed.

3.4 Correcting for basic calibration

In the following case, it is necessary to change basic calibration:
____Probe tip worn;
____Probe changed justly;
____Special application.
In measuring, the properties of probe should be re-calibrated (called basic calibration) if the error exceeds obviously the specified range. The probe can be re-calibrated by input 6 calibration values (one zero and five thickness values).

a) Under the status of shut off, press ↑ and ↓ key and ON key. The gauge will be in the status of basic calibration with a long buzzing sound.
b) Calibrate zero point first. Calibrations can be repeated many times to obtain a mean value from many calibration values, thus the accuracy of calibration can be improved.
c) Calibrate using different standard foils. Many measurements can be performed on one thickness. The thickness of one foil should be over 1.6 times than that of the other foil. The optimized factor should be 2 Such as: 50, 100, 200, 400 and 800μm. The max value should be close to but lower than the max measuring range of probe.

Caution: Each thickness should be over 1.6 times than the last thickness, or the calibration should be regarded as invalid basic calibration.

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d) Measure zero after the 6 calibration values had been input. Gauge will switch off automatically and the new calibration value has been stored in the gauge. The gauge will operate according to the new calibration value when the gauge is switched on again.

4 Factors influencing accuracy

4.1 Relative influencing factors

Table 4-1 Relative influencing factors

Measuring method / Influencing factor	Magnetic method	Eddy current method
Magnetic property of the substrate	▲	
Electric property of the substrate		▲
Thickness of substrate	▲	▲
Fringe effect	▲	▲
Curvature	▲	▲
Deformation of measured object	▲	▲
Surface roughness	▲	▲
Magnetic field	▲	
Impurity matters attached	▲	▲
Contact pressure of the probe	▲	▲
Direction of probe placing	▲	▲

▲ ------ indicates some effects existing

4.2 Explanations for influencing factors

a) Magnetic property of metal substrate

The accuracy of thickness measurement with magnetism method will be influenced by the variation of metal substrate magnetism (in practical operation, low carbon steel is deemed as having slight influence). To avoid the impact of heat treatment and cold processing, it is recommended to calibrate using the standard substrate with the same property as the substrate of the object to be measured. It is also applicable to calibrate the gauge with coating sample.

b) Conductivity of metal substrate

Measurement results are affected by the conductivity of metal substrate, and the conductivity depends on its materials composition and the way of heat treatment. The gauge should be calibrated by using a standard substrate with property similar to the substrate of the object to be measured.

c) Thickness of metal substrate

For each gauge, there is a critical thickness of metal substrate. If thickness of the metal substrate is greater than the critical value, the measuring will not be affected by it. The critical values of the gauge are listed in appendix 1.

d) Fringe effect

The instrument is very sensitive to the abrupt deformation of object surface,

and so it is not reliable to measure the thickness on the fringes or at the inner corners.

e) Curvature

The curvature of the object has some effect on the measuring, and the effect will increase obviously with the decreasing of curvature radius. Therefore it is not reliable to measure on the bent surface.

f) Deformation of measured subject

Probe can make soft coating deform, so reliable data can not be measured on these sample.

g) Roughness of surface

The roughness of substrate metal and the coating have effect on measurement. The greater is the roughness, the more serious is its effect. Surface roughness can result in system error and accidental error. So the number of measuring should increase in different positions to overcome the accidental error. If the substrate metal is rough, it is necessary to calibrate the zero point on several positions on the metal substrate (without coating) which has similar surface roughness; or calibrate the zero point of the gauge after the coating had been removed by using solvent which is non-corrosive to the substrate metal.

g) Magnetic field

The strong magnetic field generated by all kinds of electrical equipments around can seriously interface with the thickness measuring by magnetic method.

h) Matters attached

The instrument is sensitive to the matters attached, which can hamper the close contract of the probe with the coating surface. It is, therefore, necessary to remove the attached matter in order to ensure close contract between the probe and the surface to be measured.

i) Pressure of the probe

The pressure exerted on the probe has effect on the readings. It should be kept constant.

j) Direction of the probe placing

The direction of the probe can affect the measuring. Therefore the probe should be kept in perpendicular to the measured surface.

4.3 Rules to observe in using the instrument

a) **Special property of substrate metal**

For magnetism method, the magnetic property and surface roughness of the substrate metal of the standard should be similar to those of the substrate metal to be measured.
For eddy current method, the electric property of substrate metal of standard should be similar to those of the substrate metal to be measured.

b) **Thickness of substrate metal**

Check the thickness of the substrate to confirm whether it exceeds the critical thickness or not; a certain method in Chapter 3.3 can be adopted to calibrate if the thickness is lower than critical value.

c) **Fringe effect**

Measuring should not be carried out in the positions of abrupt deformation, such as edges, holes or inner corner.

d) **Curvature**

Measuring should not be done on the curved surface of sample.

e) **The number of readings**

As the reading of each time is not entirely identical, it is necessary to obtain several readings for an area measured. The local differences of the thickness of coating also call for many measurements to be taken in a designated area, especially when the surface is rough.

f) **Surface clearness**

It is necessary to remove any attached matters, such as dust, grease, corrosive products and so on, however, take care not to remove any coating matters.

5 Maintenance and trouble shooting

5.1 Requirements for environment

Strictly guard against collision, heavy dust, dampness, strong magnetic field, oil stain and etc.

5.2 Battery charging

The gauge should be charged as early as possible when the voltage of battery is too low (i.e. when the indicator “BATT” appears on the screen). The method of charging is as following:

a. Shut down;
b. Insert the charging plug of power source adapter into the charging socket of gauge. Connect the power source adapter with power supply (220V/50Hz) then. The charging lamp (green) and quick-charging lamp (red) will illuminate;
c. It indicates that battery is full when the quick-charging lamp (red) has gone out. The charging time is about 2.5 hours in normal condition;
d. Pull out the charging plug.

Note: 1. The input voltage of power source adapter is 220VAC; the output voltage is 12VDC; the max charging current is about 300mA and the max charging time is about 3 hours;

2. Nickel-Hydride accumulator battery is adopted. Therefore, it

should be recharged in time when “BATT” appears; excessive discharging will damage the battery in some degree.

3.The gauge can be in operation when charging.

5.3 Changing battery

The normal work life of battery used in the gauge is 3 years. it can be replaced by user after the battery had failed. The method is as following:

a) Press the power source switch out;
b) Unscrew the four screws of the back of host, and separate the upper cover and the lower cover;
c) Remove the gland of battery; take off the power source plug and take out the failure battery;
d) Connect the new battery according to the original mode and mount power source plug (take care not to reverse the anode and the cathode);
e) Mount the gland of battery after the new battery has been on its place; insert the power source plug into the power socket and switch on the power source to check if the working of instrument is in normal or not.
f) Mount the upper cover and the lower cover and tighten the four screws.

5.4 Changing printer paper

The changing of printer paper should be as Fig. 5-1. Push the printer paper cover forward down on the position of “hand pushing position”, and take the cover off. Insert the end of paper roll into the paper feeding port of printing head after the new paper roll had been replaced. Press the “FEED” key until the end of paper roll has stuck out of the printing head and case, then fix the printer cover.

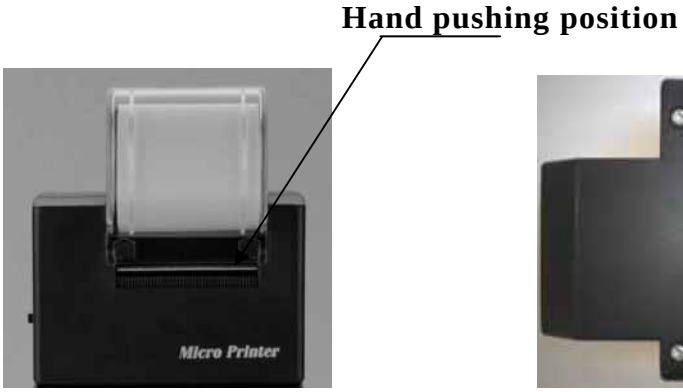

Fig. 5-1 changing printer paper

Fig. 5-2 unscrew

5.5 Changing ribbon

Remove the printer head firstly; loosen the screws (see figure 5-2); open the upper cover of printing head; and tense the copying ribbon by rotating the knob

according to the direction of the arrow on copying ribbon after the new ribbon has been replaced.

5.6 Installation and dismantle of printing head

The printing head can be removed according to the method as figure 5-3; in order to avoid damaging the case, an even force should be exerted and the direction must be correct. To make use easily, the bracket insert plate and bracket can be installed after the printing head had been removed. The clog of port should be installed to ensure the reliable operation of printing head connecting port after the printing had been removed.
Operate according to the reverse sequences when the printing head is re-used.

Fig. 5-3 installation and dismantle of printing head

5.7 Trouble shooting

The following table of error messages explains how to identify and eliminate failure:

Table 5-1 Table of error messages

Error code	Possible cause	Resolvent
E02	Probe or gauge damaged	Repair the probe or gauge
E03	Probe or gauge damaged	Repair the probe or gauge
E04	Great variation on measuring value (for example: measuring on soft coating); affected by magnetic field	Auxiliary equipments should be used when measuring on soft coating; away from the strong magnetic field
E05	Probe is too near to metal substrate	Keep probe away from metal

	when switching on	substrate.
E08	Probe or gauge damaged	Repair the probe or gauge
E11	Probe model is not in conformity to the model corresponding with original data in the batch	Replaced by a suitable probe; Select another batch unit having not been used; Re-calibration after canceling.
E15	The deviation of zero value is too great that calibration is impossible	Select a suitable substrate or repair the instrument
E20	Calibration value has been existed in the batch unit.	Select another batch unit having not been used; or Re-calibration after canceling.

If the instrument does not work properly, and no error code is shown, such as:

a) Unable to shut off automatically;
b) Unable to conduct measuring;
c) Keys does not work;
d) Abnormal measuring values.

If the troubles can't be eliminated using the methods mentioned in above table, you are advised not to dismantle the instrument. Please return the gauge to the after service of our company. We will perform the warranty regulations.

We would be very grateful if you send back the instrument together with a brief description of troubles.

6 Non-warranty Parts

1.Window 2. Battery 3. Charger 4. Key film
5. Sheath of TT210 6.Probe

7 Appendix

Appendix 1 Technical parameters

Probe model		F400		F1	F1/90°	F5	F10
Operating principle		Magnetic induction					
Measuring range (μm)		0～400		0～1250		0～5000	0～10000
Low range resolution(μm)		0.1		0.1		1	10
Accuracy	One-point calibration (μm)	±(3%H+1)				±(3%H+5)	±(3%H+10)
	Two-point calibration (μm)	±((1～3)%H+0.7)		±((1～3)%H+1)		±((1～3)%H+5)	±((1～3)%H+10)
Measuring conditions	Min curvature radius (mm)	Convex	1	1.5	Flatten	5	10
	Diameter of the min area (mm)	Φ3		Φ7	Φ7	Φ20	Φ40
	Critical thickness of substrate (mm)	0.2		0.5	0.5	1	2

Probe model		**N400**		N1	N1/90°	CN02	N10
Operating principle		Eddy current					
Measuring range (μm)		0～400 (Chrome on copper)		0～1250 (Chrome on 0～40)		10～200	0～10000
Low range resolution(μm)		0.1		0.1		1	10
Accuracy	One-point calibration (μm)	±(3%H+0.7)		±(3%H+1.5)		±(3%H+1)	±(3%H+25)
	Two-point calibration (μm)	±[(1～3)%H+0.7]		±[(1～3)%H+1.5]		---	±[(1～3)%H+25]
Measuring conditions	Min curvature radius (mm)	Convex	1.5	3	Flatten	Only flatten	25
	Diameter of the min area (mm)	Φ4		Φ5	Φ5	Φ7	Φ50
	Critical thickness of substrate (mm)	0.3		0.3	0.3	No limit	50μm aluminum foil

Note: H——Nominal value

Appendix 2

Table 1 for probe selection reference

Substrate \ Coating		Non-magnetic coating of organic material (such as painting, finishes, enamel, porcelain enamel, plastic, anodization and etc.	
		Coating thickness≤100μm	Coating thickness > 100μm
Magnetic metal such as iron, steel and etc.	Measured area Dia. > 30mm	Probe F1 0～1250μm Probe F400 0～400μm	Probe F1 0～1250μm Probe F5 0～5mm Probe F10 0～10mm
	Measured area Dia. < 30mm	Probe F400 0～400μm	Probe F1 0～1250μm Probe F400 0～400μm
Non-ferrous metal such as copper, aluminum, brass, zinc, tin and etc.	Measured area Dia.> 10mm	Probe N1 0～1250μm Probe N400 0～400μm	Probe N1 0～1250μm Probe N10 0～10mm Probe N400 0～400μm
	Measured area Dia. < 10mm	Probe N1 0～1250μm Probe N400 0～400μm	Probe N1 0～1250μm Probe N400 0～400μm

Table 2 for probe selection reference

Substrate \ Coating		Non-magnetic non-ferrous metal coating (such as chrome, zinc, aluminum, copper, tin, silver and etc.)	
		Coating thickness≤ 100μm	Coating thickness > 100μm
Magnetic metal such as iron, steel and etc.	Measured area Dia. > 30mm	Probe F1 0～1250μm Probe F400 0～400μm	Probe F1 0～1250μm Probe F5 0～5mm Probe F10 0～10mm Probe F400 0～400μm
	Measured area Dia. < 30mm	Probe F1 0～1250μm Probe F400 0～400μm	Probe F1 0～1250μm Probe F400 0～400μm
Non-ferrous metal such as copper, aluminum, brass, zinc, tin and etc.	Measured area Dia. > 10mm	Only for chrome coating on copper Probe N1 0～1250μm Probe N400 0～40μm	--------
	Measured area Dia. < 10mm	--------	--------
Non-metal such as plastic, printing circuit and etc.	Measured area is big	Probe CN02 10～200μm	Probe CN02 10～200μm