MITECH COATING THICKNESS GAUGE MCT200

User's Manual

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1 Overview

This compatible, handy pocket gauge is designed for non-destructive, fast and precise coating thickness measurement. The principal applications lie in the field of corrosion protection. It is ideal for manufactures and their customers, for offices and specialist advisers, for paint shops and electroplates, for the chemical, automobile, shipbuilding and aircraft industries and for light and heavy engineering.

1.1 Technical Parameters

- Measuring principle: Magnetic induction & Eddy current.
- Measuring range: (0～1250)μm, depends on probes, maximum 10mm for the probe F10. Refer to appendix.
- Low range resolution: 0.1μm.
- Accuracy: ±(3%Thickness+1)μm, depends on probes and conditions.
- Display: 4 digits LCD with EL back-light.
- Memory for up to 20 files(up to 50 values for each file)of stored values.
- Unit system: Metric(μm)、Imperial(mil).
- Power source: Two “AA” size, 1.5 Volt alkaline batteries, 200 hours typical operating time(EL back-light off).
- Communication: USB1.1.
- Dimensions: 125mm×67mm×31mm.
- Weight: 340g.

1.2 Features

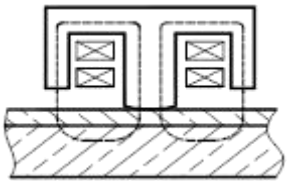
- Five types of probes(F400, F1, F1/90° , F10, N1) are available for different application, F10 probe measures up to 10mm.
- With different external probes, the gauge can be applied to measuring thickness of non-magnetic coating on magnetic metal substrate, as well as non-conductive coating on non-magnetic metal substrate.
- Two calibration methods can be applied to the gauge. The system error of the probe can be corrected with the basic probe calibration method.
- Two measuring modes: single or continuous, changeable.
- Measuring status indicator shows the measuring status.
- Measured values and user information are shown on a large, easy-to-read LCD. The display back light ensures easy reading of screen data in low light conditions.
- Battery information indicates the rest capacity of the battery.
- Auto sleep and auto power off function to conserve battery life.
- USB1.1 communication port, optional software to process the memory data on the PC.
- The gauge equips with data-pro software, can do measurement results transmission, automatic storage management, measurement data analysis, measurement reports print etc.
- Compact aluminum case, suitable for use under poor working conditions such as vibration, shock and electromagnetic interference.

1.3 Measuring Principles

The gauge adopts two thickness-measuring methods: magnetic induction method and eddy current method.

Magnetic Induction Method:

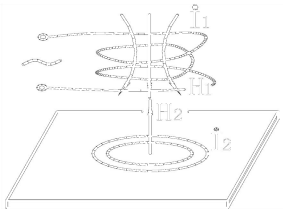
The probe and the magnetic metal substrate will form a closed magnetic circuit when probe contacting with the coating, the magnetic resistance of closed magnetic circuit varies due to the existing of non-magnetic coating. The thickness of the coating can be measured through the variation of magnetic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



Eddy Current Method:

The high frequency alternating current generates an electromagnetic field in the probe coil, eddy current

will be formed on metal substrate when the probe contacting with the 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.



The range of applications is indicated by the probes available.
-F probes work on the magnetic induction principle and should be used for non-magnetic coatings such as aluminum, chrome, copper, zinc, paint and varnish, enamel, rubber etc., on an iron or steel substrate; they are also suitable for alloyed and hardened magnetic steel.
-N probes work on the eddy-current principle and should be used for insulating coatings on all non-ferrous metals and on Austenitic stainless steels, e.g, paint, anodizing coatings, ceramics, etc, applied on aluminum, copper, zinc die-casting, brass, etc.

1.4 Configuration

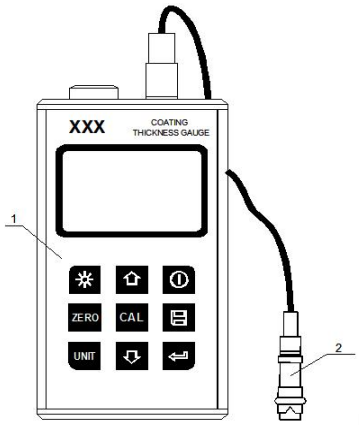
	No	Item	Quantity	Remarks
Standard Config	1	Main unit	1	
	2	Probe	1	F1 or N1
	3	Calibration Foils	5 PCS	
	4	Zero plate	1	Iron or Aluminum
	5	Instrument case	1	
	6	Manual	1	
	7	Alkaline Battery	2 PCS	AA size
Optional Config	8	Other type of probes		F400, F10, F1(90°),N1
	9	Data-Pro software	1	On CD
	10	USB cable	1	

1.5 Working Conditions

Working temperature: -10℃～＋50℃.
Storage temperature: -30℃～＋60℃.
Relative humidity: ≤90％.
The surrounding environment should avoid of vibration, strong magnetic field, corrosive medium and heavy dust.

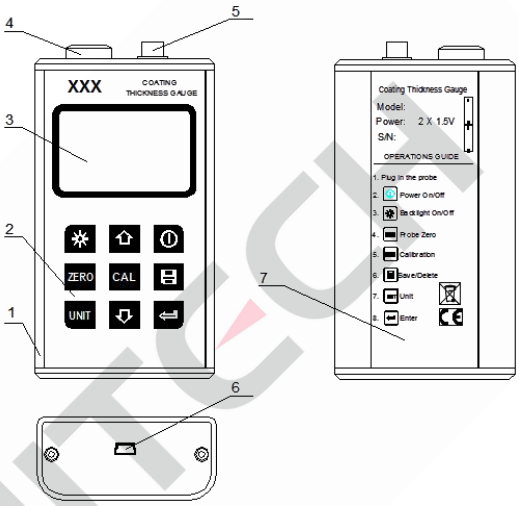
2 Structure and Functions

2.1 The Gauge Appearance



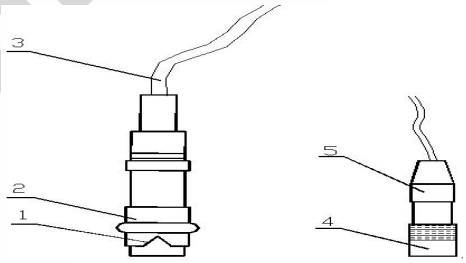
① Main unit
② Probe

2.2 Structure of The Main Unit



① The main body
② Key pad
③ LCD
④ Battery cover
⑤ Probe socket
⑥ USB port
⑦ Label

2.3 Probe Structure

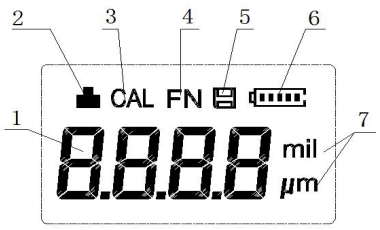


① V-groove
② Loading sleeve
③ Cable
④ Plug sleeve
⑤ Plug end

All probe systems are spring-mounted in the probe sleeve which ensure safe and stable positioning of the probe and even contact pressure, the V-groove in the sleeve of the probes facilitates reliable readings on small cylindrical parts.
The probe should be held by the spring-mounted sleeve. The hemispherical tip is made of hard and durable material.

2.4 Screen Display

Below is the full screen display:



① **Information Display**: Display the measured values and user information.
② **Measurement Status Indicator**: Indicates the measurement status while the gauge is taking

a measurement, the measurement status should be on. If it is not on or not stable, the gauge is having difficulty achieving a stable measurement, and the thickness value displayed will most likely be erroneous.

③ **Calibration Status**: Indicates the status of calibration.

④ **Probe Type**: Indicates N(Non-ferrous) or F(Ferrous) according to probe type. Probe type is detected automatically while powering up.

⑤ **Memory Icon**: Appears during memory operation.

⑥ **Battery Status**: Indicates the rest capacity of the battery.

⑦ **Unit**: Metric(μm) or Imperial(mil).

2.5 Keypad Definitions

	Power		Calibration
	Backlight		Confirm
	Probe zero calibration		Up
	Unit switch/Exit		Down
	Data save/Delete		

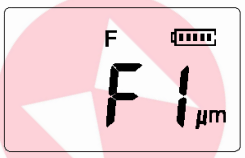
3 Operation

3.1 Probe Selection

Refer to Appendix 1 and Appendix 2 when selecting the probe.

3.2 Power On/Off

The gauge is turned on by pressing the  key. Make sure to plug on the probe before powering on the gauge, it will automatically detect the probe type and download the calibration data from the memory inside the probe during the start-up, if the probe is not plugged on or the probe is defective, the gauge will show error message and shut down automatically.



The gauge can be turned off by pressing the  key while it is on. The tool has a special memory that retains all of its settings even when the power is off.

3.3 Basic Steps

① Get the object to be tested ready.

② Insert the probe plug into the probe socket of the gauge.

③ Keep the probe away from the test object and press the  key to switch on the machine.

④ Check the voltage of battery.

⑤ If calibration is needed, choose an appropriate method to do so.

⑥ Start measurement. 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.

⑦ Switch off the machine. The machine will shut off automatically if operation stops for about 5 minutes and it can be shut off immediately when pressing the  key.

3.4 Data Logging

3.4.1 Storing a Reading

There are twenty files(F00-F19) that can be used to store the measurement values inside the gauge, at most 50 records(thickness values) can be stored to each file. By simply pressing the key after a new measurement reading appears, the measured thickness value will be saved to the selected file. It is added as the last record of the file. To change the destination file to store the measured values, follow the steps:

① Press the key to activate the data logging functions. It will display the current file name and the total record count of the file.

② Use the key and the key to select the desired file to set as the destination file.

③ Press the key to exit the data logging functions at any time.

3.4.2 Clearing Selected File

The user may require the contents of an entire file be completely cleared of all measurements. This would allow the user to start a new list of measurements starting at storage location L00. The procedure is outlined in the following steps.

① Press the key to activate the data logging functions, it will display the selected file name and the total record count in the file.

② Use the key and the key to scroll to the file that will be cleared of all measurements.

③ Press the key on the desired file, it will automatically clear the file, and display “-DEL”.

④ Press the key at any time to exit the data logging functions and return to measurement mode.

3.4.3 Viewing/Deleting Stored Record

This function provides the user with the ability to view/delete a record in a desired file previously saved in memory, Following are the steps:

① Press the key to activate the data logging functions, it will display the selected file name and the total record count of the file.

② Use the key and the key to select the desired file.

③ Press the key to enter the selected file, it will display the current record number(for example, L012) and the record content.

④ Use the key and the key to select the desired record.

⑤ Press the key on the desired record, it will automatically delete this record, and display “-DEL”.

⑥ Press the key to exit the data logging functions and return to measurement mode.

3.5 Changing the Measuring Method

The instrument supports two measuring methods: single measurement method and continuous measurement method.

① Single measurement method - Each time the probe contacted with the tested object, the measured value is displayed with a buzzing indication.

② Continuous measurement method - Not to lift the probe during dynamic measuring, The screen displays the flashing measured values.

③ Press the key to switch between the two methods.

3.6 Changing the Measuring Unit

Readings can be taken and displayed in metric and imperial units. Press the key to switch from metric units(μm) to imperials(mil) or vice versa.

3.7 EL Back-Light

With the EL background light, it is convenient to work in the dark condition. Press the key to switch on or switch off the background light at any moment as you need after power on, the EL light will

consume much power, turn on it only when necessary.

3.8 Battery Indicator

Two AA size 1.5 volt alkaline batteries are needed for the gauge. When the power is full, the indicator icon is full, after using for a long time, the indicator icon will be half. When the battery almost done, the icon will flash, you should change batteries immediately.

3.9 Auto Powering Off

The instrument features an auto powering off function designed to conserve battery life. If the gauge is idle(neither measuring nor any key operation) for 5 minutes, it will turn itself off, Before powering off, the LCD display of the instrument will continue flashing for 20 seconds, except key , press any key could stop the twinkle of LCD screen and stop the operation of power off at the moment.
While the voltage of the battery is too low, the display will show <E00>, then power off automatically.

3.10 Factory Reset

Press down the ZERO key while powering on the instrument will restore factory defaults, note that the measurement results, memory data, calibration data will also be cleared during resetting.

3.11 Connecting to a Computer

The gauge can be connected to a PC with a USB interface, insert one connection plug of the USB cable into the USB socket on the bottom side of main unit, and insert the other plug into the USB port of the computer, refer to the manual of the Data-Pro software for detailed information.

3.12 Prompt Compared Table

Display Encoding	Explanation	Display Encoding	Explanation
E00	Battery low voltage	E09	Invalid data
E02	Probe defective	-Prb	Error when reading the probe memory
E03	Probe defective	Prb0	The probe needs zero calibration
E05	Probe close to metal		
E06	Result out of range		

4 Calibration and Measurement

Calibration is the most important requirement for accurate measurement. The more closely the calibration sample matches the product sample, the more accurate the calibration.

4.1 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.
Calibration foil, As for magnetic induction 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.
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.

4.2 Substrate

For magnetic induction method, the magnetism and roughness of the surface of the zero plate should be similar to those of the substrate metal of the object to be tested, As for eddy current method, the electric properties of zero plate should be similar to those of the substrate of the object to be tested, In order to improve the applicability of the zero plate, it is necessary to compare the readings of the zero plate and the substrate of the object to be tested.
If the thickness of the substrate metal of the object to be tested is less than the critical thickness described in Appendix Table 1, the following two methods may be used for calibration.

- To calibrate on the plate of the same thickness as the substrate metal of the object to be tested.
- To calibrate by placing a metal pad, which is thick enough and has similar electrical or magnetic property, under the 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.
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.

4.3 Methods of Calibration

Three different calibration methods are available for the gauge: probe-zero calibration, two-point calibration and basic probe calibration.
Before calibration, the measuring point and the probe tip must be free from grease, oil, scraps of metal, etc, the slightest impurity will affect measurement and distort readings.

4.3.1 Probe-Zero Calibration

This method is applicable to all probes, except CN02.

① Apply the probe to the zero plate, the screen will display ＜××μm＞, then lift up the probe away from the plate.

② Press the ZERO key, the screen displays <0.0>, the calibration is finished and the thickness measurement can be performed.

③ The procedures can be repeated to obtain a more accurate zero point and results.

4.3.2 Two-Point Calibration

- **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.

① Firstly carry out probe-zero calibration according to the procedure mentioned above.

② Select a calibration foil with the thickness approximately equivalent to the coating to be measured, apply the probe to the calibration foil, the screen will display ＜××.×μm＞.

③ Press the CAL key to initialize calibration, the icon ‘CAL’ will appear on the screen.

④ If necessary, adjust the value shown on the screen by means of the arrow keys.

⑤ End calibration by pressing the CAL key twice, the ‘CAL’ icon will disappear.

Notes:
When using probe F10 to measure the thickness of the coating, one-foil method should be adopted.

- **Two-Foil Method**

This method applies to all probes except CN02, two calibration foils with different thickness will be used. The coating thickness 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, operations are as follows:

① Carry out probe-zero calibration on the zero plate.

② Make one measurement on the thinner calibration foil.

③ Press the CAL key to initialize the calibration, the icon ‘CAL’ will appear on the screen.

④ Adjust the value shown on the screen to the thinner calibration foil value by means of the arrow keys.

⑤ Press the CAL key to end the first thickness adjustment, make second measurement.

⑥ Adjust the value shown on the screen to the thicker calibration foil value by the arrow keys.

⑦ End calibration by pressing the CAL key, the ‘CAL’ icon will disappear.

- **Calibration on Sand Blasting Surface**

The physical nature of shot-blasted surfaces results in coating thickness readings which are too high. The mean thickness of the coating can be determined by the following two methods:
Method A: This method should be used for surfaces with a roughness grade of min, 20μm(0.8 mils).

① The gauge should be calibrated according to the one-foil method described above. Use a smooth surface with the same curvature radius and the same substrate.

② Now take approx 10 readings on the uncoated, shot-blasted surface to obtain the mean value Mo.

③ Subsequently, take approx, 10 further readings on the coated and similarly shot blasted test sample to produce the mean value *Mm*.

④ The difference(*Mm—Mo*)±*S* is the mean coating thickness over the peaks; *S* is the greater standard deviation of the two values Mm and Mo.

Method B: This method should be used for surfaces with a roughness grade of max, < 20μm(0.8 mils).

① Calibrate the gauge according to the two-foil method.

② Perform the thickness measurements for about 5～10 times on the object to be tested, Record the mean value of the measurements as the coating thickness.

- **Calibration for Chrome Coating on Copper**

This method is suitable for N400, N1 and N1/90° probes, and special calibration foils should be adopted.

① Only one-foil method can be used.

② The special calibration foil marking with “CHROME ON COPPER” is used.

4.3.3 Basic Calibration of Probe

In the following case, it is necessary to carry out basic probe calibration:

- Probe tip is worn.
- For special applications.

In thickness measuring, the probe should be re-calibrated(called basic probe calibration) if the error exceeds obviously the specified range, the basic probe calibration is performed by the following steps:

① Press down the CAL key while powering on the instrument, the icon ‘CAL’ will appear on the screen indicating calibration status after powering up, and the LCD shows ‘Prb0’.

② Perform the probe-zero calibration,

③ Make one measurement on the thinnest calibration foil, adjust the value shown on the screen to its nominal thickness value by means of the arrow keys, then press the CAL key to end the first thickness adjustment, the LCD shows ‘P0’.

④ Calibrate using the other four different calibration foils from small to big thickness value one by one, the thickness of one foil should be over 1.2 times than that of the other foil, or the calibration will be regarded as invalid operation, the optimized thickness of the foils should be like this: 50μm, 100μm, 200μm, 400μm and 800μm, the max value should be close to but less than the max measuring range of probe.

⑤ The gauge will automatic off after inputting 5 calibration values. When start again the gauge will operate according to the new calibration.

5 Maintenance & Notes

5.1 General Notes

- The instrument and probe should avoid of strong vibration
- The instrument should avoid humidity environment
- When unplug the probe, we should handle with care, do not spin the probe
- Oil stains and dust will aging the cable, we should clear the dust and oil after using.

5.2 Battery Check

When the battery is almost done, please change it immediately. when not using for a long time, please take out the batteries to avoid leakage.

Notes:

Make sure that the positive and negative poles are correctly positioned. If not, the main unit may be damaged.

5.3 Maintenance of Calibration Substrate

The calibration substrate has affection to the probe, please keep the substrate avoid scratch and rust.

5.4 The Cleaning of Casing

Alcohol, dilution liquid is corrosive to the casing, when cleaning the case just use clean water.

5.5 Maintenance of Instrument

If the instrument is out of order, such as damage, can not measure, display abnormal, accuracy large, keypad malfunction, please do not dismantle or adjust any part of the instrument. Please handle it to our company maintenance department to test and maintenance.

APPENDIX

Appendix1 Probe Specification Table

Probe type		F400	F1	F1/90°	F10	N1
Measuring principle		Magnetic induction			Eddy currents	
Measuring range(μm)		0～400	0～1250		0～10000	0~1250
Low range resolution		0.1μm	0.1μm		10μm	0.1μm
Accuracy	One-point calibration(μm)	±(3%H+1)			±(3%H+10)	±(3%H+1.5)
	Two-point calibration(μm)	±((1～3)%H+0.7)	±((1～3)%H+1)		±((1～3)%H+5)	±((1～3)%H+1.5)
Conditions	Min curvature of the min area(mm)	Convex≥ 1	1.5	Flatten	10	3
	Diameter Of the min area(mm)	Φ3	Φ7	Φ7	Φ40	Φ5
	Critical thickness of substrate(mm)	0.2	0.5	0.5	2	0.3

Notes: H—Nominal thickness of the coating

Appendix2 Probe Selection Table

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

Appendix3 Factors Affecting Accuracy

3.1 Factors Affecting Accuracy

Influencing factor \ Measuring method	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	▲	▲

▲means having influence.

3.2 The Explanation of Factors

Magnetic property of metal substrate. The accuracy of thickness measurement with magnetic 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 to be measured, it is also applicable to calibrate the gauge with coating sample.

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 to be measured.
Thickness of metal substrate. For each gauge, there is a critical thickness of metal substrate, If the 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 Table 1.
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.
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.
Deformation of measured subject. Probe can make soft coating deform, so reliable data can not be measured on these sample.
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.
Magnetic field. The strong magnetic field generated by all kinds of electrical equipment around can seriously interface with the thickness measuring by magnetic method.
Matters attached. The instrument is sensitive to the matters attached, which can hamper the close contract of the probe with the coating surface, therefore it is necessary to remove the attached matter in order to ensure close contract between the probe and the surface to be measured.
Pressure of the probe. The pressure exerted on the probe has effect on the readings, it should be kept constant.
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.

3.3 Rules to Follow

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.
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.
Fringe effect. Measuring should not be carried out in the positions of abrupt deformation, such as edges, holes or inner corner.
Curvature. Measuring should not be done on the curved surface of sample.
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.
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.

User Notes

Warranty:

The product is guaranteed for one year since purchased, log in www.mitech-ndt.com or follow our company official public platform to register for maintenance, Please fill the blanks as required, if the product is not registered for maintenance, it will follow the date of manufacturer.

When applying for maintenance, please visit our official website, www.mitech-ndt.com or official accounts, submit “online reporting to repair” sheet.

In accordance with the international relevant regulations, the following are out of free service and repairing:

- Damage caused by man-made or improper keeping;
- Self-dismantle or non-special repair shop dismantle;
- Do not follow the requirement of service registration or warranty expired;
- Consumable parts.

Service promise:

- MITECH users have lifelong maintenance service
- Free maintenance, inspection, software upgrade etc.